MOCK UPCAT 1: ANSWER KEY WITH SOLUTIONS

1. **D**

   $0.04 = \frac{4}{100} = \frac{1}{25} = \mathbf{\frac{10}{250}}$

2. **A**

   $\frac{2a}{2b} = \frac{\cancel{2}a}{\cancel{2}b} = \mathbf{\frac{a}{b}}$

3. **C**

   $(2a)^2 = (2^2)(a^2) = 4a^2$

   $x^5 - x^3 = (x^3)(x^2-1)$

   $\mathbf{a^3 + a^3 = (a^3)(1+1) = 2a^3}$

   $(x+y)^2 = x^2+2xy+y^2$

4. **C**

   $\frac{1}{a} + \frac{1}{b} = \frac{b}{ab} + \frac{a}{ba} = \frac{b+a}{ab}$

   $\sqrt{3} - \sqrt{2} = 1.732 - 1.414 = 0.318$

   $\mathbf{(x-y)^2 = x^2 - 2xy + y^2}$

5. **B**

   $\frac{(2^{13})(3^{14})}{(27)(6^{12})} = \frac{(2^{13})(3^{14})}{(3^3)(3^{12})(2^{12})} = \frac{(2^{13})(3^{14})}{(3^{15})(2^{12})} = \frac{(2^{13})(3^{14})}{(3^{15})(2^{12})} = \frac{(2)(\cancel{2^{12}})(3^{14})}{(3^{15})(\cancel{2^{12}})} = \frac{(2)(3^{14})}{3^{15}} = \frac{(2)(\cancel{3^{14}})}{(3)(\cancel{3^{14}})} = \mathbf{\frac{2}{3}}$

6. **C**

   $s = \frac{rst + xy}{ty - r}$

   $sty - sr = rst + xy$

   $sty - xy = rst + sr$

   $(y)(st - x) = (rs)(t + 1)$

   $r = \mathbf{\frac{y(st - x)}{s(t+1)}}$

7. **B**

   $[(\sqrt[3]{x})(\sqrt[5]{x})]^{10} = [(x^{1/3})(x^{1/5})]^{10}$

   $= (x^{10/3})(x^{10/5}) = (x^{10/3})(x^2)$

   $= x^{\frac{10}{3}+2} = x^{\frac{10}{3}+\frac{6}{3}} = x^{16/3} = \mathbf{\sqrt[3]{x^{16}}}$

8. **C**

   $(-8a^5b^2c^3)(-2a^2b^7c)^2$

   $= (-8a^5b^2c^3)[(-2)^2(a^2)^2(b^7)^2(c^2)^2]$

   $= (-8a^5b^2c^3)(4a^4b^{14}c^2)$

   $= -32a^{5+4}b^{2+14}c^{3+2} = \mathbf{-32a^9b^{16}c^5}$

9. **C**

   $m = \frac{4t}{3t-2h}$

   $3mt - 2hm = 4t$

   $3mt - 4t = 2hm$

   $(3m - 4)(t) = 2hm$

   $t = \mathbf{\frac{2hm}{3m-4}}$

10. **C**

    -8 +24 -8 +24 -8 +24

    32 24 48 40 64 56 x

    $x = 56 + 24 = \mathbf{80}$

11. **C**

    Sum of terms in a sequence

    =(Average)(# of terms)

    Average $= \frac{\text{1st term + last term}}{2}$

    $= \frac{21 + 72}{2} = 46.5$

    Number of terms

    $= \frac{\text{last term} - \text{1st term}}{\text{common difference}} + 1$

    $= \frac{72 - 21}{3} + 1 = \frac{51}{3} + 1 = 18$

    Sum = (46.5)(18) = **837**

12. **C**

    In an arithmetic sequence, the 8th term =[1st term + (7)(common difference)] and the 15th term = [1st term + (14)(common difference)].

    Let A_1 be the 1st term

    d be the common difference

    $A_1 + 14d = 30$

    $-\quad \underline{A_1 + 7d = 9}$

    $7d = 21$

    $d = 3$

    $A_1 + 14d = 30$

    $A_1 = 30 - 14d$

    $A_1 = 30 - (14)(3) = 30 - 42 = \mathbf{-12}$

13. **C**

    $\frac{3}{125} = 0.024$

    $0.028 - 0.024 = 0.004 = \frac{4}{1000} = \mathbf{\frac{1}{250}}$

14. **C**

    Let x be the price of spaghetti;

    y be the price of juice

    $x + y = 230$

    $x = y + 100$

    $y + 100 + y = 2y + 100 = 230$

    $2y = 130$

    $y = \mathbf{65}$

15. **C**

    rate: 50 envelopes/minute

    time: $\frac{number\ of\ envelopes}{rate}$

    n/50

16. **C**

Let x be the price of refrigerator

(5%)(x) = (0.05)(x) = P500.00

x = $\frac{P500}{0.05}$ = **P10 000**

17. **B**

rate: 7 tables/day

time:$\frac{number\ of\ tables}{rate}$

t/7

18. **A**

LCM (9, 21): 63

The bells will ring simultaneously 63 minutes after 12 noon or at **1:03 p.m.**

19. **B**

Let x be the mother's age;

(3x – 7) be the son's age

If x = 15, then 3x – 7 = 45 – 7 = 38

She gave birth 15 years ago and her age was then 38 – 15 = **23 years old**.

20. **D**

Let x be Trina's age;

37 - x be Trisha's age;

x - 5 be Trina's age 5 years ago;

32 - x be Trisha's age 5 years ago;

x – 5 = (2)(32 – x)

x – 5 = 64 – 2x

3x = 64 + 5 = 69

x = **23**

21. **B**

Let x be the # of tables w/ 4 chairs

20 – x be the # of tables w/ 6 chairs

(4)(x) + (6)(20 - x) = 92

4x + 120 – 6x = 92

-2x = -28

x = **14**

22. **C**

Total cost of taxed goods

=P540 + (P540) (12%)

=P540 + (P540) (0.12)

=(P540) (1.12)

=P604.80

Total cost of all goods

= taxed goods + untaxed goods

= P604.80 + P66

= **P670.80**

23. **A**

Let x be mother's age

2x be Grandmother's age

2x – 60 be Tanisha's age

x + 2x + 2x – 60 = 150;

5x – 60 = 150;

5x = 210;

x = 42;

2x – 60 = (2)(42) – 60 = 84 – 60 = **24**

24. **D**

If growth of sales of Pet Habitat this year is 20%, it's sales next year is 1.2 times as this year. So, the sales of an indicated year are 1.2 times as that of its previous year.

Ratio: 1.2 :1 = **6:5**

25. **C**

Ave. speed = $\frac{totaldistance}{totaltime}$ = $\frac{120 \cdot 2\ km}{2+3\ hrs}$

= $\frac{240\ km}{5\ hrs}$=48 km/hr = **48 kph**

26. **A**

2:25 pm = 14:25 (military time)

10:00 to 14:25 = 4 hrs and 25 mins

8:00 – 7:00 = 1 hour time difference

4 hrs. & 25 min. – 1 hr = **3 hrs. & 25 mins.**

27. **D**

Time = $\frac{distance}{speed}$=$\frac{5\ km}{25\ km/h}$= 0.2 hr

(0.2 hr)$\left(\frac{60\ minutes}{hour}\right)$ = 12 mins.

He will arrive 12 minutes past 9:00 or at **9:12 a.m.**

28. **D**

At 6:15:

Train A:

(6:15 – 5:00)(10kph) = 12.5 km from station

Train B:

(6:15 – 5:30)(8kph)= 6 km from station

Distance: 12.5km – 6km = 6.5 km = $\mathbf{\frac{13}{2}}$**km**

29. **A**

f(x) = $\frac{x+1}{x^2-1}$ = $\frac{x+1}{(x-1)(x+1)}$= $\frac{1}{x-1}$, x≠ ±1

g(x) = $\frac{3x+7}{2x}$

f[g(x)] = $\frac{1}{\frac{3x+7}{2x}-1}$ = $\frac{1}{\frac{3x+7}{2x}-\frac{2x}{2x}}$ = $\frac{1}{\frac{3x+7-2x}{2x}}$

= $\frac{1}{\frac{x+7}{2x}}$ = $\mathbf{\frac{2x}{x+7}}$

30. **C**

$28x - 4y - 12 = 0$;
$28x - 12 = 4y$;
$7x - 4 = y$;
$y = 7x - 4$; (slope-intercept form)
slope = **7**

31. **C**

$x^2 - y^2 = (x + y)(x - y) = 77$
$x + y = 11$
$x - y = \frac{77}{11} = 7$

$x + y = 11$
$+\underline{x - y = 7}$

$2x = 18$; $x =$ **9**

32. **B**

A midpoint of a line segment is equidistant from the 2 end points.
Distance (-14,-6) = |-14 – (-6)| = |-8| = 8
-6 + 8 = **2**

33. **C**

Statement	Reason
1. $\overline{BD} = \overline{CD}$; $\overline{AD} = \overline{BD}$	1. Definition of isosceles triangle
2. $\overline{AD} = \overline{CD}$	2. Transitive Property of Equality
3. $m\angle DBC = m\angle DCB$; $m\angle DAB = m\angle DBA$; $m\angle DAC = m\angle DCA$	3. Isosceles Triangle Theorem
4. $m\angle DBC + m\angle DCB + 120° = 180°$	4. Definition of a triangle
5. $m\angle DBC + m\angle DCB = 60°$	5. Subtraction Property of Equality
6. $m\angle DBC + m\angle DBC = 2(m\angle DBC) = 60°$	6. Addition Property of Equality
7. $m\angle DBC = 30°$	7. Division Property of Equality
8. $m\angle DCB = 30°$	8. Transitive Property
9. $m\angle DAB + m\angle DBA + m\angle DBC + m\angle DCB + m\angle DCA + m\angle DAC = 360°$	9. Triangle Angle Sum Theorem
10. $m\angle DAB + m\angle DAB + m\angle DBC + m\angle DBC + m\angle DCA + m\angle DCA = 2(m\angle DAB + m\angle DBC + m\angle DAC) = 180°$	10. Addition Property of Equality
11. $m\angle DAB + m\angle DBC + m\angle DAC = 90°$	11. Division Property of Equality
12. $m\angle DAB + 30° + m\angle DAC = 90°$	12. Substitution
13. $m\angle DAB + m\angle DAC = 60°$	13. Subtraction Property of Equality
14. $m\angle DAB + m\angle DAC = m\angle BAC = 60°$	14. Angle Addition Postulate
15. $\angle BAC$ and $\angle x$ forms a linear pair and are supplementary	15. Definition of a Linear Pair; Linear Pair Theorem
16. $m\angle BAC + m\angle x = 180°$	16. Definition of Supplementary
17. $60° + m\angle x = 180°$	17. Substitution of Values
18. $m\angle x =$ **120°**	18. Subtraction Property of Equality

34. **A**

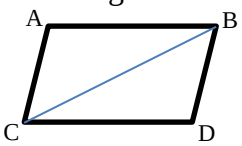
12+6 =18; height of bigger triangle
12:20::18:20 + x
$20 + x = \frac{(20)(18)}{12} = 30$
$x = 30 - 20 =$ **10**

35. **D**

The first three statements (Opposite angles are congruent, opposite sides are equal in length, and

adjacent angles are always supplementary.) are among the properties of parallelograms.

Let ABCD be a parallelogram and BC be one of its diagonals.



Statement	Reason
1. AB ‖ CD; AC ‖BD	Defn. of parallelogram
2. ∠ACB = ∠DBC; ∠ABC = ∠DCB	Alternate interior angles of parallel lines are congruent.
3. $\overline{BC} = \overline{BC}$	Reflexive Property
4. ΔACB ≅ΔDBC	ASA Postulate
5. ∠A = ∠D;	Corresponding parts of congruent triangles are congruent
Statement 1 proved. You can also prove that ∠B = ∠D by using the segment AD.	
6. $\overline{AB} = \overline{CD}$; $\overline{AC} = \overline{BD}$	Corresponding parts of congruent triangles are congruent
Statement 2 proved.	
7. m∠A+m∠ACB+m ∠ABC = 180	Definition of a triangle
8. m∠ABC ≡m∠DCB	Definition of congruent angles
9. m∠A+m∠ACB+m ∠DCB = 180	Addition Property of Equality
10. m∠ACB+m∠DCB = m∠C	Angle Addition Postulate
11. m∠A+m∠C = 180	Addition Property of Equality
Statement 3 proved. You can also prove that m∠B+m∠D = 180 if the diagonal used is AD.	

36. **B**

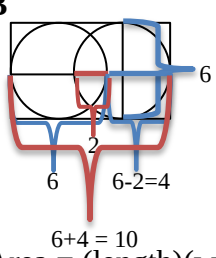
a. A rectangle is always a square.
Rectangle: a quadrilateral with opposite sides parallel and 4 right angles.
Square: a quadrilateral with opposite sides parallel, 4 right angles and 4 equal sides.
*Not all rectangles have 4 equal sides. However, we can say that all squares are rectangles.

b. A square is always a rhombus.
Rhombus: a quadrilateral with opposite sides parallel and 4 equal sides.
*Since a square has parallel opposite sides and 4 equal sides, then we can say that this statement is true.

c. A rhombus is always a rhomboid.
Rhomboid: a quadrilateral with opposite sides parallel and opposite sides and angles equal.
*The adjacent sides of rhomboids may or may not be equal.

d. A rhomboid is always a rectangle.
*Even though opposite angles of rhomboids are equal, it is possible that these angles are not 90°.

37. **B**



Area = (length)(width) = (10)(6) = **60 sq. units**

38. **A**

The Pythagorean Theorem ($a^2 + b^2 = c^2$) applies in any given right triangle. Thus, if the sides of the triangles are consecutive even integers, then we can substitute the lengths of the sides such that the resulting equation is

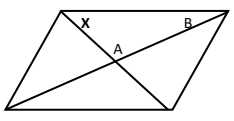
$a^2 + (a+2)^2 = (a+4)^2$
$a^2 + (a^2 + 4a + 4) = a^2 + 8a + 16$
$a^2 + a^2 + 4a + 4 = a^2 + 8a + 16$
$2a^2 + 4a + 4 = a^2 + 8a + 16$
$a^2 - 4a - 12 = 0$
$(a-6)(a+2) = 0$
$a = \mathbf{6}, -2$

Since the length of a side of a triangle cannot be negative, thus the length of the shortest side is 6.

39. **D**

Let A, B and C be the any of sides of a triangle. A + B > C; wherein A, B and C are the lengths of the three sides of a triangle. (Note: Values for A, B and C are interchangeable.)
10+9>8;
10+8>9;
9+8>10

40. **A**



Y

Z

Statement	Reason
1. ∠A and ∠Y are vertical angles	1. Definition of Vertical Angles
2. m∠A = m∠Y = 100°	2. Vertical Angle Theorem; Given
3. m∠A + m∠B + m∠X = 180	3. Triangle Angle Sum Theorem
4. 100° + m∠B + 55° = 180°	4. Given
5. m∠B = 25°	5. Subtraction Property of Equality
6. m∠B = m∠Z	6. Alternate Interior Angle Theorem
7. m∠Z = **25**	7. Transitive Property of Equality

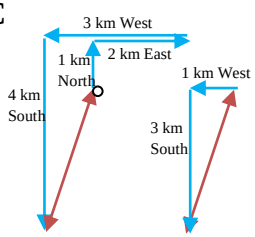
41. **C**

Width of smallest triangle: 2x;
Width of new triangle: 8x;
Height of smallest triangle: y;
Height of new triangle: 4y;
Area of smallest triangle: $\frac{(2x)(y)}{2} = xy$;
Area of new triangle: $\frac{(8x)(4y)}{2} = 16xy$;
Area is increased **16 times**

42. **B**

Area of triangle: $4cm^2$;
Side of square: $\sqrt{8}$ = Radius of circle
Area of circle: $\pi r^2 = \pi(\sqrt{8})^2 =$ **8π cm²**

43. **C**

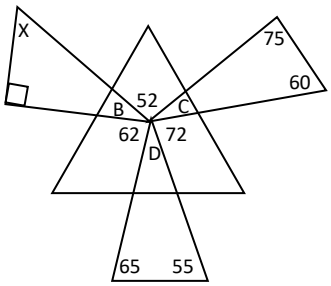


Note: ∘ origin; ↔ displacement
Displacement = $\sqrt{3^2 + 1^2} = \sqrt{9 + 1} = \sqrt{10}$

44. **C**

Volume of cylinder: $\pi r^2 h$;
Since π and height are constant, ratio of volume depends on r^2.
Ratio: $1^2:2^2:4^2$ = 1:4:16

45. **B**



Note: ☐ right angle = 90°

Statement	Reason
1. 75° + 60° + m∠C = 180°	1. Triangle Angle Sum Theorem
2. m∠C = 45°	2. Subtraction Property of Equality
3. 65° + 55° + m∠D = 180°	3. Triangle Angle Sum Theorem
4. m∠D = 60°	4. Subtraction Property of Equality
5. 52° + m∠C + 72° + m∠D + 62° + m∠B = 360°;	5. The sum of all angles that meet at a point is equal to 360°.
6. 52° + 45° + 72° + 60° + 62° + m∠B = 360°	6. Substitution of Values
7. m∠B = 69°	7. Subtraction Property of Equality
8. 90° + m∠X + m∠B = 360;	8. Triangle Angle Sum Theorem
9. 90° + m∠X + 69° = 360;	9. Substitution of Values
10. m∠X = **21°**	10. Subtraction Property of Equality

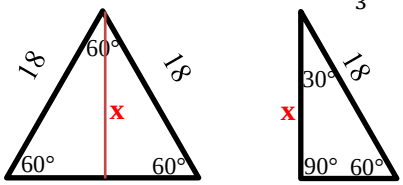
46. **C**

Distance Formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(21 - 5)^2 + (-9 - 3)^2}$
$= \sqrt{(16)^2 + (-12)^2}$
$= \sqrt{256 + 144}$
$= \sqrt{400}$
$=$ **20**

47. **B**

Since the triangle is equilateral, we can also say that the triangle is equiangular, with each angle = 60°.

If the perimeter of an equilateral triangle is 54, then the length of a side is $\frac{54}{3}$ or 18.



18

$\frac{18}{2} or\ 9$

Pythagorean Theorem: $a^2 + b^2 = c^2$

$x^2 + 9^2 = 18^2$

$x^2 + 81 = 324$

$x^2 = 324 - 81 = 243$

x = $\sqrt{243} = \sqrt{3^5} = \mathbf{9\sqrt{3}}$

48. **B**

15:20::6:x

x = $\frac{(20)(6)}{15} = \frac{120}{15} = \mathbf{8}$

49. **C**

A∩B = X

(A∩B)∩X = X∩X = **X**

50. **C**

(A∪B) = set of all numbers which are contained in either A or B = $\left\{\frac{1}{2}, \frac{1}{4}, \frac{3}{2}, \frac{3}{4}\right\}$

(A∪B)∪C = set of all numbers which are contained in either the union of A or B $\left(\left\{\frac{1}{2}, \frac{1}{4}, \frac{3}{2}, \frac{3}{4}\right\}\right)$ or in C $\left(\left\{\frac{1}{6}, \frac{1}{3}, \frac{1}{2}\right\}\right) = \left\{\mathbf{\frac{1}{2}}, \mathbf{\frac{1}{4}}, \mathbf{\frac{3}{2}}, \mathbf{\frac{3}{4}}, \mathbf{\frac{1}{6}}, \mathbf{\frac{1}{3}}\right\}$

X = A∩B = set of all numbers which are contained in both A and B = $\left\{\mathbf{\frac{1}{2}}, \mathbf{\frac{1}{4}}\right\}$

51. **B**

52. **A**

53. **B**

54. **D**

Probability = $\frac{number\ of\ desired\ outcomes}{total\ number\ of\ outcomes}$

= $\frac{5\ green\ marbles}{5\ green\ marbles + 2\ blue\ marbles + 3\ red\ marbles}$ = $\frac{5}{10} = \frac{1}{2} = 50\%$

55. **B**

If three pairs of pants could be partnered to five shirts, then the number of shirt-pants combinations from those are (3)(5) or 15 combinations.

If two pairs of pants could be partnered to four shirts, then the number of shirt-pants combinations from those are (2)(4) or 8 combinations.

Since all the shirt-pants combinations can be paired with any of the two blazers, then the number of possible 3-piece attires is (15+8)(2) = (23)(2) = **46**.

56. **A**

Sum = (Average)(Number of terms);

Since arithmetic mean is synonymous to average, we can change the equation above to

Sum = (Arithmetic Mean)(Number of terms)

= (12)(10)

=120

After one of the ten numbers is removed, the average of the remaining numbers goes up to 13. Thus the sum of the remaining 9 numbers is

Sum = (13)(9)

= 117

Thus, the number the difference between the sum of the ten numbers and the sum of the nine numbers is 120 – 117 = **3**.

57. **B**

Let A be the set of players in the 1st game

B be the set of players in the 2nd game

Assuming that all the players will play at least one game, then A∪B = 12.

A+B - A∪B = A∩B

8 + 7 – 12 = A∩B = **3**

58. **C**

Let A be the set of students playing basketball

B be the set of students playing badminton

Assuming that the whole class plays either basketball or badminton or both, then A∪B is the set of all students = 30.

A+B - A∪B = A∩B

20 + 23 – 30 = A∩B = **13**

59. **D**

If there are 98 seniors and 48 of these are girls, then there are 98 – 48 or 50 boys. Consequently, the ratio of girls to boys among seniors is **48:50**.

60. **B**

If 90% of 50 students scored 70 or higher, then 100% - 90% or 10% did not reach the score of 70. 10% of 50 students is equivalent to **5 students**.

MOCK UPCAT 2: ANSWER KEY WITH SOLUTIONS

1. **A**

$\frac{5}{8}\ of\ \frac{32}{115} of\ \frac{161}{200} = \left(\frac{5}{8}\right)\left(\frac{32}{115}\right)\left(\frac{161}{200}\right)$

$= \left(\frac{5}{8}\right)\left(\frac{\cancel{32}^{4}}{115}\right)\left(\frac{161}{200}\right) = \left(\frac{\cancel{5}}{1}\right)\left(\frac{4}{\cancel{115}^{23}}\right)\left(\frac{161}{200}\right)$

$= \left(\frac{1}{1}\right)\left(\frac{4}{\cancel{23}}\right)\left(\frac{\cancel{161}^{7}}{200}\right) = \left(\frac{1}{1}\right)\left(\frac{4}{1}\right)\left(\frac{7}{\cancel{200}^{50}}\right)$

$= \mathbf{\frac{7}{50}}$

2. **C**

$0.\overline{84} = \frac{84}{99} = \frac{\cancel{84}^{28}}{\cancel{99}^{33}} = \mathbf{\frac{28}{33}}$

3. **D**

$=11\frac{5}{21} - 21\frac{4}{51} = -\left(21\frac{4}{51} - 11\frac{5}{21}\right)$

$= -\left(20\frac{55}{51} - 11\frac{5}{21}\right) = -[(20-11) + \left(\frac{55}{51} - \frac{5}{21}\right)]$

$= -\left[9 + \left(\frac{55\cdot 7 - 5\cdot 17}{357}\right)\right] = -[9 + \left(\frac{385-85}{357}\right)]$

$= -\left(9\frac{300}{357}\right) = -9\left(\frac{100}{119}\right) = \mathbf{-9\frac{100}{119}}$

4. **A**

w: $\frac{5}{6}$ finished → $\frac{1}{6}$left

x: $\frac{7}{9}$ finished → $\frac{2}{9}$left

y: $\frac{13}{18}$ finished → $\frac{5}{18}$ left

z: $\frac{7}{12}$finished → $\frac{5}{12}$ left

$\frac{1}{6} > \frac{2}{9} > \frac{5}{18} > \frac{5}{12}$; **w, x, y, z**

5. **C**

Jake: $\frac{3}{8} \longrightarrow \frac{5}{8}$ left

Sheila: $\left(\frac{1}{3}\right)\left(\frac{5}{8}\right) = \frac{5}{24}$

$\frac{5}{8} - \frac{5}{24} = \frac{5}{12}$ left

Henry: $\left(\frac{1}{2}\right)\left(\frac{5}{12}\right) = \frac{5}{24}$

$\frac{5}{24}$ left

Note: Since Marian gave half or the remaining pie to Henry, she was left with the other half of the remaining pie. Thus, Marian has the same amount of pie as Henry does.

6. **C**

$0.52 = \frac{52}{100} = \frac{26}{50} = \mathbf{\frac{13}{25}}$

7. **C**

a. 0.00035

b. $\frac{.355}{100000}$ = 0.00000355

c. $\frac{(\mathbf{35})(\mathbf{10^{-6}})}{\mathbf{0.01}} = \frac{(\mathbf{35})(\mathbf{10^{-6}})}{\mathbf{10^{-2}}} = (\mathbf{35})(\mathbf{10^{[-6-2]}})$

$= (\mathbf{35})(\mathbf{10^{-4}}) = \mathbf{0.0035}$

d. $3550(10^{-8})$ = 0.00003550

8. **C**

a. 1/.3 = 10/3 = 3.33

b. .3/3 = 0.1

c. **$(.3)^2 = 0.09$**

d. d. .3 - .003 = 0.297

9. **B**

15mm – 6mm = 9mm removed

$\frac{9\ mm}{0.006\ mm/sheet}$ = **1500 sheets**

10. **B**

$\frac{3}{5}$ x = 15 mins;

x = $\frac{15\ mins.}{3/5}$ = $(15\ mins.)\left(\frac{5}{3}\right)$ = **25 mins.**

11. **D**

(30m)(20m) = 600 m^2

(600 m^2) $\left(\frac{P720}{50\ m^2}\right)$ = **P8640**

12. **D**

3:5 :: x:35;

5x = (35)(3) = 105

x = $\frac{105}{5}$ = **21**

13. **D**

Given only the cost of a compact disc player, you cannot determine the percent discount placed on it.

14. **B**

$\%\ Alcohol = \frac{Amount\ of\ Alcohol}{Total\ Amount\ of\ liquids}$

$= \frac{(150mL\cdot 0.2)+50mL}{150mL+50mL(alcohol)+50mL(water)}$

$= \frac{30mL+50mL}{250mL} = \frac{80mL}{250mL} = \mathbf{32\%}$

15. **C**

(x)$\left(\frac{7}{9}\right) = \frac{2}{3}$; x = $\frac{2/3}{7/9} = \frac{2}{\cancel{3}} \cdot \frac{\cancel{9}^{3}}{7} = \frac{6}{7} = \mathbf{85.71\%}$

16. **B**

$\frac{\left(\frac{5}{6}\right)^3}{\frac{25}{6^2}} = \frac{\frac{5^3}{6^3}}{\frac{5^2}{6^2}} = \left(\frac{5^3}{6^3}\right)\left(\frac{6^2}{5^2}\right) = \left(\frac{5^{\cancel{3}}}{6^3}\right)\left(\frac{6^2}{5^{\cancel{2}}}\right)$

$= \left(\frac{5}{6^{\cancel{3}}}\right)\left(\frac{\cancel{6^2}}{\cancel{1}}\right) = \mathbf{\frac{5}{6}}$

17. **B**

$(-\sqrt[3]{9^2})^6 = [(-1)(\sqrt[3]{9^2})]^6 = (-1)^6(\sqrt[3]{9^2})^6$

$= (1)(9^{\frac{2}{3}})^6 = 9^{\frac{12}{3}} = 9^4 =$ **6561**

18. **B**

$[(\sqrt{x})(\sqrt[4]{y})]^8 = [(x^{\frac{1}{2}})(y^{\frac{1}{4}})]^8 = [(x^{\frac{8}{2}})(y^{\frac{8}{4}})]$

$= \boldsymbol{x^4y^2}$

19. **A**

(6)(9)(N) = $(-3)^4(-2)^3$

N = $\frac{(-3)^4(-2)^3}{(6)(9)} = \frac{\cancel{(81)}^{9}(-8)}{(6)\cancel{(9)}} = \frac{\cancel{(9)}^{3}(-8)}{\cancel{6}^{2}} = \frac{(3)(-\cancel{8})^{4}}{\cancel{2}}$

= (3)(-4) = **-12**

20. **A**

$(\sqrt{27r^3})(\sqrt{3r}) = \sqrt{(27r^3)(3r)} = \sqrt{81r^4} = \mathbf{9r^2}$

21. **A**

3^y = z

$3^{y+2} = (3^y)(3^2) = (3^y)(9) = (9)(3^y) = \mathbf{9z}$

22. **A**

0.104 – 2y = 0.02y – 0.3

0.104 + 0.3 = 0.02y + 2y

0.404 = 2.02y

y = 0.404/2.02 = **0.2**

23. **B**

(3)(4)(8)(32)(R) = (16)(32)(12)

R = $\frac{(16)(32)(12)}{(3)(4)(8)(32)} = \frac{(16)\cancel{(32)}(12)}{(3)(4)(8)\cancel{(32)}} = \frac{(16)\cancel{(12)}}{\cancel{(3)(4)}(8)} = \frac{\cancel{16}^{2}}{\cancel{8}} = \mathbf{2}$

24. **A**

P = $\frac{JK}{L^2}$

Let M be the new value for P after the variables J, K or L were changed

a. **If L is halved**

M = $\frac{\boldsymbol{JK}}{(\frac{1}{2}\boldsymbol{L})^2} = \frac{\boldsymbol{JK}}{\frac{1}{4}\boldsymbol{L^2}} = \mathbf{4}\frac{\boldsymbol{JK}}{\boldsymbol{L^2}} = \mathbf{4P}$

b. If L is doubled

M = $\frac{JK}{(2L)^2} = \frac{JK}{4L^2} = \frac{1}{4}$ P

c. If J is doubled

M = $\frac{(2J)(K)}{L^2} = \frac{2JK}{L^2} = 2$P

d. If L is quadrupled

M = $\frac{JK}{(4L)^2} = \frac{JK}{16L^2} = \frac{1}{16}$ P

25. **C**

Let x be Lou's age

3x – 6 be Lee's age

x + 5 be Lou's age after 5 years

3x – 6 + 5 = 3x-1 be Lee's age after 5 years

(2)(x + 5) = 3x – 1

2x + 10 = 3x – 1

11 = x or x = **11**

26. **C**

$\frac{P2800}{3\ parts+2\ parts+1\ part} = \frac{P2800}{6\ parts}$ = P466.67/part

2nd child will get 2 parts:

(2)(P466.67) = **P933.33**

27. **C**

Let A be Pedro's money

B be Juan's money (before giving Pedro)

C be Jose's money

B = 4C = (4)(P30) = P120

A = ½ B = (½)(P120) = P60

28. **A**

$-x^2 - 3x + 36 = 3x^2 - 3x + 108$

$4x^2 = 144$

$x^2 = 36$

$x = \sqrt{36} = \pm 6$

29. **C**

$\frac{10x+25p-3}{5xp+1} = 2$

10x + 25p – 3 = (2)(5xp + 1)

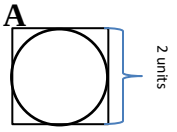
10x + 25p – 3 = 10xp + 2

10x – 10xp = 2 + 3 – 25p

(10x) (1-p) = 5 – 25p = (5)(1 – 5p)

x = $\frac{\cancel{5}\,(1 - 5p)}{\cancel{10}\,(1-p)} = \frac{\mathbf{1-5p}}{\mathbf{2(1-p)}}$

30. **A**



diameter: 2 units

radius: (½)(diameter) = (½)(2) = 1 unit

Area: $\pi r^2 = \pi(1)^2 = \boldsymbol{\pi}$

31. **D**

(16 in)(30 in) = 480 in^2

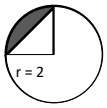
Squares with side 1: 1 in by 1 in

$Area_{square}$: (1 in)(1 in) = 1 in^2

$Area_{shaded} = Area_{rectangles} – Total\ Area_{squares}$

= 480 – (6)(1) = 480 – 6 = **474 in^2**

32. **A**



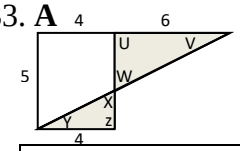
$A_{circle} = \pi r^2 = \pi(2)^2 = 4\pi$

$A_{quarter\text{-}circle} = (¼)(A_{circle}) = (¼)(4\pi) = \pi$

$A_{triangle} = ½\ b \cdot h = ½\ (2)(2) = ½\ (4) = 2$

$A_{shaded} = A_{quarter\text{-}circle} - A_{triangle} = \boldsymbol{\pi - 2}$

33. **A**



Statement	Reason
1. ∠W&∠X are vertical angles	1. Definition of Vertical Angles
2. m∠W = m∠X	2. Vertical Angle Theorem
3. ∠V and ∠Y are alternate interior angles	3. Definition of Alternate Interior Angles
4. m∠V = m∠Y	4. Alternate Interior Angle Theorem
5. ΔWUV is similar to ΔXZY	5. AA Similarity Postulate
6. The sides of ΔWUV are in proportion to ΔXZY	6. Definition of Similar Triangles

WU:UV::XZ:ZY

Note: WU + XZ = 5

Let x = WU

x + XZ = 5

XZ = 5–x

x:6 :: (5-x):4

(x)(4) = (6)(5–x)

4x = 30–6x

10x = 30

x = 3 = WU

5–x = 5–3 = 2 = XZ

$Area_{triangle} = \frac{1}{2}bh$

$Area_{\Delta WUV} = \left(\frac{1}{2}\right)(6)(3) = \frac{1}{2}18 = 9$

$Area_{\Delta XZY} = \left(\frac{1}{2}\right)(4)(2) = \left(\frac{1}{2}\right)8 = 4$

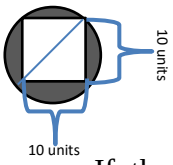
$Area_{shaded} = 9 + 4 = \mathbf{13}$

34. **D**

$Area_{shaded}$:$Area_{ABCD}$

13:(5)(4); **13: 20**

35. **B**



If the perimeter of the square is 40, then each side is 40/4 or 10 units long and its area is 100 square units. If you draw a diagonal inside the inscribed square, you can notice that this line is also the diameter of the circle. To compute for the length of this line, we can use the Pythagorean Theorem.

Length of Diagonal:

$x^2 + y^2 = z^2$

$10^2 + 10^2 = z^2$

$200 = z^2$

$z = 10\sqrt{2}$

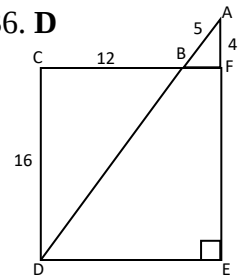
$diagonal/diameter = 10\sqrt{2}$

It follows that the radius of the circle is $\frac{10\sqrt{2}}{2}$ or $5\sqrt{2}$. Thus the area of the circle is:

$A = \pi r^2 = \pi(5\sqrt{2})^2 = 50\pi.$

$A_{shaded} = A_{circle} - A_{square} = \boldsymbol{50\pi - 100}$

36. **D**



Statement	Reason
1. DE ∥ BF	1. A trapezoid has one pair of parallel sides
2. m∠FED=m∠AFB = 90°	2. Corresponding Angles Postulate
3. ΔFAB is a right triangle	3. Definition of a right triangle
4. BF = 3	4. Pythagorean Theorem (3-4-5 Pythagorean Triple)
5. CF = CB + BF	5. Segment Addition Postulate
6. CF= 12 + 3 = 15	6. Substitution of Values; Given
Since CDEF is a rectangle, then CF = DE.	

$\text{Area}_{\text{trapezoid}} = \frac{b_1+b_2}{2}h = \frac{3+15}{2}16 = \frac{18}{2}16$

$= (9)(16) =$ **144 sq. units**

37. **C**

Let x be the width of the rectangle

x+3 be the length of the rectangle

2 (x + 3) + 2 (x) = 34

2x + 6 + 2x = 34

4x + 6 = 34

4x = 34 – 6 = 28

$x = \frac{28}{4} = 7$

x + 3 = 10

Area = (length)(width) = (10)(7)

= **70 sq. units**

38. **A**

$A_{\text{smaller circle}} : A_{\text{bigger circle}}$

$\pi r_{small}{}^2 : \pi r_{big}{}^2$

$d_{small} = radius_{big}$

$2radius_{small} = radius_{big}$

$A_{small} : A_{big}$

$\pi(radius_{small})^2 : \pi(radius_{big})^2$

$\pi(radius_{small})^2 : \pi(2radius_{small})^2$

$\pi(radius_{small})^2 : \pi(4)(radius_{small})^2$

$\mathbf{1:4}$

39. **D**

$V_{cone} = \frac{1}{3}\pi r^2 h$

$245\pi\ cm^3 = \frac{1}{3}\pi r^2(15\ cm)$

$735\pi\ cm^3 = \pi r^2(15\ cm)$

$\mathbf{49\pi\ cm^2} = \pi r^2$ = Area of circular base

40. **B**

$SA_{cube} = 6s^2$

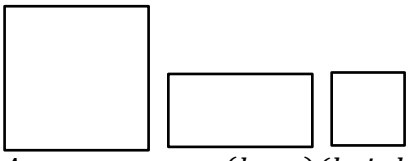
$216\ cm^2 = 6s^2$

$s^2 = 36cm^2$

$s = 6\ cm$

$V_{cube} = s^3 = (6\ cm)^3 = \mathbf{216cm^3}$

41. **D**



$Area_{rectangle} = (base)(height)$

$Area_{square\ paper} = (16cm)(16cm)$

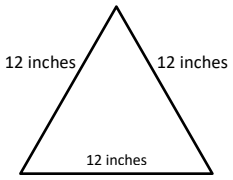
$Area_{after\ first\ fold} = (16\ cm)(8cm)$

$Area_{after\ second\ fold} = (8\ cm)(8\ cm)$

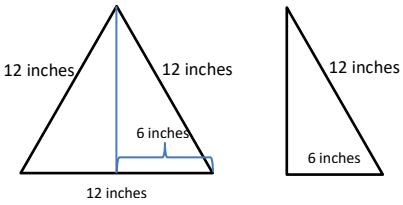
$= \mathbf{64\ cm^2}$

42. **C**

If the perimeter of an equilateral triangle is 36 inches, then each side measures 36/3 or 12 inches.



To measure the height, we can draw a perpendicular bisector in the triangle and consider the height as one of the sides of the half-triangle.



We can use the Pythagorean Theorem to look for the measurement of the height.

$a^2 + b^2 = c^2$

$(6\ inches)^2 + b^2 = (12\ inches)^2$

$36\ inches^2 + b^2 = 144\ inches^2$

$b^2 = 144\ inches^2 - 36\ inches^2$

$b^2 = 108\ inches^2$

$b = 6\sqrt{3} = height$

$A_{triangle} = \frac{1}{2}bh = \frac{1}{2}(12)(6\sqrt{3})$

$= (6)(6\sqrt{3}) = \mathbf{36\sqrt{3}}$

43. **B**

$SA_{cylinder} = 4\pi r^2$

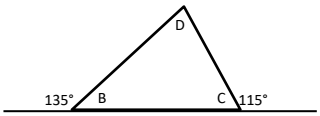
$256\pi mm^2 = 4\pi r^2$

$64\ mm^2 = r^2$

$r = \mathbf{8\ mm}$

Since the radius of the ball is 8 mm, the minimum radius of a cylinder for a ball to get through it is also 8 mm.

44. **C**



Let B and C be the other angles in the triangle.

Statement	Reason
1. 135° and ∠B forms a linear pair; 115° and ∠C forms a linear pair	1. Definition of a linear pair
2. 135° and ∠B are supplementary; 115° and ∠C are supplementary	2. Linear Pair Theorem
3. 135° + m∠B = 180°; 115° + m∠C = 180°	3. Definition of Supplementary angles
4. m∠B = 45°; m∠C = 65°	4. Subtraction Property of Equality
5. m∠B + m∠C + m∠D = 180°	5. Triangle angle sum theorem
6. 45° + 65° + m∠D = 180°	6. Addition Property of Equality
7. m∠D = **70°**	7. Subtraction Property of Equality

45. **B**

2:3:5 = (2x):(3x):(5x)

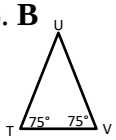
2x + 3x + 5x = 180°

10x = 180°

x = 18°

Largest Angle: 5x = **90°**

46. **B**



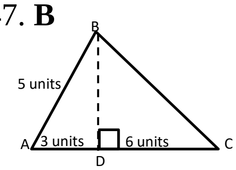
Given the first measures of two of the interior angles of the triangle, we can say that the measure of the third angle is 30°, since the sum of the measures of the three interior angles in any given triangle is 180°.

a. **TU = UV**; (TRUE; Converse of Isosceles Triangle Theorem: If two angles of a triangle are equal in measure, then the sides opposite those angles are equal in measure.)

b. **TV > UV**; (**FALSE**; If two angles of a triangle are not congruent, then the longer side is opposite the larger angle. Since 75° > 30°, then both TU and UV are greater than TV.)

c. **TU > TV** (TRUE; same explanation as in b)
d. **∠U = 30°** (TRUE; Triangle Angle Sum Theorem: the sum of the measures of the three interior angles in any given triangle is 180°.)

47. **B**



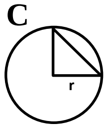
Since the dashed line is a perpendicular bisector, we can say that ΔABD is a right triangle. Thus, the height is 4 units (Pythagorean triple: 3-4-5).

The area of the triangle can then be computed by adding the areas of the two right triangles.

$A_{total} = \frac{(AD)(DB)}{2} + \frac{(DC)(DB)}{2} = \frac{(3)(4)}{2} + \frac{(6)(4)}{2}$

$= \frac{12}{2} + \frac{24}{2} = 6 + 12 =$ **18 sq. units**

48. **C**



If the area of the circle is 64π square units, then the radius of the circle is

$A = \pi r^2$

$64\pi = \pi r^2$

$64 = r^2$

$r = 8\, units$

Since the radius of the circle is also the base and height of the triangle, the area of the triangle is $\frac{(b)(h)}{2} = \frac{(r)(r)}{2} = \frac{(8)(8)}{2} = \frac{64}{2}$

= **32 sq. units**

49. **C**

Sum = (Average)(number of items)
Sum of weights = (57g)(3) = 171g

Since balls A and B are identical and the weight of ball A is 46g, then the weight of ball B is also 46g. Thus, the weight of ball C is 171g – [(46g)(2)] = 171g – 92g = **79g**.

50. **D**

Probability= $\frac{number\ of\ desired\ outcomes}{total\ number\ of\ possible\ outcomes}$

Desired outcome: Sum shown on dice is divisible by 5. (1 + 4; 4 + 1; 2 + 3; 3 + 2; 6 + 4; 4 + 6; and 5 + 5): seven favorable outcomes)

Possible outcomes: (6)(6) = 36(Six possible outcomes on each die.)

$Probability = \mathbf{\frac{7}{36}}$

51. **C**

Let A be the group of Ilonggo-speaking students

B be the group of Visayan-speaking students

Since there are 3 students who speak neither Ilonggo nor Visayan, then the total number of students who can speak at least one language is A ∪ B = 15 – 3 = 12.

A + B – A ∪ B = A ∩ B
8 + 7 – 12 = A ∩ B
15 – 12 = 3 = A ∩ B (number of students who knows both dialects)

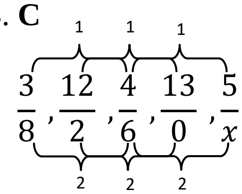
Probability = $\frac{students\ who\ knows\ both\ dialects}{total\ number\ of\ students}$

$= \frac{3}{15} = \mathbf{\frac{1}{5}}$

52. **B**

3 soft drinks + 2 juices = 5 drinks
\# of combinations = 2 sandwiches · 5 drinks
= **10 combinations**

53. **C**



6 – 2 = **4**

54. **C**

$|(-9)-(-6)| = |-3| = 3$

$S_n = \frac{(n)(a_1+a_n)}{2}$

$= \frac{(n)(-9+a_n)}{2}$

$= \frac{(n)\{-9+[a_1+(n-1)d]\}}{2}$

$= \frac{(n)\{-9+[-9+(n-1)3]\}}{2}$

$= \frac{(n)[-9+(-9+3n-3)]}{2}$

$= \frac{(n)[-9+(3n-12)]}{2}$

$= \frac{(n)(-9+3n-12)}{2}$

$= \frac{(n)(3n-21)}{2}$

$= \frac{3n^2-21n}{2} = 66$

$132 = 3n^2 - 21n$

$3n^2 - 21n - 132 = 0$

$n^2 - 7n - 44 = 0$

$(n - 11)(n + 4) = 0$

$n = \mathbf{11}, -4$

However, since the number of terms cannot be negative (there is no such thing as -4 terms in a sequence), then the number of terms in the sequence must be 11.

55. **B**

4x, 6y, ___

common ratio: $\frac{6y}{4x} = \frac{3y}{2x}$

next term: ~~6~~^{3}~~y~~ $(\frac{3y}{~~2x~~}) = \frac{9y^2}{x}$

56. **A**

$3x^2 - kx - 2 = 0$

$3x^2 - kx = 2$

$x\,(3x - k) = 2$

$3x - k = \frac{2}{x}$

$3x - \frac{2}{x} = k$

$\frac{3x^2 - 2}{x} = k$

57. **A**

R = $\frac{1}{\frac{1}{X}+\frac{1}{Y}}$

Since x = $\frac{1}{3}$ and y = 1, then R =

R = $\frac{1}{\frac{1}{1/3}+\frac{1}{1}} = \frac{1}{3+1} = \mathbf{\frac{1}{4}}$

58. **A**

a = 3b + 1

a – 1 = 3b

b = $\frac{a-1}{3}$

m = $\frac{1}{a}$ + b

m = $\frac{1}{a} + \frac{a-1}{3}$

m = $\frac{3}{3a} + \frac{a^2-a}{3a} = \frac{3+a^2-a}{3a} = \mathbf{\frac{a^2-a+3}{3a}}$

59. **B**

$\frac{x^{1/3}y^{-4}z^{12}}{x^5y^{1/2}z^{15}} = x^{(\frac{1}{3}-5)}y^{(-4-(1/2))}z^{12-15}$

$= x^{-14/3}y^{-9/2}z^{-3} = \mathbf{\frac{z^{-3}}{x^{14/3}y^{9/2}}}$

60. **A**

$(3a^{-1}b^{2/3}c^2)^3 = 27a^{-3}b^2c^6 = \frac{27b^2c^6}{a^3}$

$= \frac{(27)(8)^2(-1)^6}{(-2)^3} = \frac{(27)(64)(1)}{(-8)} = \frac{(27)(~~64~~)^{8}(1)}{(~~-8~~)^{-1}}$

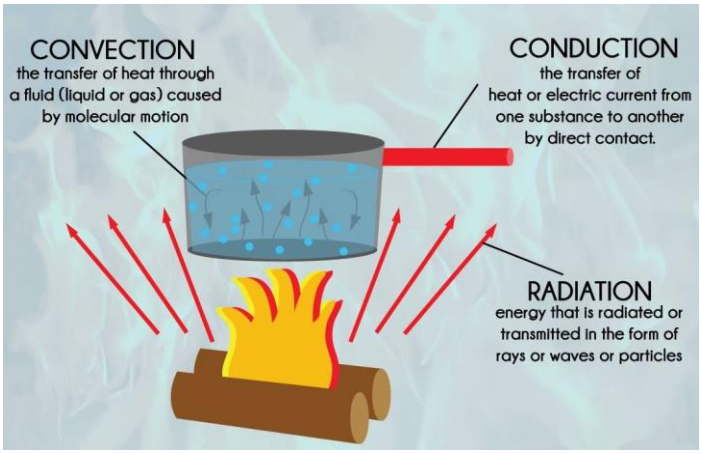
= **-216**

MOCK UPCAT 3: ANSWER KEY WITH EXPLANATIONS

1. **B**

Humidity is the amount of water vapor in air. The air can hold water vapor depends on its temperature. The higher the humidity, the air can contain more water vapor. Warm air can hold more moisture than cooler air. As humidity starts to rise, the sweat beading up on the skin can't evaporate and provide cooling relief. When the air contains much water vapor, the sweat can hardly evaporate making an individual feels sticky the whole day.

2. **A**



Source: https://me-mechanicalengineering.com/wp-content/uploads/2015/11/heat-transfer.jpg

Convection is the heat transfer through a fluid. The differences in temperature produce convection currents. The less dense or hotter parts of the fluid rise while cooler or denser areas sink. Birds and gliders make use of upward convection currents to rise.

3. **B**

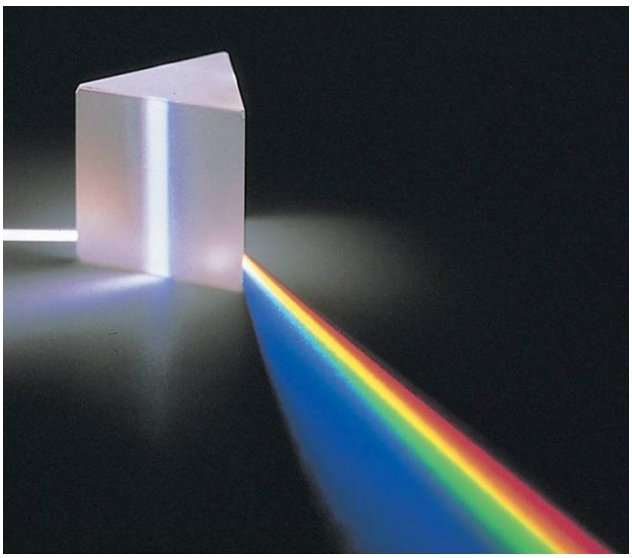
Air travels from an area of high pressure to an area of low pressure to 'even out' the pressure difference and to produce equilibrium.

4. **B**

The feather quickly reaches a balance of forces and thus a zero acceleration or terminal velocity. However, the coconut never reaches a terminal velocity during its fall because the forces never become completely balanced. Therefore, there's still acceleration and it falls faster than the feather because it has a far greater weight. It continues to accelerate as it falls, approaching a terminal velocity yet never reaching it. However, the feather does not require much air resistance before it ceases its acceleration and it obtains the state of terminal velocity in an early stage of its fall. The small terminal velocity of the feather means that the remainder of its fall will occur with a small terminal velocity.

5. **B**

The seven colors of the visible spectrum are formed by the refraction of a composite light, such as white light, when it passes through a transparent medium.



Source:http://apollo.lsc.vsc.edu/classes/met130/notes/chapter19/sundogs.html

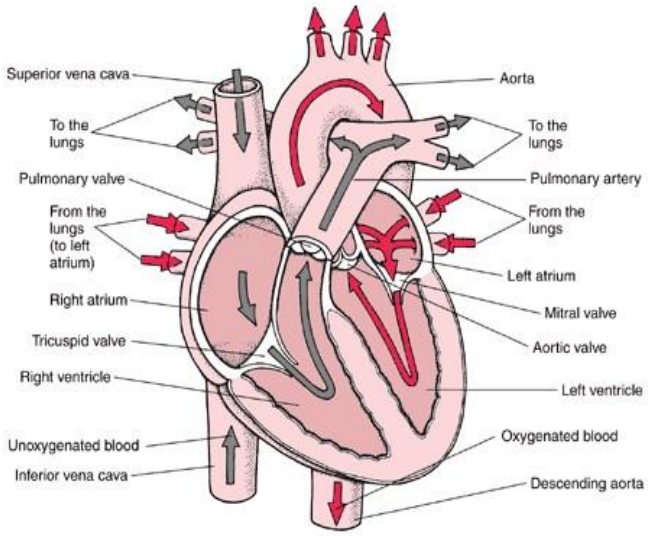
6. **B**

Plant photosynthesis occurs in leaves and green stems. Since green objects reflect the color green and absorbs all the other components of white light (ROYBIV), then the plants can only use these components in photosynthesis. Thus, if a plant is placed under green light, then it will reflect all light and absorb none. Thus, photosynthesis will not occur in this setup.

7. **B**

Blood flows through the heart as follows:

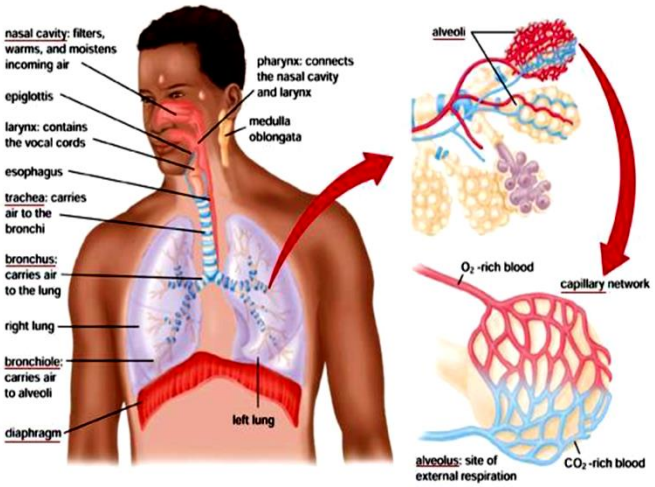
Superior/Inferior Vena Cava → Right Atrium → Tricuspid Valve → Right Ventricle → Pulmonary Valve → Pulmonary Artery → Lungs → Pulmonary Veins → Left Atrium →Bicuspid (Mitral) Valve → Left Ventricle → Aortic Semilunar Valve → Aorta → Entire body



Source: http://intensivecare.hsnet.nsw.gov.au/shock

8. **B**

During inhalation, air travels from one's nose or mouth to the alveoli where an O_2-CO_2 exchange occurs. Thus, air flows through the respiratory system as follows:
nasal cavity → pharynx →larynx → trachea → bronchus → bronchiole → alveoli



Source:http://www.docstoc.com/docs/88989762/Structure-and-Function-of-the-Respiratory-System

9. **B**

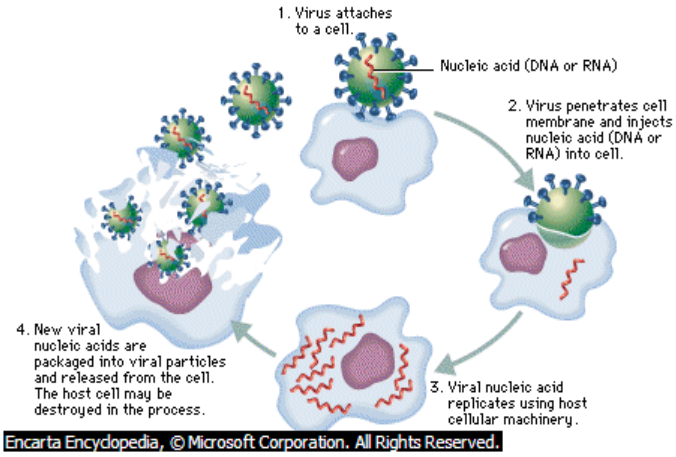
Angiosperms		
	Monocot	**Dicot**
Cotyledons	1	2
Venation	parallel	netted
Petals & Sepals	in 3's	in 4's or 5's
Root System	fibrous	taproot
Vascular System	scattered	in rings

10. **A**

Monera is a kingdom which consists of all prokaryotic organisms, which are simple, single-celled organisms.

11. **C**

A virus consists of genetic material (RNA/DNA) which is surrounded by a protective protein coating called capsid. It is not considered free-living since it cannot reproduce outside of a living cell. Viruses have evolved to pass on their genetic information to living cells so it can replicate along with the cell.



12. **A**

The food chain starts with an organism that produces its own food from a primary energy source or autotrophic. Examples of these are plants and algae. Thus, the food chain must start with cabbage.

Next on the chain is a first-order consumer, an organism which eats autotrophic organisms. Since a snail is an herbivore, it should be next in this specific chain.

Rats on the other hand are omnivores. They eat either plants or animals. Specifically, they can eat snails. Even though rat could be next to cabbage in the food chain, snails cannot eat any organism in the chain aside from cabbage.

Molds are detrivores - organisms which break down dead plant and animal matter. Thus it must be last in this food chain.

13. **C**

An organism can be classified as a second order consumer if it eats a first order consumer or an herbivore. Since according to the food web, man eats chickens, which in turn, eats corn, then chickens can be classified as herbivores or first-

order consumers and man can be classified as a second-order consumer.

14. **B**

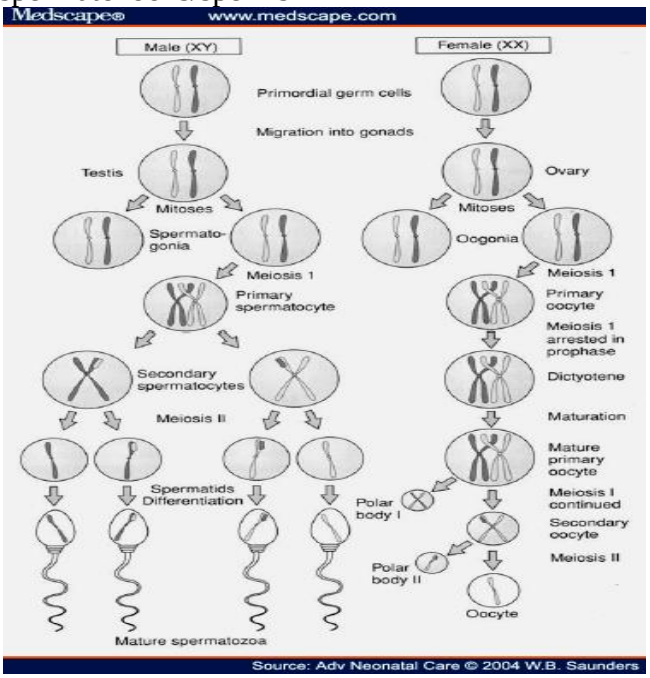
The organism shown in the figure is a planarian. Since it has a simple body plan, then it can regenerate a complete body from fragments of itself through regeneration.

15. **D**

If an organism has adapted well to its environment, it has a survival advantage and is thus less likely to become extinct. Also, mutations are less likely to occur within organisms of this kind since mutations usually occur in direct response to selective pressure to increase the chances of survival. Likewise, if an organism has already adapted well to its environment, then it will stay there and prevent from migrating. In addition, the adaptation of an organism to its environment is a good trait and will probably be passed on to its offspring.

16. **D**

Spermatogenesis: spermatogonium (diploid) → primary spermatocyte → 2 secondary spermatocytes (haploid) → 4 spermatids → 4 spermatozoons/sperms



17. **B**

Type A blood (according to the A-B-O blood type classification system) has two possible genotypes namely ***AA*** or ***AO***. On the other hand, type O blood has only one possible genotype namely ***OO***. Also, an offspring will get one allele from each parent.

AA x OO			**AO x OO**		
	O	O		O	O
A	***AO***	***AO***	A	***AO***	***AO***
A	***AO***	***AO***	O	***OO***	***OO***

As shown by the chart, a cross between a woman with blood type A and a man with blood type O can only produce genotypes ***AO*** or ***OO*** and thus blood types A or O. Therefore, it is impossible that her dad is her real dad because she cannot inherit a ***B*** allele from her father.

18. **D**

It was observed in Mendel's dihybrid crosses that characteristics were inherited as separate units and that each unit was inherited independently of the others.

19. **B**

Given that the allele for long antennae is denoted as ***L***, we can assume that the allele for short antennae is denoted as ***l***. If all the offspring have long antennae, then their possible genotypes are ***LL*** or ***Ll***. However, since their mother has short antennae and a genotype ***ll***, the offspring must have at least one ***l*** allele. Thus, their genotype is ***Ll***.

20. **D**

Transcription is the synthesis of a complementary RNA copy from a DNA segment. Thus, the RNA consists of the 'partner' bases of the ones in DNA and that uracil is used in place of thymine. (Partner bases: Adenine and Thymine/Uracil; Cytosine and Guanine)

Before	**3' ATGCT 5'**
After	5' UACGA 3'

21. **B**

If *X* denotes the dominant allele for free earlobes and *x* denotes the recessive allele for attached earlobes, then the result of a cross between a heterozygous man and a woman with attached earlobes (homozygous recessive or *xx*) is

	x	*x*
X	*Xx*	*Xx*
x	*xx*	*xx*

Thus, the offspring has 2 out of 4 or a 50% chance of having free earlobes.

22. **B**

	w/cell wall	w/ mitochondria	w/ nucleus	w/ ribosomes
Monera	OK	-	-	OK
Protista	-	OK	OK	OK
Fungi	OK	OK	OK	OK
Plantae	OK	OK	OK	OK
Animalia	-	OK	OK	OK

Only organisms of the Kingdoms Fungi and Plantae possess these characteristics.

23. **D**

Enzyme	Place	Substrate	Products	Origin
Salivary amylase	Mouth	Starch, glycogen	Maltose	Salivary glands
Pepsin	Stomach	Protein	Peptides	Stomach glands
Lipase	Sm. Int.	Fats	Glycerol, fatty acids	Stomach glands
Pancreatic amylase	Sm. Int	Starch	Maltose	Pancreas
Pancreatic lipase	Sm. Int	Fats	Glycerol, fatty acids	Pancreas
Trypsin	Sm. Int	Peptides	Simpler peptides	Product of enzymes from pancreas and duodenum
Maltase	Sm. Int	Maltose	Two glucose molecules	Glands in wall of small int.

Source:http://www.docstoc.com/docs/42151762/DIGESTIVE-ENZYMES-WORKSHEET-ANSWERS

Before small intestine digests absorbs the simplest forms of organic matter, food must first be digested in the mouth, esophagus, stomach and the small intestine with the help of enzymes. Thus, food must first be broken down into maltose, peptides / simpler peptides (amino acids), glycerol and fatty acids.

24. **D**

If the tibial nerve (which is a motor and sensory nerve) is blocked, then areas below the obstruction (such as toes) cannot move nor feel.

25. **C**

Extinction of dinosaurs cannot be caused by human disturbance since the dinosaurs became extinct at the end of the Cretaceous era (85 million years ago), while archaic *Homo sapiens* between 400,000 to 250,000 years ago on the Cenozoic era.

26. **B**

All insects have 6 legs. Since ants, beetles and butterflies have 6 legs, they can be classified as insects. A tick has 8 legs and is thus an arachnid.

27. **A**

The Paleozoic era is the oldest and the Cenozoic era is the newest. Thus, the organisms that evolved the most recent are in the group with a starting point that is nearest the Cenozoic era, which are the Chordates.

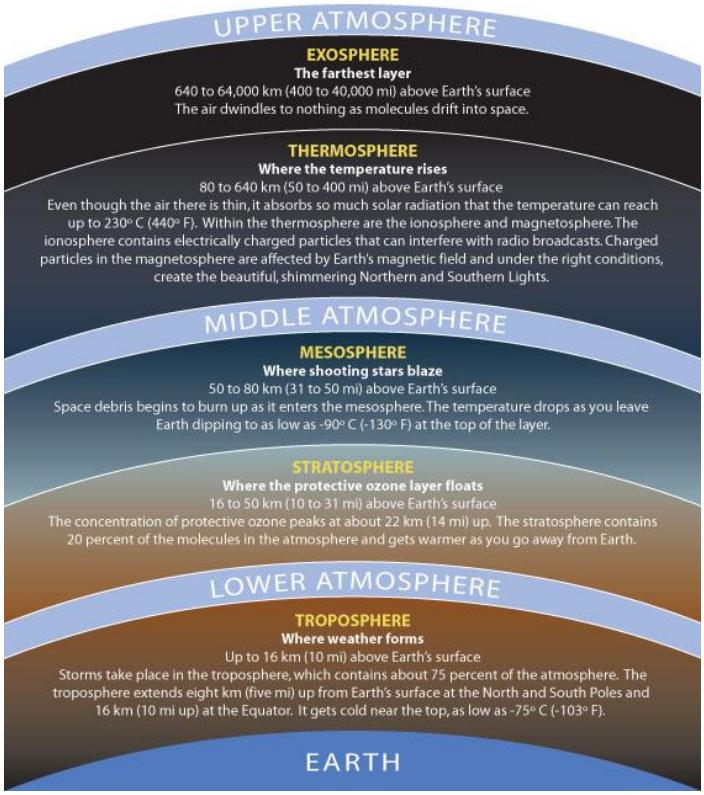
28. **C**

An increase in the population of a group is symbolized by an outward sloping of the graph. Thus, arthropods had the greatest increase during the Cenozoic era.

29. **B**

The only group that became extinct before the Cenozoic era is the Graptolites. Graptolites became extinct specifically during the Permian period.

30. **C**



Source: http://forces.si.edu/atmosphere/04_00_01.html

The coldest layer of the atmosphere is the mesosphere.

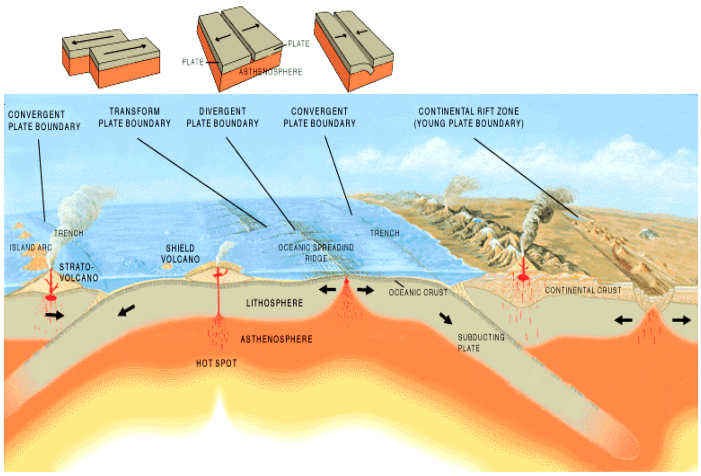
31. **A**

Weather is formed in the troposphere. It is also where most clouds and 99% of the water vapor are found. Since rain is water condensed from water vapor and falls as drops from clouds, then we can say that rain comes from the troposphere.

32. **D**

A transmitter radiates energy upwards toward the thermosphere where it will be refracted by ions, downwards to the surface of earth. Radio signals can be sent to farther places through this method than if propagated through the surface of the Earth, since there are many obstructions in the surface of Earth.

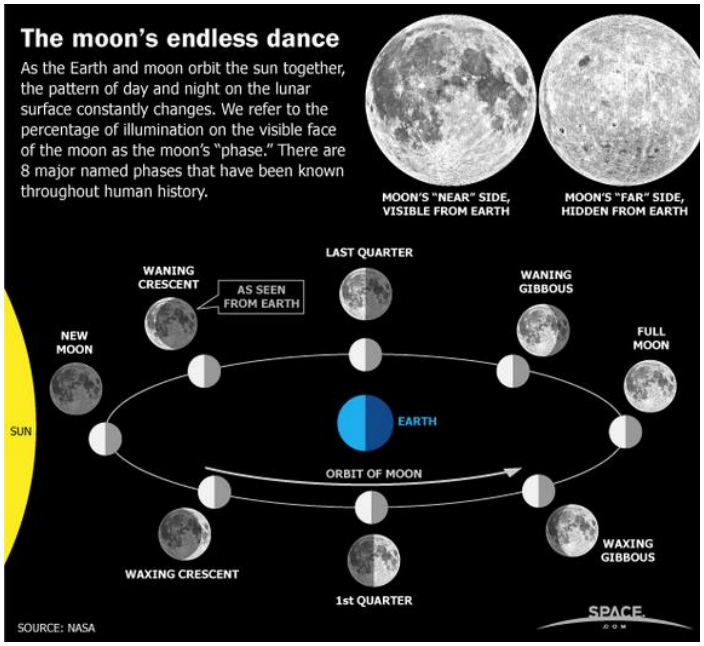
33. **C**



Source: http://www.eoearth.org/article/Mid-ocean_ridges?topic=50013

Mid-ocean ridges are formed when two tectonic plates diverge or move away from each other. When this forms, magma rises up and cools down, forming new rocks.

34. **C**

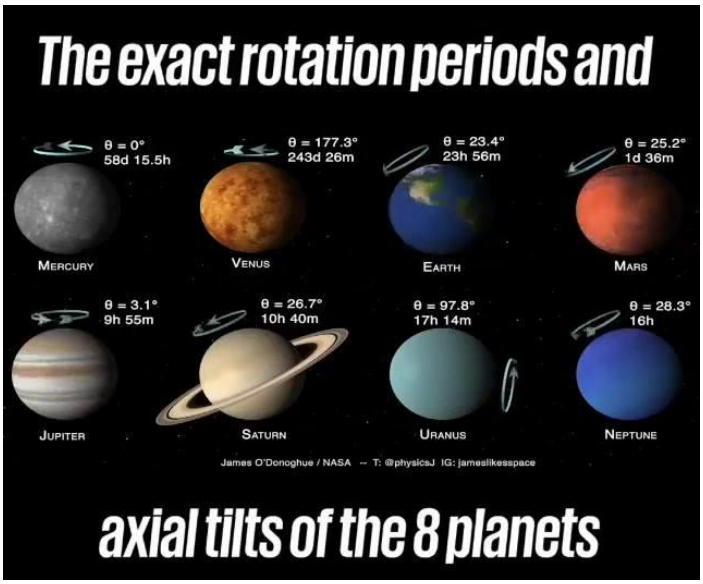


Source: http://www.space.com/62-earths-moon-phases-monthly-lunar-cycles-infographic.html

35. **D**

The Sun, which is our nearest star, is found approximately 150 million kilometers from the Earth. It is also about 250,000 times closer to Earth than Proxima Centauri – the next closest star. Proxima Centauri is found more than 30 trillion kilometers from Earth.

36. **C**



Source: https://lifeboat.com/blog.images/uranus-is-a-real-oddball-in-our-solar-system.jpg

Most of the planets in the Solar System orbit the sun like a top spinning across the floor, with their spin-axes more or less vertical to their direction of motion however, Uranus rolls along its orbital plane like a wheel when it rotates.

37. **A**

Mercury is a metallic element that is liquid in room temperature. It is used in thermometers and barometers. Zirconium is a grayish-white metallic element used in coating fuel rods in nuclear reactors. Carbon dioxide is a compound consisting of two oxygen atoms and a carbon atom that are covalently bonded. Milk on the other hand is a mixture of water and milk solids such as carbohydrates, proteins, fat and minerals.

38. **C**

Change	Example
1.Change in color	metal rusting $4Fe+3O_2+6H_2O \rightarrow 2Fe_2O_3 \cdot nH_2O$
2.Evolution of gas	fizz (carbon dioxide) formed by pouring vinegar to baking soda

	$CH_3COOH+NaHCO_3 \rightarrow CH_3COONa+H_2O+CO_{2(g)}$
3.Precipitate formation	Redox reaction between silver nitrate and sodium chloride $AgNO_3+NaCl \rightarrow AgCl_{(s)}+NaNO_3$

39. **B**

Selenium is a nonmetallic element used in copper mining.

40. **B**

Charges:
Ca: +2, Cl: -1, Na: +1, C: +4, O: -2
$CaCl_2 + Na_2CO_3 \rightarrow Ca_{(+2)}CO_{3(-2)}+2Na_{(+1)}Cl_{(-1)}$

41. **C**

mass = $\left(9.1\ x\ 10^{-28}\ \frac{grams}{atom}\right)(6.02\ x\ 10^{23}\ atoms)$
$= 5.4782\ x\ 10^{-4}\ grams \approx 5.78\ x\ 10^{-4} grams$

42. **C**

Gas constant (R), as its name implies, is a constant which defines the relation of the gas's pressure and volume to its absolute temperature (in Kelvin). Its value is $8.314\ \frac{joules}{Kelvin}$

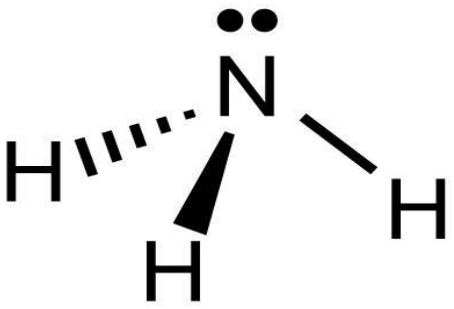
43. **D**

Organic compounds contain carbon, hydrogen and oxygen atoms. CH_3COOH or acetic acid is the main component in vinegar.

44. **D**

A molecule is the smallest physical unit of a given substance which can exist independently. Thus, a glucose molecule is the smallest unit of glucose. It also still retains the physical properties possessed by glucose.

45. **B**

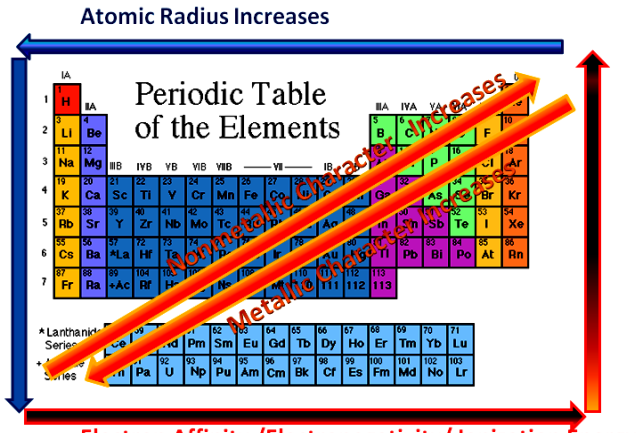


Source:http://chemistry.about.com/od/factsstructures/ig/Chemical-Structures---A/Ammonia-Chemical-Structure.htm

46. **D**

Na (sodium) is an alkali metal. F (flourine) is a halogen. Xe (xenon) is a noble gas. No two of these elements are from the same family. Thus, none of these are similar.

47. **A**



Source:http://i150.photobucket.com/albums/s118/hi78953/chemwiki.png

As we move across a period (row) from left to right, the number of electrons increases, thus increasing nuclear charge. This causes the attraction between the nucleus and electrons to increase. Thus, the electrons are being pulled more tightly by the nucleus. As a result, the radius or size of the atom decreases.
Atomic Radius: Li > B > O > F

48. **D**

As we move across a period (row) from left to right, the valence shell of an atom is being filled up and attraction between the nucleus and electrons increases. Thus, more energy is released upon gaining an electron (higher electron affinity).
Electron Affinity: F > N > Be > Li

49. **B**

$CaCl_2+Na_2CO_3 \rightarrow CaCO_3+2NaCl$

$2\ moles\ CaCl_2 \left(\frac{1\ mole\ CaCO_3}{1\ mole\ CaCl_2}\right)$
$= 2\ moles\ CaCO_3$

$3\ moles\ Na_2CO_3 \left(\frac{1\ mole\ CaCO_3}{1\ mole\ CaCl_2}\right)$
$= 3\ moles\ CaCO_3$

Since calcium chloride produces fewer moles of product than sodium carbonate, then calcium chloride is the limiting reactant.

50. **C**

Oxidation-reduction (Redox) reactions combine compounds wanting to gain electrons (reduce) and compounds willing to give electrons (oxidize).

51. **D**

If A is represented by ⊕, then 0.6 of the particles (in a container with a pressure of 0.6 atm) are ⊕. In choice d, 6 out of 10 or 0.6 of the particles are A.

52. **C**

Let x be the number of hours the girl travelled at 40 mph

5-x be the number of hours the girl travelled at 60mph

$40mph\ (x\ hrs) + 60mph\ (5 - x\ hrs) = 240$

$40x + 300 - 60x = 240$

$-20x = -60$

$x = 3$

53. **C**

Weight is the downward pull of Earth's gravity on any object.

54. **B**

If the strings of a guitar are plucked harder, then the vibrations that accompany the plucking will contain more (sound) energy.

55. **D**

A short circuit is a failure in an electric circuit is caused by excessive flow of current due to negligible (or no) resistance.

56. **D**

$$Voltage_{total} = 1\ volt + 3\ volts + 4\ volts$$
$$= 8\ volts$$

57. **C**

$R_{total} = 1\Omega + 1\Omega + R_{parallel}$

$3 = 1\Omega + 1\Omega + R_{parallel}$

$R_{parallel} = 1\Omega$

$$\frac{1}{R_{parallel}} = \frac{1}{2\Omega} + \frac{1}{R}$$

$$\frac{1}{1\Omega} = \frac{1}{2\Omega} + \frac{1}{R}$$

$$1 = \frac{1}{2} + \frac{1}{R}$$

$$\frac{1}{R} = \frac{1}{2}$$

$R = 2$

58. **A**

A wavelength is the distance between two points on neighboring waves that are in the same phase (For example: crest to crest or trough to trough).

59. **B**

$Force_{left} = Force_{right}$

$Force = (mass)(distance)$

$(Mass)(4m + 2m) + (3kg)(2m) = (10kg)(3m)$

$Mass(6m) + 6N = 30N$

$Mass(6m) = 24N$

$Mass = 4kg$

60. **D**

$Work = (Force)(Distance_{\perp})$

Thus, there is no work done on an object if it doesn't move in a motion that is perpendicular from gravity.

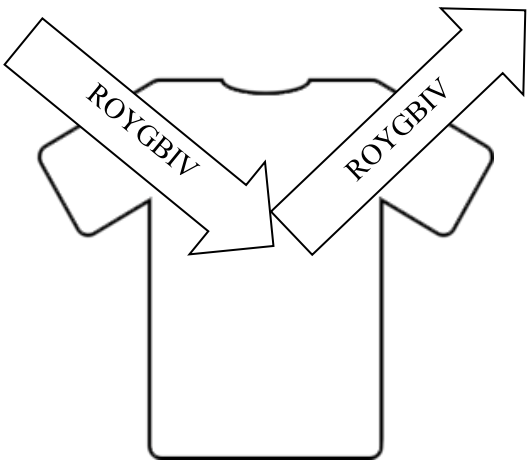
If a cart is pushed a certain distance, then it moves at the surface of the Earth which is perpendicular from the pull of gravity.

Carrying a briefcase while going upstairs and climbing a mountain with a backpack involves moving in a diagonal motion, which consists of a vertical and a horizontal component. Thus, work is done in the first three examples.

The force exerted by a person's head to a basket placed on top of it is upwards. This force is parallel to the pull of gravity. Thus, there is no work exerted by the head to the basket.

MOCK UPCAT 4: ANSWER KEY WITH EXPLANATIONS

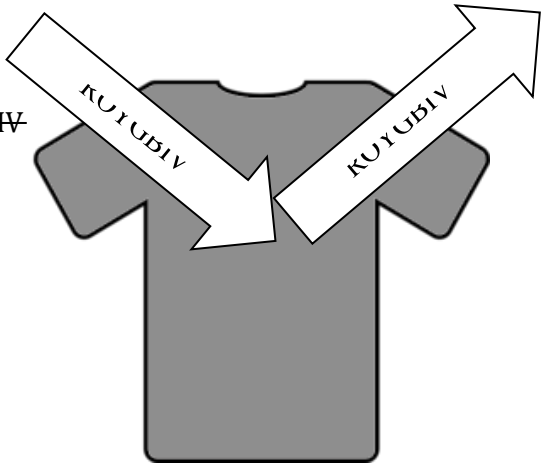
1. **D**



White reflects all colors of light "the presence of all colors"

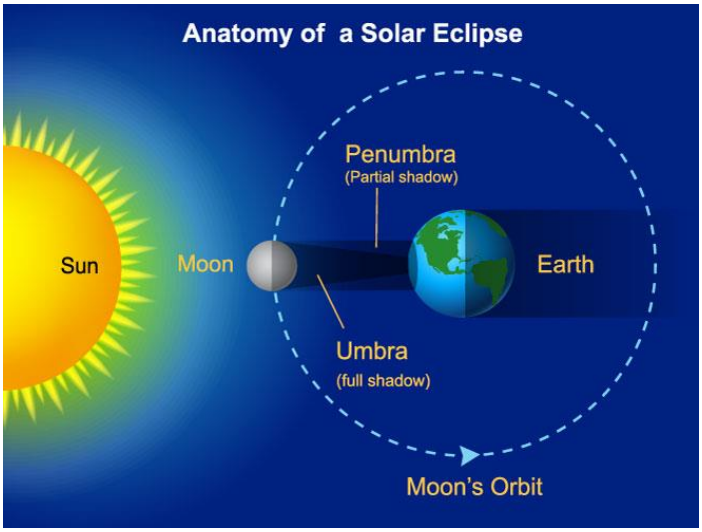
Black absorbs all colors of light "the absence of all colors"

Half of ~~ROYGBIV~~



Gray both reflects and absorbs the colors of the visible spectrum.

2. **B**



Source: https://cdna.allaboutvision.com/i/resources-2017/solar-eclipse-anatomy-330x248@2x.jpg

A solar eclipse occurs when the moon passes in front of the sun, blocking it out partially or completely. The eclipse results in parts of the earth being covered in the shadow of the moon. Therefore it occurs when the moon is between the earth and the sun.

3. **B**

A shadow appears on a surface behind somebody or something blocking the light. The length of a shadow is proportional to the cotangent of the angle of the light source relative to the horizon. During sunrise and sunset, angle is almost 0 (cot 0 = undefined ~ ∞) and shadows are very long. However, during noon, the sun is directly overhead and angle is about 90° (cot 90° = 0) and shadows are beneath the object. Thus, as time approaches 12 noon, the shadow shortens.

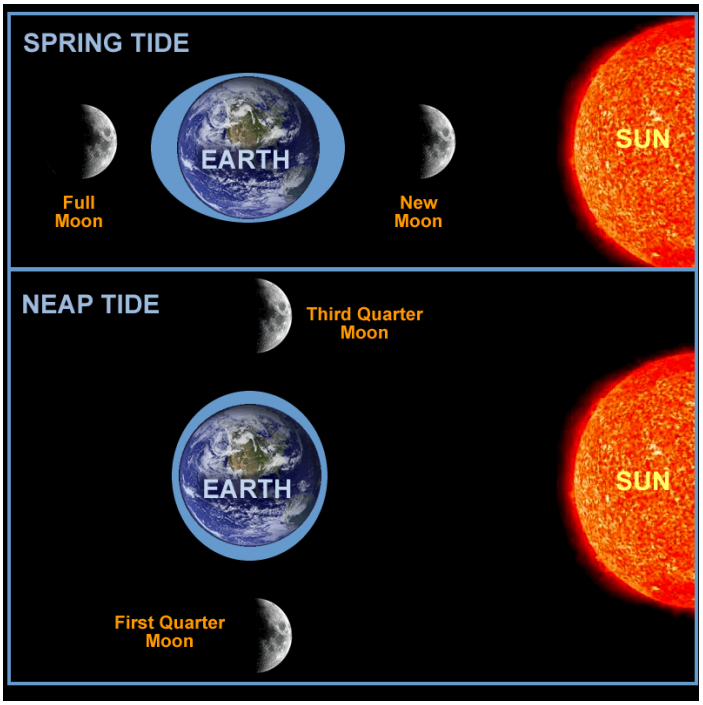
Also, since a shadow appears behind a light obstruction, we can say that its position is on the opposite side of the light source. While the sun rises in the east (morning), shadows point to the west. While the sun sets in the west (afternoon), shadows point to the east.

Thus, if a shadow is short and points west, then the time approaches 12 and it is in the morning (11 am).

4. **A**

All planets, except Venus and Uranus, rotate to the East. As an effect, the stars and satellites rise in the East and set in the West. Also, areas in the East experience a 12-hour time difference to those areas that are directly opposite (180° longitudinal difference) them.

5. **D**

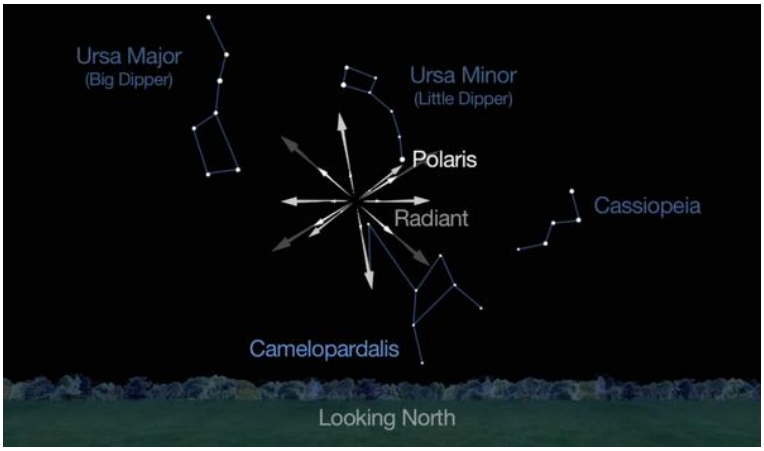


Source:http://www.windows2universe.org/earth/Water/images/tides_lg_gif_image.html&edu=elem

When the moon is in its New or Full phase, the Sun, Moon and Earth form a line. This circumstance causes the Sun to intensify the Moon's tidal pull to Earth's waters. This leads to higher tides which are called spring tides. When the moon is at its 1st or 3rd Quarter, the Sun, Earth and the moon forms a right angle. This circumstance causes the Sun to cancel some of the Moon's tidal pull to Earth's waters. This leads to lower-than-normal tides which are called neap tides.

(Note: Since the distance between the Moon and Earth is much smaller than that of the Sun and Earth, the Moon has a much greater attraction to Earth and has more effect on tides than the Sun.)

6. **A**



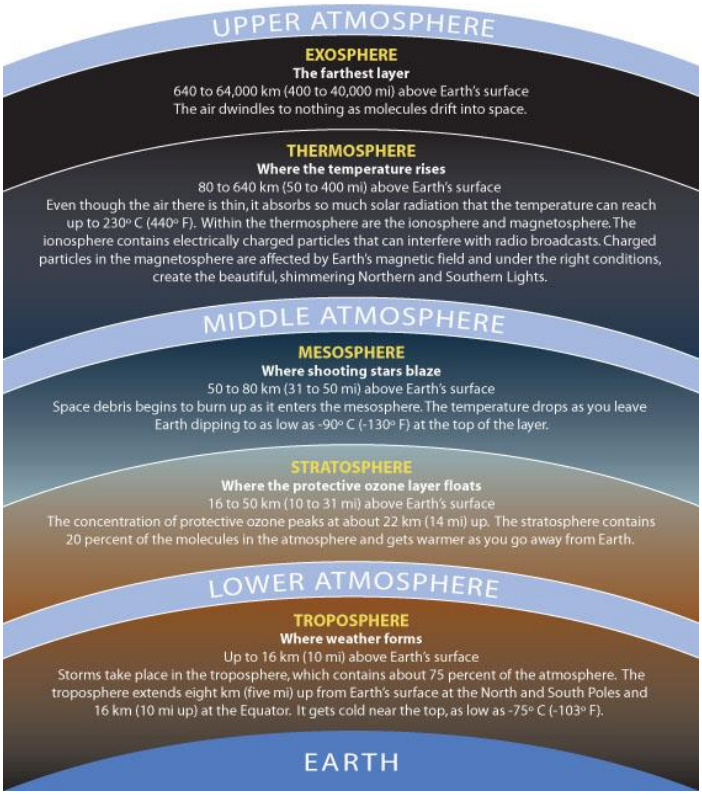
Source:https://pbs.twimg.com/media/BoRh3p9CUAEVOwT.png

A constellation is a group of stars that, when seen from Earth, form a pattern. The stars in the sky are divided into 88 constellations. There are also asterisms, a group of stars and patterns within a constellation, like the Big Dipper (in Ursa Major), the Little Dipper (in Ursa Minor), Keystone (in Hercules), and the Pleiades (in Taurus).

Source: https://www.enchantedlearning.com/subjects/astronomy/stars/constellations.shtml

The constellation Little Dipper is part of the bigger constellation "Ursa Minor".

7. **A**



Source: http://forces.si.edu/atmosphere/04_00_01.html

Weather is formed in the troposphere. It is also where most clouds and 99% of the water vapor are found. Since rain is water condensed from water vapor and falls as drops from clouds, then we can say that rain comes from the troposphere.

8. **D**

"Cloudiness" on glass windows can be intensified by blowing on it. This is due to the temperature gradient outside and inside the room. When hot air inside the room (or from the mouth) touches the cold glass, it condenses and thus forms small water droplets on the surface of the glass that will cause the "cloudiness". After some time, these water droplets may accumulate.

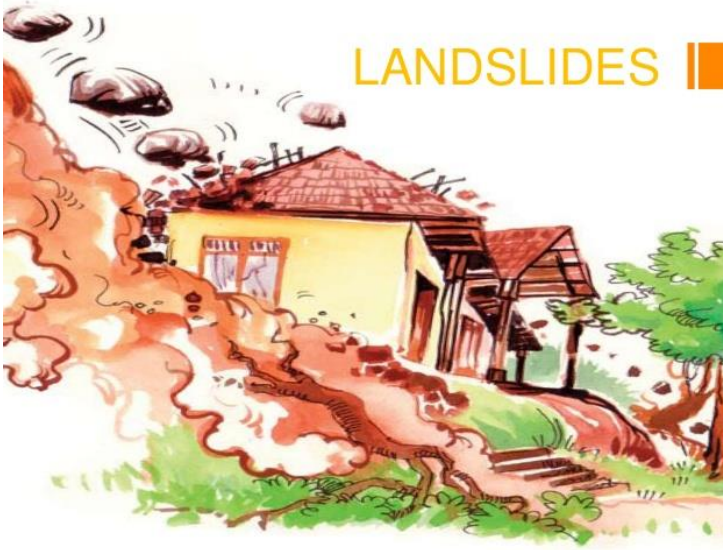
9. **A**

Sirius is 20 times brighter (absolute brightness) than and is twice as huge as the Sun.

10. **D**

Pangaea began to break apart in the Triassic period, the first period during the Mesozoic Era.

11. **D**.



Source: https://image.slidesharecdn.com/group3-160527110134/95/geological-disaster-10-638.jpg?cb=1464347040

Landslide is the movement of large masses of rocks, debris, mud and soil. It encompasses of five modes of slope movement: falls, topples, slides, spreads, and flows. Landslides are caused by both natural and human-related activities. It can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. Earthquake can trigger landslide underwater which called "submarine landslides". On the other hand, quarrying the stones that lies underneath the soil reduces the strength and stability of the soil.

12. **C**

$50 > m$;
$m + m > 30 + 50$;
$2m > 80$;
$m > 40$;
$50 > m > 40$;

13. **D**

Top to Bottom: A D B E C
Bottom to Top: C E B D A

14. **B**

Meiosis is a process of cell division that occurs in sex cells during which the nucleus divides into four nuclei which each contains half the chromosomal number of a usual nucleus.

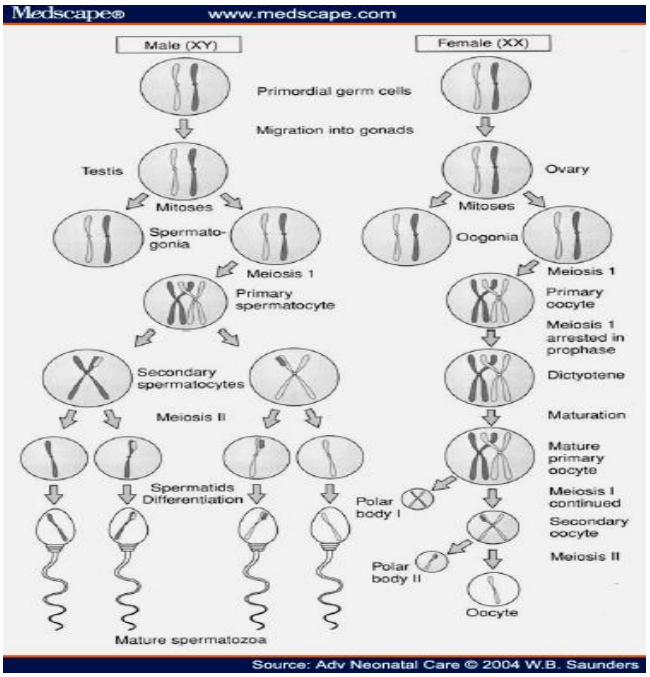
15. **A.**

During translation, transcribed mRNA binds to the ribosome. Complementary transfer RNAs with bound amino acids attach to the E, P and A sites of the ribosome. The mRNA passes along the ribosome in surges of 3 nucleotides.
(Partner bases: Adenine and Uracil; Cytosine and Guanine)

mRNA codon sequence	U – A – G
tRNA codon sequence	A – U – C

16. **C**

Oogenesis: oogonium (diploid) → primary oocyte (diploid) → secondary oocyte (haploid) and polar bodies → 1 egg and 1 polar body (from secondary oocyte) and 2 polar bodies



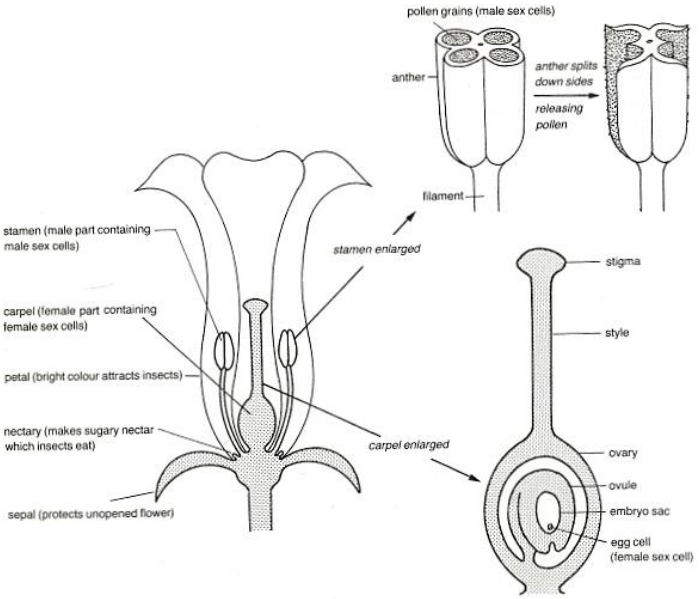
17. **B**

If ***B*** denotes the allele for black fur coat and ***b*** denotes the allele for brown fur coat, then a black dog or bitch must have a genotype ***BB*** or ***Bb***.

Given that they had brown puppies, then each parent should have an allele for brown fur coat. Thus, both parents have the genotype ***Bb***.

The cross between parents with genotype ***Bb*** produced 6 black puppies and 2 brown puppies. This is in the ratio 3:1. This follows the trend in the F2 generation of Mendel's experiment. Thus we can say that it followed the Mendelian Mode of Inheritance wherein black is the dominant trait and brown is the recessive trait.

18. **C**



Source:http://www.ssc.education.ed.ac.uk/bsl/biology/stamen.html

Stamen, the male reproductive part of a flower consists of the filament, anther and pollen.

19. **B**

If a woman has blood type O, then her genotype is ***OO***. If her husband's blood type is B and her father-in-law has blood type O, then her husband's genotype is ***BO*** (Her husband must have at least one ***O*** allele inherited the father).

As shown as the chart below, a cross between parents with genotypes ***BO*** and ***OO***, will result into a offspring with a phenotypic ratio of 1 ***OO*** : 1 ***BO***. Thus, there is $\frac{1}{2}$ or 50% chance of getting an offspring with a blood type of B.

OO x ***BO***		
	B	O
O	***BO***	***OO***
O	***BO***	***OO***

20. **C**

Each of the prokaryotic cells has a cell wall which protects the cell and gives it shape.

Some eukaryotic cells, such as plants and some fungi, have cell walls. However, most eukaryotic cells do not possess a cell wall. Animals have a cell membrane which consists of a lipid bilayer. Selected particles can diffuse through this membrane.

21. **A**

Scientific Name	Common Name
Chanos chanos	milk fish (bangus)
Musa squamosa	*Musa* is the genus that comprise of bananas and plantains.
Pterocarpus indicus	Narra
Livistona rotundifolia	Anahaw

22. **A**

The class Crustacea which is under the phylum Arthropoda consists mainly of aquatic arthropod invertebrates. Crustaceans have a hard external skeleton, segmented body, several pairs of jointed legs, antennae and eyes. Lobsters, crabs, shrimp, crayfish and barnacles are examples of crustaceans.

23. **D**

A shark is a cartilaginous fish while a sea horse is a bony fish. Despite this, both of them have segmented spinal column. A tadpole is the larva of a frog. An adult frog has 10 vertebrae. Octopuses, on the other hand, do not have vertebrae. They move through jet propulsion and walk with their highly flexible tentacles.

24. **A**

The phylum Cnidaria consists of invertebrate ocean animals characterized with tentacles that surround the mouth. Examples of cnidarians are sea anemones, corals and jellyfish.

25. **A**

Yeast is a small unicellular fungus that is used to ferment sugars and other carbohydrates.

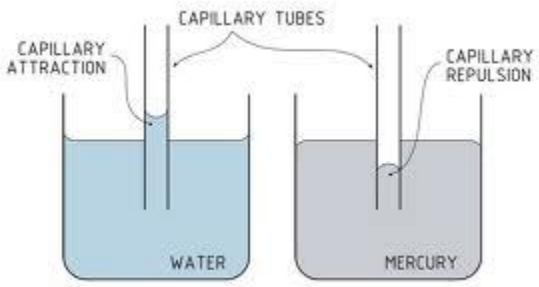
26. **A**

A cladogram is diagram which presents evolutionary relationships. We can see in the given cladogram that birds and Saurischian dinosaurs have four common characteristics while birds and Ornithischian dinosaurs have two common characteristics. The two types of dinosaurs share only one common characteristic with humans and do not share any characteristic with other animals. Thus, we can say that the dinosaurs are most closely related to birds.

27. **A**

When we look at the diagram, we can see that frogs, humans and whales split from crocodiles, birds, Saurischian dinosaurs and Ornithischian dinosaurs. Thus, we can say that animals from different groups are distantly related and that common characteristics in the two groups are developed independently of each other.

28. **B**



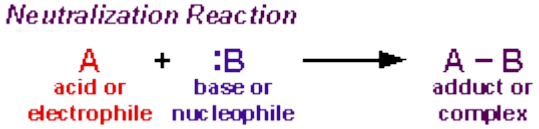
Source:http://chemwiki.ucdavis.edu/Physical_Chemistry/Physical_Properties_of_Matter/Intermolecular_Forces/Cohesive_And_Adhesive_Forces/Capillary_Action

Water is a polar molecule. Its two oxygen atoms are slightly negative compared to the hydrogen atom. Because of this polarity, neighboring water molecules bond to each other through hydrogen bonds. (Positive hydrogen of one water molecule coheres to the negative oxygen of another water molecule.) This is called cohesion.

If a surface, as that of a glass test tube, has a lot of hydrogen atoms, then negative oxygen atoms from the water will be attracted and adhere to it.

When water is in a test tube, negative oxygen will be attracted to the positive sides. Thus we can see that water level in the sides is higher than that in the middle.

29. **D**



According to the Lewis theory of acid-base reactions, an acid is an electrophile (accepts electrons) while a base is a nucleophile (electron donors).

30. **D**

$\text{pH} = -\log[\text{H}_3\text{O}^+]$

$[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$

$[\text{H}_3\text{O}^+] = 10^{-6}\text{M} = 1 \text{ x } 10^{-6} \text{ M}$

31. **C**

If you treat an acidic solution with excess base, then the solution will be less acidic or more basic. This means that its pH level will increase.

32. **C**

$29 \text{ x } 10^{-3}\text{g Mg(OH)}_2 \text{ x } \left(\frac{\text{mol Mg(OH)}_2}{58 \text{ g Mg(OH)}_2}\right) \text{x}$

$\left(\frac{2 \text{ mol HCl}}{1 \text{ mol Mg(OH)}_2}\right) \text{x} \left(\frac{36 \text{ g HCl}}{\text{mol HCl}}\right) = 36 \text{ x } 10^{-3}\text{g HCl} =$

36 mg HCl

33. **D**

According to the Charles's Law, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$, so

$V_2 = \frac{V_1 T_2}{T_1} = \frac{(10 \text{ L})(27+273)}{(2+273)} = 11.\overline{90}$

34. **D**

Ideal Gas Law: $PV = nRT$

$n = \frac{PV}{RT} = \frac{(1.00 \text{ atm})(25 \text{ L})}{\left(8.134 \frac{\text{J}}{\text{mol K}}\right)(25+273)} = 0.010313821 \text{ M}$

$V = \frac{nRT}{P} = \frac{(0.010313821 \text{ M})\left(8.134 \frac{\text{J}}{\text{mol K}}\right)(596 \text{ K})}{0.5 \text{ atm}}$

$= 100 \, L$

35. **A**

Molecule	Molecular Formula
Ozone	O_3
Nitrogen	N
Hydrogen	H
Carbon Monoxide	CO

36. **A**

An orbital is a division of the available space within an atom for an electron to orbit around the nucleus. Each orbital can accommodate up to two electrons.

A nucleus is the central region of an atom. It consists of protons and neutrons and is thus, positively charged. Thus, there are no electrons in this region.

A shell is a group of electrons that are associated with the same level of energy. Outer shells have more space than the inner ones and can accommodate more orbitals and thus, more electrons.

An orbit is the path where an electron passes through as it moves around the nucleus of an atom according to Bohr's planetary model. However, since Bohr's planetary model was already disproved by the Quantum model, then this is not a possible answer.

We are left with choices A (orbital) and C (shell). However, among the known elements, only the first seven shells of an atom hold electrons and only the first four shells are ever filled up.

37. **C**

The empirical formula is a chemical formula that shows the relative proportion of elements in the compound rather than specifies the number of atoms in a given molecule of a compound.

38. **C**

Electronegativity measures the tendency of an atom in a molecule to draw electrons in a chemical bond.

39. **C**

Mass ratio (C:H): 3:1

Molecular mass of Carbon: 12 g/mol

Molecular mass of Hydrogen: 1 g/mol

Ratio of molecular mass (C:H): 12:1

Since (molecular mass)(number of atoms) = total mass, then we can determine the ratio between the number of atoms in each compound through proportion.

$\frac{3x}{1y} = \frac{12}{1}; 3x = 12y; x = 4y$

For every one carbon atom, there are four hydrogen atoms.

40. **D**

Since HCl is a monoprotic acid and NaOH is a monoprotic base, then one mole of HCl can be neutralized with one mole of NaOH.

$(0.1 \text{ M HCL}) \text{ (x L)} = (0.350 \text{ M NaOH}) \text{ (25 x } 10^{-3} \text{ L)}$

$x \text{ L} = \frac{(0.350 \text{ M NaOH})(25 \text{ x } 10^{-3})}{0.1 \text{ M HCl}}$

$= 87.5 \text{ x } 10^{-3} \text{ L} = 87.5 \text{ mL}$

41. **A**

Property	Definition
heat capacity	quantity of heat required to increase the temperature of one mole of a substance by 1°C.
heat of fusion	quantity of heat required to be absorbed by a substance to undergo state change from solid to liquid
heat of formation	quantity of heat evolved or absorbed in the formation of one mole of a substance
heat of vaporization	quantity of heat required to be absorbed by a substance to undergo state change from liquid to gas

42. **B**

A combination reaction is the union of substances to form a single chemical compound.

43. **D**

Since $\text{Potential Energy} = \text{mgh}$, then, as a bullet goes straight upwards, its height above the ground increases, and thus, its potential energy increases.

44. **D**

Levers can amplify a small input force to a greater output force. For example, a large force over a short distance at one end of the lever can be lifted by a smaller force over a longer distance at another end of the lever. Thus, in this specific example, if the ball is nearer to the fulcrum, then less force is to be applied to lift the ball.

45. **D**

When a composite light (such as white light) passes through a transparent medium (such as a prism), light refracts and forms the seven colors of the visible spectrum.

46. **C**

Given that $\text{Work} = (\text{Force})(\text{Distance}_{\perp})$, the only possibilities wherein no work is accomplished is when force was not exerted or if there is no motion that is perpendicular from the pull of gravity. Pushing against wall does not produce motion and thus, it has no work.

47. **D**

$$\text{KE} = \tfrac{1}{2}\,\text{mv}^2$$

Let M be the new value for KE after the variables m and v are changed.

a. If mass is halved
$$\text{M} = \frac{1}{2}\left(\frac{1}{2}\text{m}\right)(\text{v}^2) = \frac{1}{4}\text{mv}^2 = \frac{1}{2}\text{KE}$$
b. If mass is doubled
$$\text{M} = \frac{1}{2}(2\text{m})(\text{v}^2) = \text{mv}^2 = 2\text{KE}$$
c. If velocity is halved
$$\text{M} = \frac{1}{2}(\text{m})(\frac{1}{2}\text{v})^2 = \frac{1}{8}\text{mv}^2 = \frac{1}{4}\text{KE}$$
d. If velocity is doubled
$$\text{M} = \frac{1}{2}(\text{m})(2\text{v})^2 = 4\text{KE}$$

48. **C**

Assuming that the body is moving at constant speed of 45 km/hr in a circular path, it experiences an acceleration that is directed towards the center of the circular path.

49. **B**

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{\pi(2.0\text{m})^2}{2\text{s}} = \frac{4\pi\text{m}^2}{2\text{s}} = \frac{2\pi\text{m}^2}{\text{s}}$$

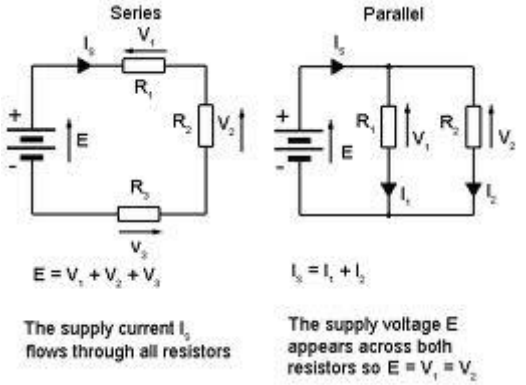
50. **B**

Everything falls at a constant acceleration of ***g*** ($9.8\ \text{m/s}^2$). However, some other factors affect this acceleration. Raindrops fall at the atmosphere, specifically, at the thermosphere. This means that it is exposed to air resistance. After some time, the force caused by gravity will be balanced out by the force due to air resistance. Thus, the raindrops will fall at a constant speed.

51. **D**

$$\text{v}^2 = \text{v}_\text{o}{}^2 + 2\text{ad}$$
$$\text{v}^2 = 0^2 + 2\left(10\,{}^{\text{m}}/_{\text{s}^2}\right)(5.0\text{m}) = 100\,{}^{\text{m}}/_{\text{s}}$$

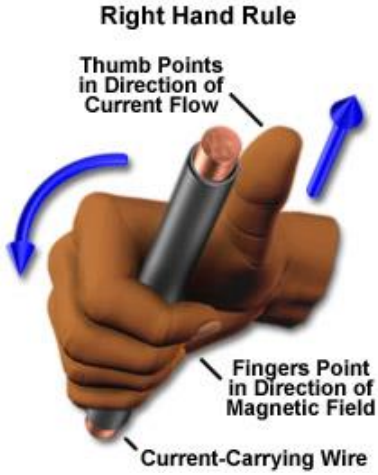
52. **B**



Source:http://www.learnabout-electronics.org/resistors_20.php

In a parallel circuit, devices are attached in such a way to allow all positive poles to be connected to one conductor and all negative ones to another conductor. So, if one device is removed or defective, all other devices are still connected to the conductors and that current still flows to each one of it.

53. **A**



Source:http://www.magnet.fsu.edu/education/tutorials/java/handrules/

According to the right-hand-rule, if you point your thumb to the current, and assume your fingers in a curved position, then your fingers will show the direction of magnetic field. Since current in electrical circuit flows in a linear motion, then the magnetic field is in a circular shape.

54. **A**

According to the Ohm's Law, electric current is directly proportional to the applied voltage and is inversely proportional to the resistance due to connected devices (V = IR). Thus if resistance is doubled, current should be halved.

55. **D**

$$v = v_0{}^2 + at = 0 + \left(1.5\ {}^{m}/_{s^2}\right)(20s)$$
$$= 30\ {}^{m}/_{s}$$

56. **C**

$$d = (v_i)(t) + \left(\frac{1}{2}\right)(a)(t^2)$$
$$20m = (0)(t) + \left(\frac{1}{2}\right)(1.5\ {}^{m}/_{s})(t^2)$$
$$20m = 0.75\ t^2$$
$$t^2 = {}^{80}/_{3}$$
$$t = 5.164 \text{ seconds} \cong 5 \text{ seconds}$$

57. **D**

$$\text{distance}_x = (3\ {}^{m}/_{s})(1.5 \text{ seconds}) = 4.5 \text{ m}$$

58. **A**

$$\text{distance}_y = (v_i)(t) + \left(\frac{1}{2}\right)(a)(t^2)$$

$$5 \text{ m} = (0)(t) + \left(\frac{1}{2}\right)(10\ {}^{m}/_{s})(t)^2$$

$$5 \text{ m} = 5t^2$$

$$t^2 = 1$$

$$t = 1.0 \text{ second}$$

59. **D**

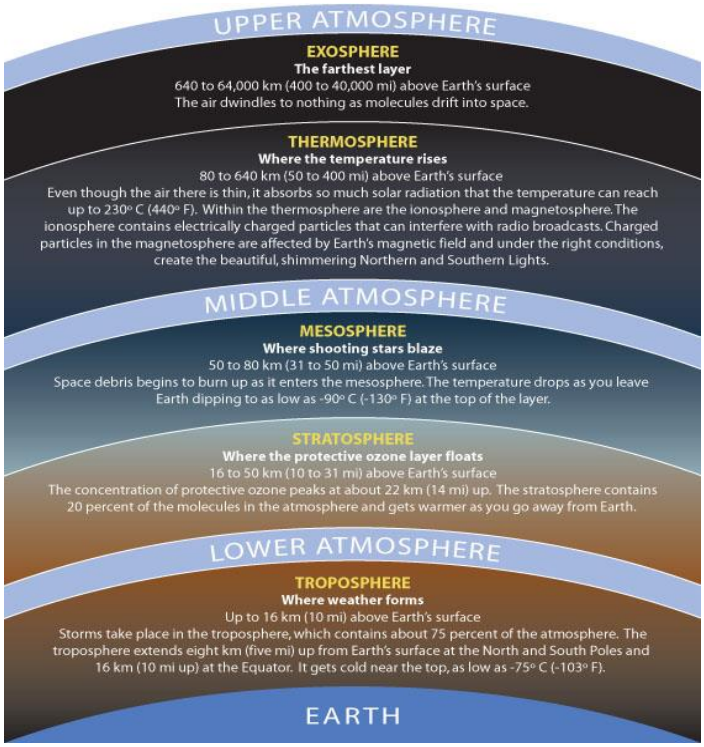
$$a = \frac{v^2}{r} = \frac{(2\ {}^{m}/_{s})^2}{0.2 \text{ m}} = 20.0 \text{ m/s}$$

60. **C**

According to Ohm's Law, V = IR. Thus, if a device has high resistance, it will receive a low current.

MOCK UPCAT 5: ANSWER KEY WITH EXPLANATIONS

1. **A**



Source: http://forces.si.edu/atmosphere/04_00_01.html

Troposphere is the layer of atmosphere which contains most of the clouds and 99% of the water vapor. Since lightning is the discharge of built-up static electricity in clouds, lightning must be formed in an area which contains clouds.

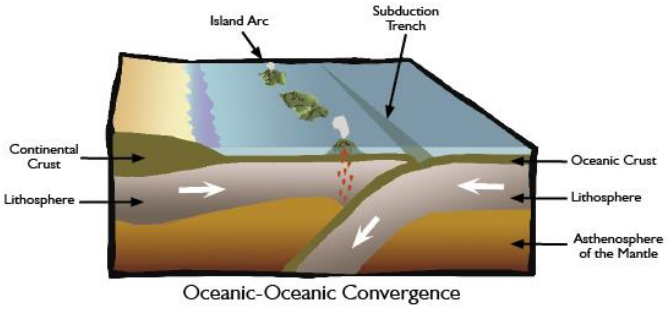
2. **C**

Heat is first transferred from the flames to the metal steamer by conduction. Water particles near the bottom of the steamer are also heated through conduction. After some time, the density of the heated water decreases and will thus rise. Cool water will then sink. This heat transfer occurs through convection.

3. **C**

A sound wave is formed by a disturbance or vibration and is transmitted through collisions of matter. Since particles in a solid are compact, sound waves immediately propagate to the neighboring particle. Thus, sound waves can be transmitted faster throughout a solid object.

4. **A**

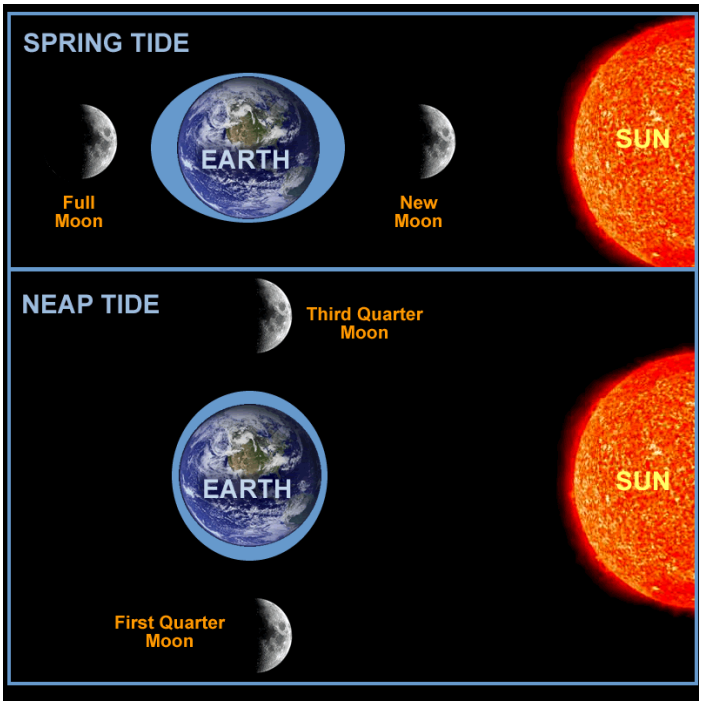


Oceanic-Oceanic Convergence

http://www.ncgeology.com/Eno_interactive_webs/Geologic_Principles_Geologic_story.html

When two oceanic plates converge, the older and thus, cooler and denser, will sink to the asthenosphere. An oceanic trench will form where the denser plate is subducted beneath the less dense plate.

5. **A**



Source:http://www.windows2universe.org/earth/Water/images/tides_lg_gif_image.html&edu=elem

When the moon is at its 1st or 3rd Quarter, the Sun, Earth and the moon forms a right angle. This circumstance causes the Sun to cancel some of the Moon's tidal pull to Earth's waters. This leads to lower-than-normal tides which are called neap tides.

(Note: Since the distance between the Moon and Earth is much smaller than that of the Sun and Earth, the Moon has a much greater attraction to Earth and has more effect on tides than the Sun.)

6. **B**

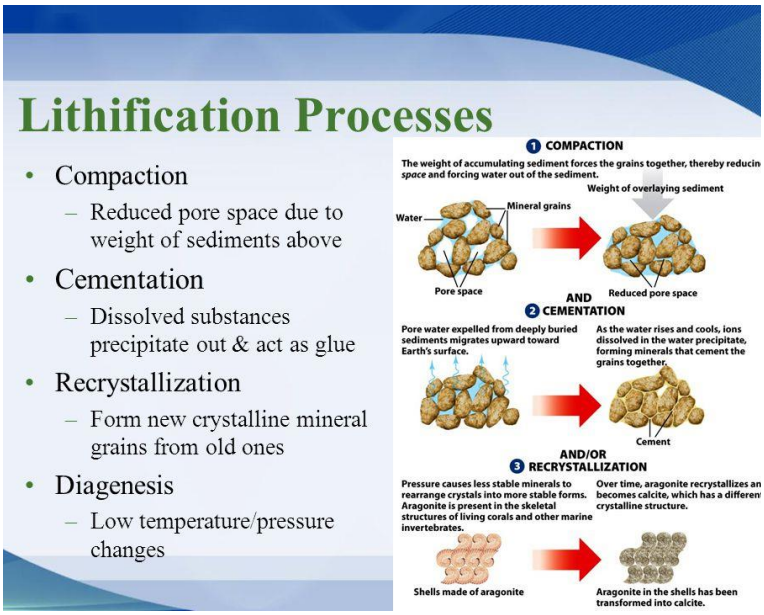
Source: http://www.astronomy.org/programs/seasons/

The star which all other stars revolve around is known as the North Star or the Polaris.

7. **B**

The correct measurement of the **speed of light** in a vacuum is "exactly 299, 792, 458 metres per second" which is equal to 2.99792458×10^8 m/s.

8. **B**



Source:http://slideplayer.com/4182361/14/images/7/Lithification%20Processes.jpg

9. **A**

During a total solar eclipse, the Moon appears to completely block the light from the Sun from reaching the Earth. Because of this, an observer can only see the outer layer of the Sun's atmosphere which is the corona. However, during normal days, the corona is not visible because it is really dark compared to the photosphere.

10. **C**

A material will be able to scratch a fingernail only if it is harder than the latter. Talc and gypsum are both softer than a fingernail. On the other hand, calcite, which has a hardness of 3, is harder than a fingernail.

11. **B**

Apatite has a hardness of 5, while feldspar has a hardness of 6. For a material to be able to scratch apatite but not feldspar, it must have a hardness which is intermediate that of apatite and that of feldspar.

12. **C**

Fluorite cannot scratch any material is harder than it. Thus, that material must have hardness which is higher than that of fluorite. Among the choices, only apatite is harder than fluorite.

13. **D**

Spectral Class	Color	Temperature
O	blue	28,000 - 50,000
B	blue-white	9900- 28,000
A	white	7400-9900
F	yellow-white	6000-7400
G	yellow	4900-6000
K	orange	3500-4900
M	orange-red	2000-3500

Source:http://www.windows2universe.org/cool_stuff/HR_spectralclass.html&edu=high

14. **C**

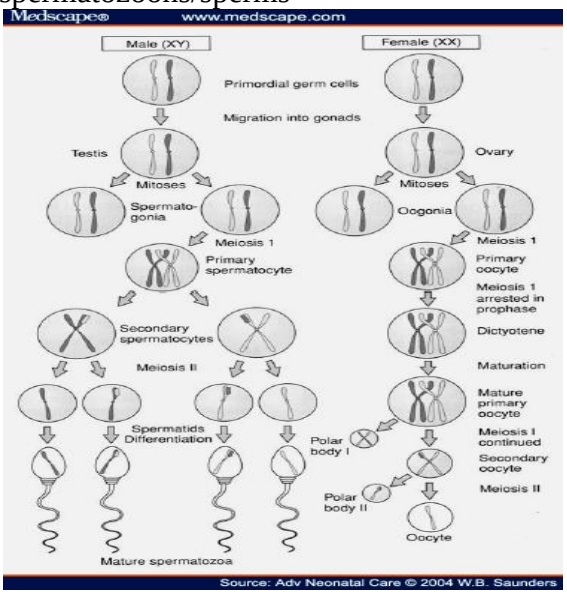
Earthquakes can be measured by its effects or seismic intensity. The Mercalli scale rates the ground movement by a description of reactions of humans, other organisms and artificial structures to the tremor. This scale ranges from 1 to 12 wherein 1 denotes a weak earthquake and 12 denotes a very destructive one.

15. **B**

Mitosis is the process wherein a cell divides into two daughter cells, each of which has the same number of chromosomes as the parent cell. This process is used in somatic cells. However, sex cells or gametes are formed by meiosis. In meiosis, the daughter cells have half the number of chromosomes of the parent cell.

16. **A**

Spermatogenesis: spermatogonium (diploid) → primary spermatocyte → 2 secondary spermatocytes (haploid) → 4 spermatids → 4 spermatozoons/sperms



17. **A**

Monera is a kingdom which consists of all prokaryotic (or simple, single-celled) organisms.

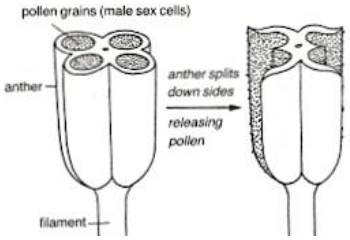
18. **D**

Echinodermata is a phylum which consists of animals which usually have a five-part radial symmetry and are equipped with tube feet, such as starfish, brittle stars, sand dollars, sea cucumbers and sea urchins.

19. **B**

Peas are round green seeds that grow in a pod. A seed is a plant part that contains embryo. Thus, it is produced by the fertilization of ovule. Usually, the ovule is enclosed within the ovary. The ovary turns into an outer covering after fertilization of the ovule.

20. **D**



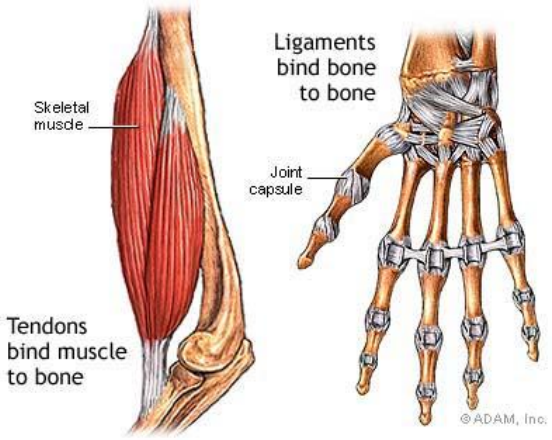
Source:http://www.ssc.education.ed.ac.uk/bsl/biology/stamen.html

Stamen is the male reproductive part of a flower. It consists of the filament, anther and pollen.

21. **B**

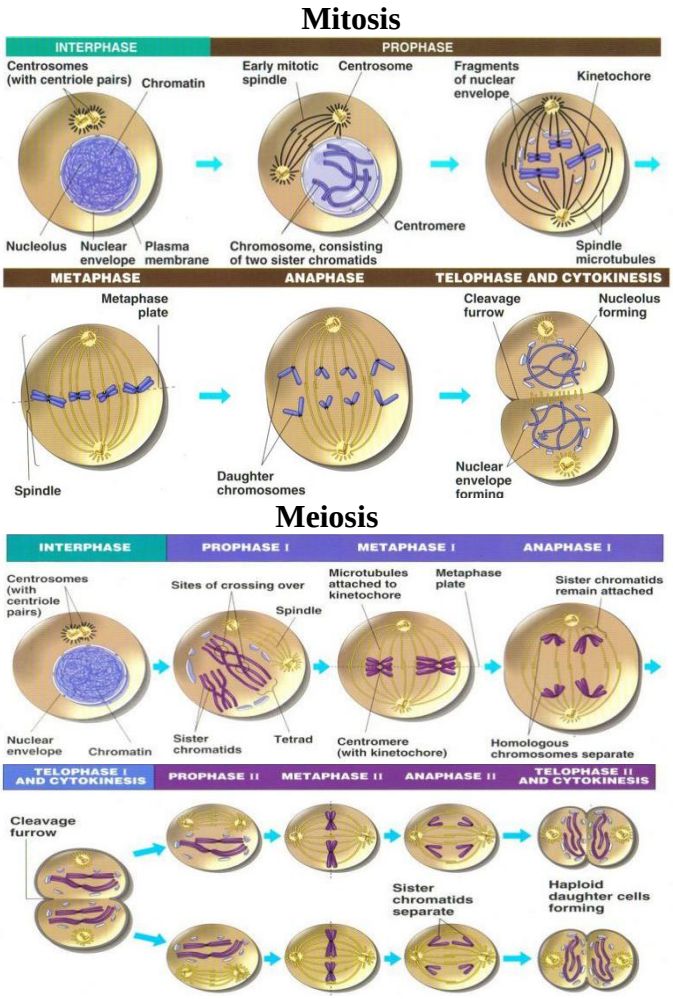
Cardiac and smooth muscles are involuntary. These muscles are usually found in organs. Conversely, skeletal muscles are voluntary. This means that it is usually under conscious control. Contractions of these muscles cause bones and cartilages to move. Biceps are among the skeletal muscles.

22. **B**



Source:http://www.nytimes.com/imagepages/2007/08/01/health/adam/19089Tendonvsligament.html

23. **A**



In the diagram, we can see that chromosomes, centrioles and the mitotic spindle participate in cell reproduction. During prophase, centrioles move to the opposite poles of the cell and form the mitotic spindle, which in turn, pull the chromosomes apart during anaphase.

24. **C**

Almost all of marine life is found between the shoreline and the edge of the continental shelf. Sunlight cannot penetrate deeper areas of the ocean. Without sunlight, photosynthetic aquatic plants would not be able to undergo photosynthesis and thus, die. As a result, all consumers will not be able to thrive.

25. **D**

Natural erosion from Mt. Makiling, discharge of sewage and wastes from factories, and run-off fertilizers and animal wastes from farms will cause the infiltration of excess minerals to Laguna de Bay, which in turn, can cause eutrophication.

26. **B**

$pH = -\log[H^+] = -\log[1.0\ x\ 10^{-8}] = 8$
$pOH = 14 - pH = 14 - 8 = 6$

27. **B**

According to The Law of Conservation of Mass, in any chemical reaction, the mass of reactants must be equal to the mass of products. Thus, the mass of KNO_3 must be equal to the sum of the masses of KNO_2 and O_2 which is 65.

28. **C**

$N_t = N_0\left(\frac{1}{2^t}\right)$
where *N(t)* is the amount remaining after N_0 radioactive particles underwent decomposition *t* times
$\frac{1}{16}N_0 = N_0\left(\frac{1}{2^t}\right)$
$\frac{1}{2^t} = \frac{1}{16}$
$2^t = 16$
t = 4

Thus, in four days, the sample underwent four decompositions. Thus, its half-life is one day.

29. **B**

Distillation is the process of separation of water to other particles through boiling and condensation. Pure water or H_2O does not have any other particles. Thus, it cannot be distilled.

30. **A**

An atom is the smallest portion of any material which still retains its properties. Despite this, it can still be dissociated into protons, neutrons and electrons through nuclear fission.

31. **B**

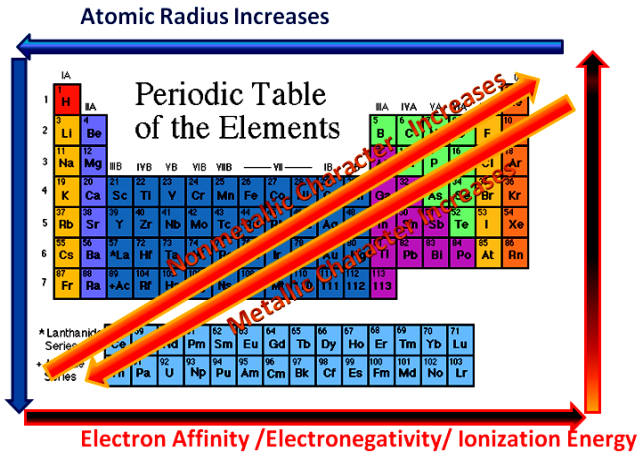
Carbon-12 and Carbon-14 are isotopes. Isotopes are forms of a chemical element that differ in the number of neutrons. All carbon isotopes still have an atomic number of 6. However, the mass number of Carbon-12 is 12 while that of Carbon-14 is 14. Thus, the number of neutrons in Carbon-12 is 12 – 6 or 6 while the number of neutrons in Carbon-14 is 14 – 6 or 8.

32. **C**

A noble gas is a chemically inert gas. This is due to its full outer shell of electrons. Thus, they possess an ns^2np^6 configuration.

33. **B**

Usually, metals tend to lose electrons to form cations while non-metals tend to gain electrons to form anions. This is due to the fact that elements follow the Octet Rule, which states that elements lose or gain electrons so that they will have the same number as that of the nearest noble gas. Thus, the ability of an element to form anions increases with decreasing metallic property (or increasing nonmetallic property). Among these elements, fluorine is the least metallic and thus has the highest tendency to form anions.



Source:http://i150.photobucket.com/albums/s118/hi78953/chemwiki.png

34. **B**

The polarity of bonds can be measured by the difference between the electronegativities of the two elements. If the elements have a high electronegativity difference, then one of the two elements has a much stronger pull to electrons than the other one does. This makes the molecule is more polar. Since electronegativity follows a trend (Refer to picture in # 33), we can say that the farther elements are in a periodic table, the higher is the electronegativity difference between them. Among these bonds, the one which has the highest electronegativity difference is O-H.

35. **D**

According to periodic trends, as electron affinity increases, atomic radius decreases, electronegativity increases, ionization energy increases and nonmetallic property increases. Also, a more nonmetallic element has a higher tendency to form anions and thus, a lower tendency to form cations (Refer to # 33).

36. **B**

$$12\ g\ glucose\left(\frac{1\ mol}{180.16\ g}\right)(6.022\ x\ 10^{23}\ molecules)$$
$$\approx 12\ g\ glucose\left(\frac{1\ mol}{180\ g}\right)(6\ x\ 10^{23}\ molecules)$$
$$\approx 4\ x\ 10^{22}\ molecules$$

37. **B**

After 250mL of water dissolve 20g of NaCl, 40g of NaCl remain undissolved.

20g : 250mL :: 40g : x

(20g)x = (40)(250)

$$x = \frac{(40g)(250\ mL)}{(20g)} = 500\ mL\ of\ water$$

38. **A**

$$Rate\ of\ Effusion = \frac{1}{\sqrt{MM}}$$
$$\frac{Rate_A}{Rate_B} = \frac{\sqrt{MM_B}}{\sqrt{MM_A}} = \sqrt{\frac{MM_B}{MM_A}}$$
$$\frac{Rate_x}{Rate_{CO_2}} = \sqrt{\frac{MM_{CO_2}}{MM_x}} = 2$$
$$\frac{MM_{CO_2}}{MM_x} = 4$$
$$MM_{CO_2} = 4MM_x$$
$$44\ \frac{g}{mol} = 4MM_x$$
$$MM_x = 11\ \frac{g}{mol}$$

39. **B**

Matter moves from an area of higher concentration to an area of lower concentration. In the given setup, water concentration in solution A is $1 - \frac{10\ g}{50\ g/mol} = 1 - 0.2 = 0.8$ while that in solution B is $1 - \frac{10\ g}{100\ g/mol} = 1 - 0.1 = 0.9$. Thus, water will move from solutions B to A.

40. **B**

$$(10\ g)(24°C - 20°C)\left(0.2\ \frac{cal}{g-°C}\right)$$
$$= (10\ g)(4°C)\left(0.2\ \frac{cal}{g-°C}\right) = 8 \text{ calories}$$

41. **C**

Opposite charges attract while like charges repel. Thus, if both balls have a positive charge, they will repel each other. Since they exert the same repulsive force to each other, each ball will have the same displacement from its original position.

42. **D**

$$V_f = V_i + at = 50\ m/s + (2\ m/s^2)(10\ s)$$
$$= 50\ m/s + 20\ m/s = 70\ m/s$$

43. **C**

$$S = V_i t + \frac{1}{2}at^2 = 0 + \frac{1}{2}(10\ m/s^2)(4\ s)^2$$
$$= 80\ meters$$

44. **C**

As an object that is thrown up reaches the maximum point, its velocity drops to zero. The time the object needs to reach its maximum point is

$$t = \frac{V_f - V_i}{a} = \frac{0-4\ m/s}{-10\ m/s^2} = \frac{-4\ m/s}{-10\ m/s^2} = 0.4\text{s}$$

In 0.4 seconds, it will reach a height of

$$S = V_i t + \frac{1}{2}at^2$$
$$= (4\ m/s)(0.4s) + \frac{1}{2}(10\ m/s^2)(0.4s)^2$$
$$= 1.6\ m + 0.8\ m = 2.4\ m \sim 2.5\ m$$

Note: The actual value of acceleration due to gravity is 9.8 m/s^2 (which is rounded to 10 m/s^2). Thus, the actual answer should be greater than 2.4 m.

45. **A**

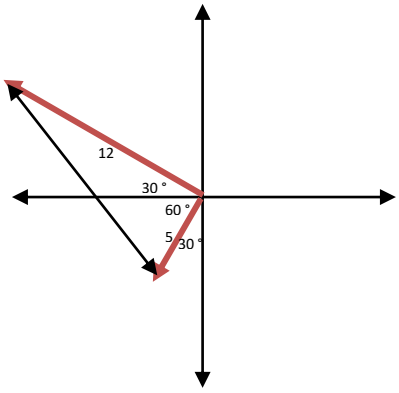
$$\frac{F}{m} = a = \frac{50\,000\ N}{500\ kg} = 100\ m/s^2$$

46. **A**

$$F = ma$$
$$m = \frac{F}{a} = \frac{60\ N}{3.0\ m/s^2} = 20\ kg$$

47. **C**

Suppose that the forces acting on a hockey puck are 5.0 N at 30° **W of S** and 12.0 N of W. What is the acceleration of the puck, given that its mass is 0.1 kg.



$$a^2 + b^2 = c^2$$
$$(5)^2 + (12)^2 = c^2$$
$$c^2 = 169$$
$$c = 13\ N$$
$$F = ma$$
$$a = \frac{Force}{mass} = \frac{13\ N}{0.1\ kg} = 130\ m/s^2$$

48. **D**

To be able to lift an object, you must apply a force that can overcome the force of gravity.

$$F = ma = (5\ kg)(10\,m/s^2) = 50\ N$$

49. **C**

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.5\ kg)(2\,m/s)^2 = 1\,J$$

50. **A**

$$PE = mgh$$
$$10\,J = (2\ kg)(10\,m/s^2)(h)$$
$$h = \frac{10\ J}{(2\ kg)(10 m/s^2)} = 0.5\,m$$

51. **A**

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(50\ kg + 30\ kg)(10\,m/s)^2$$
$$= 4000\,J$$

52. **C**

$$Power = \frac{Work}{time} = \frac{(Force)(distance)}{time}$$
$$= \frac{(mass)(acceleration)(distance)}{time}$$
$$a = \frac{V_f - V_i}{t} = \frac{6\ m/s - 3\ m/s}{2.0\ s} = 1.5\ m/s^2$$
$$S = distance = V_i t + \frac{1}{2}at^2$$
$$= (3\ m/s)(2.0\ s) + \frac{1}{2}(1.5\ m/s^2)(2.0\ s)^2$$
$$= 6\,m + 3\,m = 9\,m$$
$$Power = \frac{(mass)(acceleration)(distance)}{time}$$
$$= \frac{(40.0\ kg)(1.5\ m/s^2)(9\ m)}{2\ s} = 270\ Watts$$

53. **C**

500 mg = 0.5 kg

$$\frac{F}{m} = a = \frac{300.0\ N}{0.5\ kg} = 600\ m/s^2$$
$$V_f = V_i + at = 0 + (600\ m/s^2)(0.1\ s)$$
$$= 60\,m/s$$

54. **C**

Since $momentum = (mass)(velocity)$, we can say that it is a vector quantity. For a system to have a net momentum of +12 kgm/s, the movement should be to the right. This eliminates choices a, b and d. System A doesn't have a net momentum since the similar balls move in the same speed at different directions. Both systems A and B have negative momenta since its movement is to the left.

55. **B**

$$V_f = V_i + at$$
$$t = \frac{V_f - V_i}{a} = \frac{14.75\ m/s - 2\ m/s}{1.5\ m/s^2} = 8.5\ s$$

56. **A**

$$KE = \frac{1}{2}mv^2$$

Let K be the new value of KE after the variables m and v are changed

$$K = \frac{1}{2}\left(\frac{1}{2}m\right)(2v)^2 = \frac{1}{2}\left(\frac{1}{2}\right)(m)(4)(v^2)$$
$$= 2\left(\frac{1}{2}mv^2\right) = 2\,KE$$

Thus, if the mass of a body is halved and the velocity is doubled, its kinetic energy will double.

57. **B**

The pitch of guitar strings represents the frequency of the sound wave produced by the strings. A higher pitch is produced by high-frequency sound waves. The frequency of a

stretched wire depends on three factors which, combined in a single formula, is found to be

$f = \frac{1}{2L}\sqrt{\frac{T}{m}}$

where f is the frequency, L is the length, T is the tension and M is the mass per unit length (linear density)

From the formula, we can see that the frequency is proportional to tension and is inversely proportional to length and to mass per unit length. Thus, an object with a high pitch must be tight, short and has a low linear density. Assuming that the strings are made of the same material, a thin wire has a lower linear density than that of a thick wire.

58. **D**

$Voltage = (Current)(Resistance)$

$V = IR$

$I = \frac{V}{R}$

Current is inversely proportional to resistance. Thus, least current will be used in the object with the greatest resistance, which is the television.

59. **D**

$Power = (Voltage)(Current)$

$Voltage = (Current)(Resistance)$

$Power = (Current)^2(Resistance)$

$P = I^2R = (3.0\ A)^2(400.0\ \Omega) = 3600\ Watts$

60. **B**

In a parallel circuit, $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$.

$\frac{1}{R_T} = \frac{1}{20\ \Omega} + \frac{1}{50\ \Omega} = \frac{7}{100\ \Omega}$

$R_T = \frac{100}{7}\Omega \approx 14\ \Omega$

MOCK UPCAT 6: ANSWER KEY

1. **D**
2. **B**
3. **A**
4. **A**
5. **D**
6. **C**
7. **B**
8. **D**
9. **D**
10. **C**
11. **C**
12. **B**
13. **B**
14. **A**
15. **B**
16. **C**
17. **A**
18. **A**
19. **B**
20. **D**
21. **C**
22. **D**
23. **A**
24. **C**
25. **D**
26. **B**
27. **D**
28. **C**
29. **C**
30. **A**
31. **D**
32. **A**
33. **A**
34. **D**
35. **B**
36. **A**
37. **D**
38. **A**
39. **B**
40. **B**
41. **C**
42. **A**
43. **B**
44. **D**
45. **D**
46. **A**
47. **B**
48. **D**
49. **B**
50. **A**
51. **C**
52. **C**
53. **D**
54. **A**
55. **C**
56. **B**
57. **A**
58. **A**
59. **B**
60. **C**
61. **D**
62. **C**
63. **D**
64. **D**
65. **B**
66. **D**
67. **A**
68. **B**
69. **C**
70. **C**
71. **B**
72. **A**
73. **C**
74. **A**
75. **D**
76. **C**
77. **D**
78. **D**
79. **D**
80. **B**
81. **C**
82. **D**
83. **D**
84. **A**
85. **B**

MOCK UPCAT 7: ANSWER KEY

1. **C**
2. **C**
3. **A**
4. **D**
5. **D**
6. **C**
7. **B**
8. **A**
9. **C**
10. **A**
11. **B**
12. **A**
13. **B**
14. **A**
15. **B**
16. **C**
17. **B**
18. **D**
19. **B**
20. **B**
21. **C**
22. **C**
23. **B**
24. **B**
25. **C**
26. **D**
27. **D**
28. **B**
29. **C**
30. **D**
31. **B**
32. **D**
33. **D**
34. **B**
35. **C**
36. **D**
37. **B**
38. **C**
39. **C**
40. **C**
41. **B**
42. **D**
43. **D**
44. **B**
45. **A**
46. **B**
47. **A**
48. **D**
49. **A**
50. **A**
51. **D**
52. **C**
53. **C**
54. **B**
55. **B**
56. **A**
57. **A**
58. **A**
59. **B**
60. **C**
61. **D**
62. **B**
63. **A**
64. **A**
65. **D**
66. **D**
67. **C**
68. **A**
69. **A**
70. **A**
71. **C**
72. **C**
73. **D**
74. **D**
75. **B**
76. **B**
77. **D**
78. **D**
79. **A**
80. **C**
81. **D**
82. **A**
83. **B**
84. **C**
85. **B**
86. **C**
87. **A**
88. **D**
89. **A**
90. **D**

MOCK UPCAT 8: ANSWER KEY WITH SOLUTIONS

1. **A**

$$\frac{x}{z+1} = y$$
$$x = yz + y$$
$$x - y = yz$$
$$\frac{x-y}{y} = z$$

2. **D**

Use a simple example. k = 1

a. $k^2 = 1^2 = 1$; odd

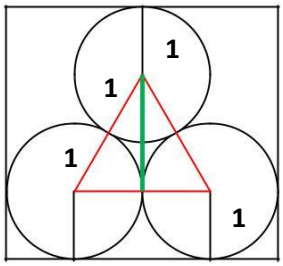
b. $k^2 + 2 = 1^2 + 2 = 3$; odd

c. 2k + 1 = 2(1) + 1 = 3; odd

d. 2k +2 = 2(1) + 2 = 4; even

e. 2k + k/2 = 2(1) + (1/2) = 2.5; not odd nor even.

3. **E**



The red triangle inside is equilateral triangle with side 2 units. The angles inside the equilateral triangle are equal to 60^o. To get the height of the triangle (the green line), we use the 30-60-90 triangle relationship.

If the hypotenuse is 2 units, the side opposite to the 60^o, which happens to be the height of the equilateral triangle, is equal to $\sqrt{3}$. The total height of the figure is $2 + \sqrt{3}$.

4. **E**

Let w = width, l = length, P = perimeter

$$w = -\frac{l}{2} - 2.$$

we know that P = 2w + 2l

40 = 2w + 2l

40 = 2(– 2) +2l

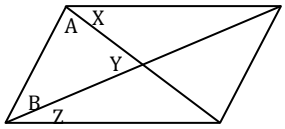
40 = l – 4 + 2l

40 = 3l – 4

44 = 3l

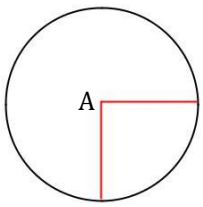
l = 44/3

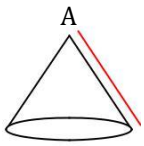
5. **E**



Statement	Reason
1. m∠A+ m∠B+ m∠Y = 180	1. Triangle Angle Sum Theorem
2. m∠Z+ m∠B+ + m∠A + m∠X = 180	2. Consecutive Angles of a Parallelogram
3. m∠A+ m∠B+ m∠Y = m∠Z + m∠B+ m∠A + m∠X	3. Transitive Property of Equality
4. m∠Y = m∠Z+ m∠X	4. Subtraction Property of Equality
5. m∠Z = - m∠X+ m∠Y	5. Subtraction Property of Equality

6. **D**





The area of the remaining portion of the circle is:

$$A_{new} = A_{old} = \frac{3}{4} x\, \pi\, 1^2 = \frac{3\pi}{4}$$

The surface area of the cone without a base is πrl where l is the slant height of the cone, in this case, the old r = 1.

$\pi rl = \pi$ x r x 1 = $\frac{3\pi}{4}$

r = 3/4

7. **E**

Fibonacci Sequence

Start with 1 and 1.

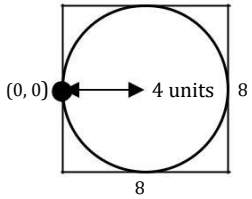
3^{rd} number = $1^{st} + 2^{nd}$ =1+1 = 2

4^{th} number = $2^{nd} + 3^{rd}$ =1+2 = 3

5^{th} number = $3^{rd} + 4^{th}$ = 2+3 = 5

8^{th} number = $6^{th} + 7^{th}$ = 8+13 = 2

8. **E**



The center of the circle lies on the x-axis, 4 units away from the origin. Thus, (4,0).

9. **B**

Let w = width, l = length, P = perimeter

$w = \frac{l}{2} + 2$

l = w + 3

we know that P = 2w + 2l

Using the equation of w and P,

$P = 2(\frac{l}{2} + 2) + 2l$

P = l + 4 + 3l

P = 4 + 3l

10. **C**

For an implication statement of the form *If P, then Q*, only the form *If not P, then not Q* is true. This is called the contrapositive of the statement. Implications and their contrapositives are equivalent.

11. **B**

$$f(x) = \frac{4x + 8}{3 - 2x}$$

$$f(x - 1) = \frac{4(x - 1) + 8}{3 - 2(x - 1)}$$

$$= \frac{4x - 4 + 8}{3 - 2x + 2} = \frac{4x - 4}{5 - 2x}$$

12. **B**

Let x be the number of hours they worked together.

Paolo's rate = ¼

John's rate = ½

$$\frac{x}{4} + \frac{x}{2} = 1$$

$$x + 2x = 4$$

$$3x = 4$$

$$x = \frac{4}{3} = 1\frac{1}{3} \text{ hours}$$

13. **C**

The form of the parabola $x = a(y-k)^2 + h$ where (h,k) is the vertex (x,y) of the parabola. The parabola is opening to the left, so the coefficient a of y^2 must be negative.

14. **C**

2x + y = -6 multiply by 3

-6x + 4y = 18

6x + 3y = -18

-6x + 4y = 18

eliminate x

7y = 0

y = 0

15. **C**

$$\frac{x^2}{x + x + x} = \frac{x^2}{3x} = \frac{x}{3}$$

16. **C**

6x + 9y = 7 multiply by 2

3x - 6y = -14 multiply by 3

12x + 18y = 14

9x - 18y = -42

eliminate y

21x = -28

x = -28/21 = -4/3

substituting x into the second equation

3(-4/3) – 6y = -14

-4 – 6y = -14

-6y = -10

y = 10/6 = 5/3

The answer is (-4/3, 5/3).

17. **B**

$5x^2y^2 + 3x^2y - 10xy - 36 + (xy(16xy - 4x + 10))$

$= 5x^2y^2 + 3x^2y - 10xy - 36 + 16x^2y^2 - 4x^2y + 10xy$

$= 21x^2y^2 - x^2y - 36$

18. **B**

Let Jericho's age be x since it has no descriptions

	Now	+ 2 years
Joan's age	x + 8	x + 8 + 2 = x +10
Jericho's age	x	x + 2

x+10 = 2 (x+2)
x+10 = 2x + 4
x = 6

19. **C**

0.0001y =1
0.0001y x 1000 = 1 x 1000; 0.1y = 1000
0.0001 y x 10000 = 1 x 10000; 1y = 10000

1y + 0.1y = 10000 + 1000 = 11000

20. **C**

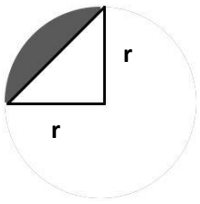
$$\frac{p+q}{p-q} = \frac{\frac{2}{3}+\frac{5}{7}}{\frac{2}{3}-\frac{5}{7}} = \frac{\frac{14+15}{21}}{\frac{14-15}{21}} = \frac{\frac{29}{21}}{-\frac{1}{21}}$$
$$= \frac{29}{21} \div -\frac{1}{21} = \frac{29}{21} x -\frac{21}{1}$$
$$= -29$$

21. **B**

The volume of the prism is equal to V = Ah where A is the area of the base. In this case, a prism with a square base has area $V = s^2h$.

$54 = s^2 \times 6$
$s^2 = 9$
s = 3

22. **B**



The area of the triangle is $\frac{r^2}{2}$.

The area of the quarter circle is $\frac{\pi r^2}{4}$.

Subtracting the area of the triangle from the area of the quarter circle, we get

$$\frac{\pi r^2}{4} - \frac{r^2}{2} = \frac{\frac{22}{7}(r^2)}{4} - \frac{r^2}{2}$$
$$= \frac{22r^2}{28} - \frac{14r^2}{28} = \frac{8r^2}{28} = \frac{2}{7}r^2$$

23. **B**

Since the first point is at (0,0), and the midpoint is at (4,2), this means that half of the line segment is 4 units to the right and 2 units upward. Thus, we need to extend it by another 4 units to the right and 2 units upward, getting (8,4).

24. **B**

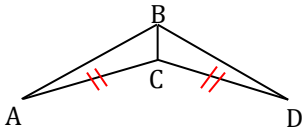
Let h be the heights and s be the lengths of the shadow
The ratio of height and length of the tree is equal to the ratio of the height and length of the stick.

$$\frac{h}{s} = \frac{1\text{ m}}{3\text{ m}} = \frac{x}{15.3\text{ m}}$$
$$x = 5.1\text{ m}$$

25. **B**

$A_{square} = s^2 = 36cm^2$
s = 6cm
$Perimeter_{square} = 4s = 4(6) = 24$ cm
$Perimeter_{square} = Perimeter_{triangle} = 24$ cm

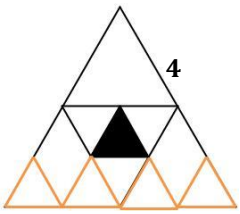
26. **C**



An angle bisector divides the angle into two equal lengths.

Since $\overline{BC}$ is a bisector of $\angle ABD$ and $\overline{AC} = \overline{CD}$,
$\Delta ABC \cong \Delta DBC$

27. **D**



It can be seen that the length of the shaded triangle is 1.

Thus, its height is equal to $\frac{\sqrt{3}}{2}$. Solving bh/2, $\frac{1 x \frac{\sqrt{3}}{2}}{2} = \frac{\sqrt{3}}{4}$

28. **B**

Let r be the radius of the rear wheel and f be the radius of the front wheel. The relationship between the two radius is: r = 2f.

Getting the circumference of the rear wheel:

$$C_{rear} = \pi d = \pi \text{ x } 2r$$

Substituting the relationship of the two wheels into the equation above,

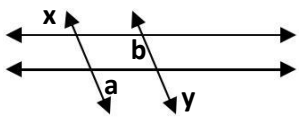
$$\pi d = \pi \text{ x } 2r = \pi \text{ x } 2(2f) = 4\pi f$$

Thus,

$$C_{front} = \pi d = \pi \text{ x } 2f = 2\pi f$$

$$C_{rear} = 2C_{front}$$

29. **A**



Statement	Reason
1. m∠X = m∠A	1. Alternate Exterior Angles
2. m∠A= m∠B	2. Alternate Interior Angle
3. m∠B= m∠Y	3. Vertical Angles
4. m∠X= m∠Y	4. Transitive Property of Equality

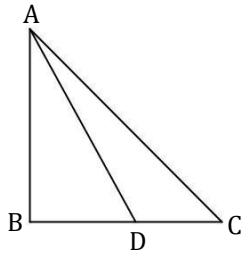
30. **D**

Using ratio and proportion, we have to add all the partitions of the ratio. 3 + 4 + 5 = 12. This corresponds to the total of the angles of the triangle, which is 180^o. 180/12 = 15. This is the multiplier of the ratio. To get the largest angle, we should multiply 15 by the biggest partition in the ratio. 15 x 5 = 75.

31. **C**

The hypotenuse of triangle ABC is equal to $2\sqrt{2}$. If the ratio of the hypotenuse of triangle DEF to triangle ABC is $2: 2\sqrt{2}$ which can be simplified to $1: \sqrt{2} = \sqrt{2}: 2$. Since BC = 2, the length of EF is equal to $\sqrt{2}$.

32. **A**



Since the triangle is isosceles, m∠A = 45.
m∠BAD = 45 – 15 = 30^o. To get AB and BC,

BD = AD sin 30

$4\sqrt{3} = \text{AD}\left(\frac{1}{2}\right)$

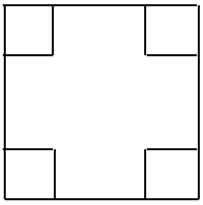
$\text{AD} = 8\sqrt{3}$

To get AB and BC,

$$\text{AB} = \text{BC} = \text{AD}\cos 30 = 8\sqrt{3}\left(\frac{\sqrt{3}}{2}\right) = (4\text{x}3) = 12$$

The area is equal to (12x12)/2 = 72 square units.

33. **D**



The area of the large square is 16. That means, the side of the large square is equal to $\sqrt{16} = 4$. The perimeter of each small square is equal to 4. Thus, the side of each small square is 4/4 = 1. The area of each small square is 1 x 1 = 1 square unit. 4 small squares = 4 square units. 16 – 4 = 12 square units.

34. **D**

(-3 x -6) – (-4 + -5) = 18 – (-9) = 18 + 9 = 27

35. **E**

Simplify all the values into decimal form.

a. 0.333
b. 0.600
c. 0.625
d. 0.626
e. 0.667

36. **B**

Working backwards: 5 x 20 = 100. The sum of the 5 integers is 100. 3 x 8 = 24. The sum of the middle 3 integers is 24. Thus, the sum of the first and last integer is 100 – 24 = 76. Their average is 76/2 = 38.

37. **B**

Let x be the number of girls
x + 2 be the number of boys
15 = x + (x + 2) + 5 = 2x + 7

8 = 2x
x = 4
There are 4 girls.

38. **D**
There was initially ½ V of water.
1/6 V remained after 120 mL has been removed. Thus,
1/2 V – 1/6 V = 120 mL
1/3 V = 120 mL
V = 360 mL.

39. **A**
Cars = ½ (1000000) = 500000
Bus = ¼ (1000000) = 250000
Car + Bus = 750000 = 7.5×10^5

40. **E**
The common difference is 7/12.
4/3 – ¾ = 16/12 – 9/12 = 7/12
¾ - 1/6 = 9/12 – 2/12 = 7/12
Thus, 1/6 – 7/12 = 2/12 – 7/12 = -5/12

41. **D**
15, 15, 16, 16, 17, 17,18, 18, 18, 19, 19
18 occurs 3 times.

42. **A**
In 3 hours, there are 180 minutes (3 x 60 = 180). Therefore, in 3 three hours, there are 180 x 2 = 360 people who arrived. 365-360 = 5 people initially in a party.

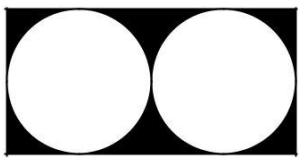
43. **B**
0.6 (4) = 0.2 + 0.8 + 1.0 + x
2.4 = 2.0 + x
x = 0.4

44. **E**

Every second, M covers 5.5m while J covers 4.5m. That's a total of 10m. Therefore, it will take 2 seconds for them to cover a total distance of 20m. At that time, M will have covered 11m.

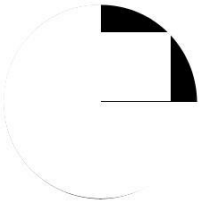
45. **C**
Permutation. $\frac{n(n-1)}{2} = \frac{6(5)}{2} = 15$

46. **D**



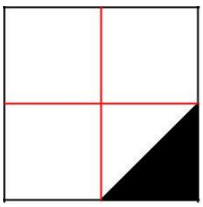
The area of the circle $9\pi = \pi r^2$
Thus, the radius of each circle is 3, and the diameter = 2r = 6. With two circles side by side, the length of the rectangle = 2d =12 and the width of the rectangle is d = 6.
The area of the whole rectangle is 12 x 6 = 72 square units.
The area of the shaded region = 72 – 2(9 π) = 72-18 π = 18(4- π).

47. **C**



The diagonal of the square = radius of the quarter circle = 6.
The area of the quarter circle = $\frac{\pi r^2}{4} = \frac{\pi \times 6^2}{4} = 9\pi$
The area of the square is $d^2/2 = 6^2/2 = 18$.
Thus, the area of the shaded region is 9π - 18.

48. **A**



The perimeter of the square is 16. Thus, its side = 16/4 = 4. Half its side is the side of the triangle. From the illustration, we can see that the triangle is ½ of ¼ of the area of the whole square. Since its side is 4, the area of the square = s x s = 4 x 4 = 16. ½ x ¼ x 16 = 2.
Or, since we know that half the side of the square is the side of the triangle, the area of the triangle is bh/2 = (2x2)/2 = 2

49. **B**
In a sequence, the n^{th} term can be computed as
$a_n = a_1 + d(n-1)$
The 9^{th} term, $a_9 = a_1 + 8d = 9$
The 15^{th} term, $a_{15} = a_1+14d = 30$.
Treating the two equations as a system of equations with a_1 and d as the variables,
$a_1 + 8d = 9$ multiply by -1
$a_1 + 14d = 30$
$-a_1 - 8d = -9$
$a_1 + 14d = 30$

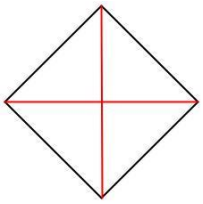
eliminating a_1,
$6d = 21$
$d = 3.5$

Using a_9 to get a_1,
$9 = a_1 + 8(3.5)$
$a_1 = 9 - 28$
$a_1 = -19$

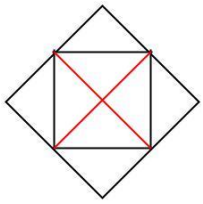
50. **C**
Let R be the radius of the bigger circle, r be the radius of the smaller circle.

$R = 3r$
If the circumference of the smaller circle is $2\pi r = 6\ \pi$, then the radius of the smaller circle is 3. Thus, the radius of the bigger circle is $R = 3(3) = 9$. Therefore, the circumference of the bigger circle is $2\ \pi r = 2\ \pi(9) = 18\pi$.

51. **B**

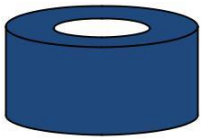


The smaller square is half the area of the biggest square.



The smallest square is half the area of the smaller square.
If the area of the biggest square is 1 square unit, then ½ of ½ of 1 = ¼ square unit. $s^2 = 1/4$; $s = 1/2$ unit.

52. **C**



The radius of the hollow portion is 2 units.
Thus, its volume = $\pi r^2 h = \pi(4)(3) = 12\pi$.
The radius of the whole cylinder is 3 units.
Thus, the volume of the whole cylinder is
$= \pi r^2 h = \pi(9)(3) = 27\pi$.
Thus, the volume of the concrete portion is $27\pi - 12\pi = 15\pi$.

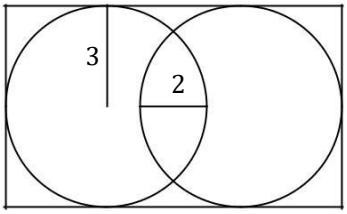
53. **B**
Let x be Jaz's age.
Her grandmother is 60 + x.
Her mother is 3x - 3.

$102 = x + (60 + x) + (3x - 3)$
$102 = 5x + 57$
$5x = 45$
$x = 9$

Thus, her mother is 3(9) - 3 = 24 years old.

54. **C**
The side of square is equal to the diameter of the circle.
s = 40/4 = 10. Thus, the circumference of the circle
$= \pi d = 10\pi$.

55. **C**



The width of the figure is equal to 2 x radius of the circle = 2 x 3 = 6.
The length of the figure is 2 x diameter of the circles – 2 = 2 x 6 - 2 = 10.
Thus, the area of the rectangle is 6 x 10 = 60.

56. **B**
Joe is Jen's husband.

57. **C**
0.028 – 3/125 = 0.028 – 0.024 = 0.004 = 1/125

58. **E**
Let x be the number of tables with 4 chairs and y be the number of tables with 6 chairs.
$x + y = 20$ multiply by -6
$4x + 6y = 92$
eliminate y
$-6x - 6y = -120$
$4x + 6y = 92$
$-2x = -28$
$x = 14$

59. **E** Since it is beyond 75%, it must be 80%.
60. **B** The 2007 graph is half the 2008 graph, thus, 2:1.

MOCK UPCAT 9: ANSWER KEY WITH EXPLANATIONS

1. **C**

Fungi are **eukaryotic** protista that differs from bacteria and other prokaryotes. They have **cell walls** that contain chitin, mannan and other polysachharides. They could be unicellular or multicellular. **Molds and yeasts** are examples of fungi.

2. **C**

Since both parent rats had brown eyes, but produces baby rats with red eyes, this means that the allele for the red eyes is a recessive trait and both parents had the Bb genotype. The babies with red eyes have the bb genotype. Thus, brown eyes are dominant while red eyes are recessive.

3. **C**

The soil, sand and small rocks occupy small spaces and sink in the bottom of the lake. Since big rocks occupy more space, they will lessen the space for water of the lake.

4. **B**

When the first sperm membrane fuses with the egg membrane, it separates the fertilization membrane and forms a barrier to other sperm. Then, both the egg and the sperm form a nucleus within the egg. They each contain half of the chromosomes that the embryo will have.

Source: http://www.austinivf.com/embryology/egg-oocyte-fertilization.php

5. **D**

Amoeba does not have cell walls, only cell membranes. Green Alga have chloroplasts. Molds have no flagellum. This leaves Lactobacillus. Lactobacilli are rod-shaped, Gram-positive, fermentative, organotrophs. They are usually straight, although they can form spiral or coccobacillary forms under certain conditions. They are often found in pairs or chains of varying length. Lactobacilli are classified as lactic acid bacteria, and derive almost all of their energy from the conversion of glucose to lactate during homolactic fermentation. In this process 85 -90% of the sugar utilized is converted to lactic acid. They generate ATP by nonoxidative substrate-level phosphorylation.

6. **D**

Molds and amoeba do not have chloroplasts. Euglena does not have cell walls. This leaves Green Alga. Green algae have chloroplasts that contain chlorophyll a and chlorophyll b, giving them a bright green color, as well as the accessory pigments beta carotene and xanthophylls, in stacked thylakoids. The cell walls of green algae usually contain cellulose and they store carbohydrate in the form of starch. All green algae have mitochondria with flat cristae. When present, paired flagella are used to move the cell. They are anchored by a cross-shaped system of microtubules and fibrous strands. Flagella are only present in the motile male gametes of charophytes and are absent from the gametes of Pinophyta and flowering plants.

7. **B**

Planet	Radius (km)
Mercury	2440
Venus	6052
Earth	6378
Mars	3397
Jupiter	71492
Saturn	60268
Uranus	25559
Neptune	24766
Pluto	1150

8. **D**

The basic feature of quantum mechanics that is incorporated in the Bohr Model is that the energy of the particles in the Bohr atom is restricted to certain discrete values. One says that the energy is quantized. This means that only certain orbits with certain radii are allowed; orbits in between simply don't exist.

Source: http://csep10.phys.utk.edu/astr162/lect/light/bohr.html

9. **A**

The letter symbol for Flourine is F.

10. **B**

Antacids contain sodium bicarbonate. Another important ingredient is citric acid. Both of these chemicals react with each other producing carbonic acid. In its liquid form this carbonic acid decomposes producing water and carbon dioxide. What this means is that the glass of water is very much like your favorite soda that also contains carbon dioxide in it. The fizz that you see is the carbon dioxide bubbles bubbling to the surface.

Source: http://humantouchofchemistry.com/how-antacids-work.htm

11. **B**

sugar = 0.82(150 g) = 123g

12. **C**

The number of electrons of a neutral atom is the same as the atomic number, thus, 11.

13. **C**

Losing 2 electrons means losing 2 negative charges, leaving 2 protons unbalanced.

14. **D**

$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$

15. **B**

Use the equation $C_1V_1 = C_2V_2$.

Since C_2 = twice of original = $2C_1$

$2*(0.05\ g/mL)$

$0.10\ g/mL$

Therefore,

$$C_1V_1 = C_2V_2$$

$$(0.05\ g/mL)*(100\ mL) = (0.10\ g/mL)*V_2$$

$$V_2 = 50\ mL$$

16. **A**

Use the equation $C_1V_1 = C_2V_2$.

Since C_2 = twice of original = $2C_1$

$9.4 * (0.05\ g/mL)$

10. $0.20\ g/mL$

Therefore,

$$C_1V_1 = C_2V_2$$

$$(0.05\ g/mL) * (100\ mL) = (0.20\ g/mL) * V_2$$

$$V_2 = 25\ mL$$

17. **B**

Molarity = $(n_{solute}) / (L_{solution})$

10. $[(g / MM)_{solute}] / (L_{solution})$
11. $[5.9\ g / (23+36)\ g/mol] / (0.5\ L)$
12. $0.2\ mol/L = 0.2\ M$

18. **C**

$$25:50 = 1:2 = C:O$$

$$CO_2$$

19. **B**

$m_{molecule} = (44\ g / 1\ mol)*(1\ mol / 6.0x10^{23}$ molecules) $= 7.3 \times 10^{-23}\ g$

20. **B**

Assume 4g/100 ml.
Add 4g / 100ml + 4g / 100ml = 8 g / 200 ml.
Add an equal volume of water = 8g / 400 ml.

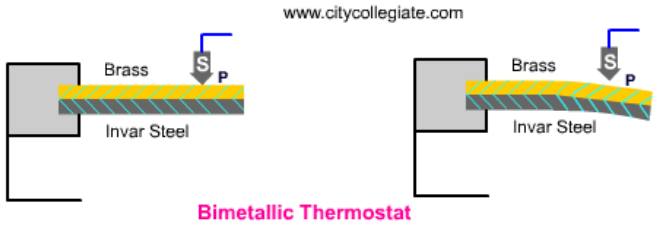
(8g / 400 ml) x 100 = **2%**

21. **C**

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

22. **A**

Thermostat is a device which is used to maintain a desired temperature in a system like refrigerator, air-conditioner, iron and in a number of devices. Thermostat works on the principle of thermal expansion of solid materials. A bimetallic thermostat



device consists of a strip of two different metals having different coefficients of linear expansion. The bimetallic strip works as an electric contact breaker in an electric heating circuit. The circuit is broken when the desired temperature is reached Due to difference in the coefficients of linear expansion of two metals, The bimetallic strip bends in the form of a downward curve and the circuit is broken. The metallic strip is in contact with a screw 'S'. When it becomes hot, bends downward and contact at 'P' is broken. Thus the current stops flowing through the heating coil. When the temperature falls, the strip contracts and the contact at 'P' is restored.
Source: http://www.citycollegiate.com/thermostat.htm

23. **C**

Using Boyle's Law, $P_1V_1 = P_2V_2$

$P_2 = P_1V_1/V_2 = (5atm)(50L)/(20L)$

$= 12.5\ atm$

24. **D**

$^oF = (9/5)(1OO^oC) + 32 = 180 + 32 = 212^oF$

25. **A**

Redox reactions, or oxidation -reduction reactions, primarily involve the transfer of electrons between two chemical species. The compound that loses an electron is said to be oxidized, the one that gains an electron is said to be reduced. There are also specific terms that describe the specific chemical species. A compound that is oxidized is referred to as a reducing agent, while a compound that is reduced is referred to as the oxidizing agent.

26. **B**

Chemical reactions proceed at different rates. The factors that affect reaction rates are:

- surface area of a solid reactant
- concentration or pressure of a reactant
- temperature
- nature of the reactants
- presence/absence of a catalyst.

27. **B**

Only substance II has the positive slope, thus, its solubility will increase with increasing temperature.

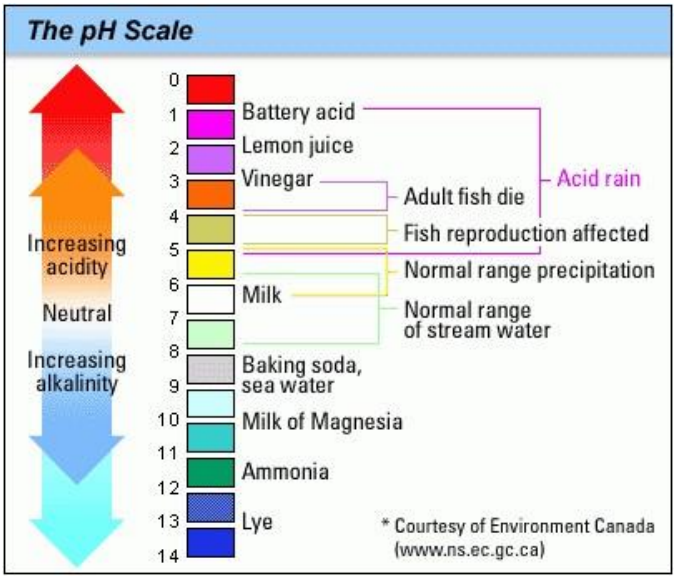
28. **D**

A catalyst is a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.

29. **C**

If we overlap the graphs of Pressure vs. Volume and Temperature vs. Volume, we can see that as Pressure decreases, Temperature increases at constant volume. Thus, as pressure increases, temperature decreases.

30. **A**



	Red litmus	Blue litmus
ACIDIC SOLUTION	Stays red	Turns red
NEUTRAL SOLUTION	Stays red	Stays blue
ALKALINE SOLUTION	Turns blue	Stays blue

Source: https://qph.fs.quoracdn.net/main-qimg-0ae0532abed1a3489733bbe8cbc4e417

The red litmus paper stays red when it is tested on acids and turns blue when it is tested on bases while blue litmus paper stays blue when it is tested on bases and turns red when it is tested on acids.

	red litmus	blue litmus
A	red	red
B	red	red
C	blue	blue
D	blue	blue

Liquid A and B are acids while liquid C and D are bases therefore the *ph* of AB is less than the *ph* of CD.

31. **D**

When a substance changes from one state to another, it occurs with a change of heat. Although the heat content of the material changes, the temperature remains the same. Therefore, when a substance melts, heat is absorbed and temperature stays constant.

32. **A**

The electron configuration of an atom is the representation of the arrangement of electrons that are distributed among the orbital shells and subshells. Commonly, the electron configuration is used to describe the orbitals of an atom in its ground state, but it can also be used to represent an atom that has ionized into a cation or anion by compensating with the loss of or gain of electrons in their subsequent orbitals.

The sequence of the orbitals is 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, and 7p where s holds 2 electrons, p holds 6 electrons, d holds 10 electrons and f holds 14 electrons.

Hund's Rule states that electrons will fill all the empty orbitals first before filling orbitals with electrons in them.

Source:
http://chemwiki.ucdavis.edu/Inorganic_Chemistry/Electronic_Configurations

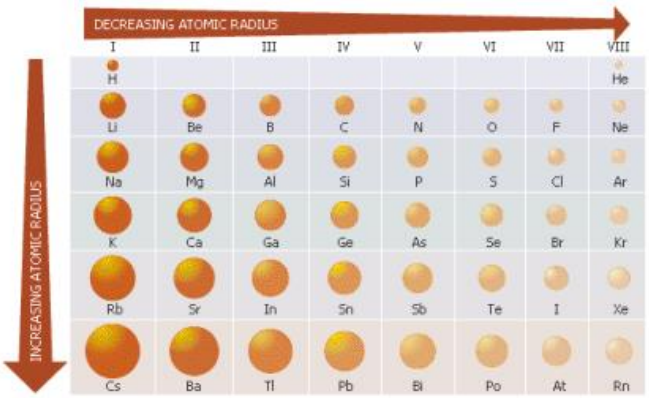
33. **B**

Since Mg has the Mg^{2+} ion while the Cl has the Cl^- ion, this will proceed in a reaction as:
$Mg^{2+} + 2Cl^- \rightarrow MgCl_2$

34. **C**

a. True, the total value of the "exponents" of the orbitals is 14.
b. True, the s orbital can hold up to 2 electrons.
c. False, the s orbital in the 3rd level is not filled, thus, the atom is not in the ground state.
d. True, the atom has 3 electrons in its highest level, the 3rd energy level.

35. **B**



Source:
http://ckjh.cksd.wednet.edu/staff/erics/advanced%20physical%20science/Unit%203%20the%20periodic%20table/unit%20notes/ionization%20energy%20note_files/image007.gif

36. **D**

There are seven elements that form diatomic molecules. This is a list of the seven diatomic elements.

- Hydrogen (H_2)
- Nitrogen (N_2)
- Oxygen (O_2)
- Fluorine (F_2)
- Chlorine (Cl_2)
- Iodine (I_2)
- Bromine (Br_2)

37. **B**

$N_2 + 3H_2 \rightarrow 2NH_3$
Using stoichiometry,

$$6 \text{ moles } H_2 \left(\frac{1 \text{ mole } H_2}{3 \text{ moles } H_2}\right) = 2 \text{ mole } H_2$$

38. **B**

Since only 2 moles of N is needed to react with 6 moles of H, while

$$6 \text{ moles } N_2 \left(\frac{3 \text{ mole } H_2}{1 \text{ mole } N_2}\right) = 18 \text{ mole } H_2$$

18 moles H is needed to react with 6 moles N, the limiting reactant is hydrogen.

39. **B**

We need to base calculation to the limiting reactant

$$6 \text{ moles } H_2 \left(\frac{2 \text{ mole } NH_3}{3 \text{ moles } H_2}\right) = 4 \text{ mole } NH_3$$

40. **D**

General Characteristics of Acids:

- pH < 7
- Sour taste (though you should never use this characteristic to identify an acid in the lab)
- Reacts with a metal to form hydrogen gas
- Increases the H+ concentration in water
- Donates H+ ions
- Turns blue litmus indicator red

General Characteristics of Bases:

- pH > 7
- Bitter taste
- Slippery feel
- Increases the OH- concentration in water
- Accepts OH- ions
- Turns red litmus indicator blue

Source: https://sites.google.com/site/acidbasechemistry/characteristics-of-acids-and-bases

41. **D**

a. Near the equivalence point, the equivalence point drastically decreases as the acid-base solution becomes more acidic.
b. Notice that there isn't any steep bit on this graph. Instead, there is just what is known as a "point of inflection". That lack of a steep bit means that it is difficult to do a titration of a weak acid against a weak base.
c. As the base gets stronger, its pH value gets higher.
d. You can see that the pH only falls a very small amount until quite near the equivalence point. Then there is a really steep plunge.
Source: https://sites.google.com/site/acidbasechemistry/characteristics-of-acids-and-bases

42. **D**

45 g in 200mL. Thus, 225g in 1000mL = **225 g/L**

43. **B**

$$\frac{70\text{ g}}{200\text{ mL}} = 0.35\text{ g/mL}$$

Since the amount of solute is equal to the solubility of the solute in water, the solution is saturated.

Kinds of Saturation	Definition
Saturated Solution	A solution with solute that dissolves until it is unable to dissolve anymore, leaving the undissolved substances at the bottom
Unsaturated Solution	A solution (*with less solute than the saturated solution*) that completely dissolves, leaving no remaining substances
Supersaturated Solution	A solution (*with more solute than the saturated solution*) that contains more undissolved solute than the saturated solution because of its tendency to crystallize and precipitate.

Source:http://chemwiki.ucdavis.edu/Physical_Chemistry/Equilibria/Solubilty/Types_of_Saturation

44. **B**

The molecular mass of acetic acid is 4 x 12.01 + 4 x 1 + 2 x 16 = 60.05 g/mol.
To get the number of moles,

$$4\text{g}\left(\frac{1\text{ mol}}{60.05\text{ g}}\right) = 0.067\text{ mol}$$

to gel molarity,

$$\text{M} = \frac{\text{moles of solute}}{\text{volume of solution}} = \frac{0.067\text{mol}}{0.1\text{L}} = 0.67\text{M}$$

45. **A**

Molarity of NaF:

$$100\text{ g NaF}\left(\frac{1\text{ mole}}{42\text{ g}}\right) = 2.38\text{ moles NaF}$$

M = 2.38 moles / 5L = 0.48 M

Molarity of KCl:

$$300\text{ g KCl}\left(\frac{1\text{ mole}}{75\text{ g}}\right) = 4\text{ moles KCl}$$

M = 4 moles / 5L = 0.8 M

This means, A is less concentrated than B.

46. **A**

If two solutions of different concentration are separated by a semi-permeable membrane which is permeable to the smaller solvent molecules but not to the larger solute molecules, then the solvent will tend to diffuse across the membrane from the less concentrated to the more concentrated solution. This process is called osmosis.The water will, thus, move from A to B.

47. **D**

Colligative properties are properties of a solution that depend mainly on the relative numbers of particles of solvent and solute molecules and not on the detailed properties of the molecules themselves.

The colligative properties are:

1. Vapor pressure depression
2. Boiling point elevation
3. Melting point depression
4. Osmotic pressure

The freezing point of pure water is 0°C, but that melting point can be depressed by the adding of a solvent such as a salt. The use of ordinary salt (sodium chloride, NaCl) on icy roads in the winter helps to melt the ice from the roads by lowering the melting point of the ice. A solution typically has a measurably lower melting point than the pure solvent.
Source: http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/meltpt.html#c1

48. **A**

An object will float if it is less dense than the liquid it is placed in. An object will sink if it is denser than the liquid it is placed in.

49. **D**

The Charles' Law states temperature is proportional to the volume. Boyle's Law states that the product of the pressure

and volume for a gas is a constant for a fixed amount of gas at a fixed temperature. Avogadro's gas law states the volume of a gas is proportional to the number of moles of gas present when temperature and pressure are held constant. Gay -Lussac's law is an ideal gas law where at constant volume, the pressure of an ideal gas is directly proportional to its absolute temperature.

50. **D**

2 moles N_2 x (28 g / mol) = 56 g N_2
2 moles O_2 x (32 g / mol) = 64 g O_2
$\%N_2 = \frac{56}{64 + 56} \times 100 = \frac{56}{120} \times 100 = 46.67\% = 47\%$

51. **D**

Covalent molecular results from the sharing of electrons between two atoms, like the bonding between two nonmetals.

52. **C**

A Covalent network solid is a chemical compound in which the atoms are bonded by covalent bonds in a continuous network, like diamond or graphite.

53. **B**

Since the solution can still dissolve more solute, it has not reached its saturation point yet, thus, it is unsaturated.

54. **C**

Henry's Law states: "At a constant temperature, the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid."

Dalton's Law of Partial Pressures, or Dalton's Law, states that the total pressure of a gas in a container is the sum of the partial pressures of the individual gases in the container.

Hess's Law states: The enthalpy change accompanying a chemical change is independent of the route by which the chemical change occurs.

Raoult's law states that the vapor pressure of a solvent above a solution is equal to the vapor pressure of the pure solvent at the same temperature scaled by the mole fraction of the solvent present.

55. **B**

He had a total travel time of 1 ½ hours.
So, 1.5 hours x 35 kph = 52.5 km

56. **D**

There are a lot of forces acting on the box like the normal force and weight. But these forces are cancelling each other out, that is why the box is not moving.

57. **A**

Pressure depends upon the height of the liquid. Since water in glass A has the highest height, this exerts the greatest pressure.

58. **C**

A falling object is losing height, thus, losing potential energy, while gaining acceleration. As it gains acceleration, its velocity also increases. So the kinetic energy also increases.

59. **C**

At point C, all of the potential energy of the system has been converted to its kinetic energy. Since kinetic energy is dependent on velocity, point C has the highest velocity. Thus, this is the point with the fastest flow.

60. **D**

A body that moves in a circular path at constant speed has an acceleration directed towards the center of the circle, called as centripetal acceleration.

MOCK UPCAT 10 (UPDATE): ANSWER KEY WITH EXPLANATIONS

1. **C**

An organism with 64 chromosomes would have a fertilized egg with also 64 chromosomes, since this is the product of union two haploid cells, an egg cell and a sperm cell with each having 32 chromosomes.

2. **D**

Transcription is the synthesis of a complementary RNA copy from a DNA segment. Thus, the RNA consists of the 'partner' bases of the ones in DNA and that uracil is used in place of thymine. (Partner bases: Adenine and Thymine/Uracil; Cytosine and Guanine)

Before: 3' ATGCGTACG 5'
After: 5' UACGCAUGC 3'

3. **D**

Gel electrophoresis is used for separation of DNA, RNA, and protein fragments from one another, for determination of DNA profile and for decomposition of molecules into cations and anions.

4. **D**

Since the father is blood type A, he has 2 possible genotypes, AA and AO, which will be crossed with blood type AB of the woman. So we can have 2 crosses: AA x AB and AO x AB. AA x AB will have 2AA:2AB as offsprings, whereas, AOxAB will have 1AA:1AO:1AB:1BO.

5. **B**

Organism A and B exhibit competition while Organism C exhibits coprophagia. Coprophagia is the consumption of feces. Organism C could be a domestic dog or a dung beetle. Option B cannot be inferred because while Organisms A and B are competing with resources, it does not always mean that they will eat the other.

6. **D**

The three processes involve chemical reactions that change the materials into new substances with different properties.

7. **C**

Mass number equal to 23 is the sum of protons and neutrons. 11 is the atomic number equal to the number of protons. Since the Sodium cation has a charge of +1, it has less one electron compared to the number of protons. Therefore, it has 10 electrons.

8. **D**

Osmosis is a process where the solvent molecules transfer through a semipermeable membrane from a diluted solution to a more concentrated one to achieve equilibrium in concentration. Therefore, pure water from B will move to A and C solutions.

9. **A**

Isotopes are variations of an element with a different number of neutrons. The number of protons (and consequently the atomic number) is the same for isotopes of an element. A and B are the only pair with the same number of protons, but different numbers of neutrons as shown by the mass number.

10. **A**

Empirical formula shows the proportion of the elements but not the actual number of atoms in a compound. Lime water is an example of a common name. Benzoyl peroxide is an example of a chemical name. Option B gives the actual number of atoms of the compound. Option A gives the simplest positive ratio of the elements involved.

11. **C**

The solubility of gasses generally increases as the temperature decreases.

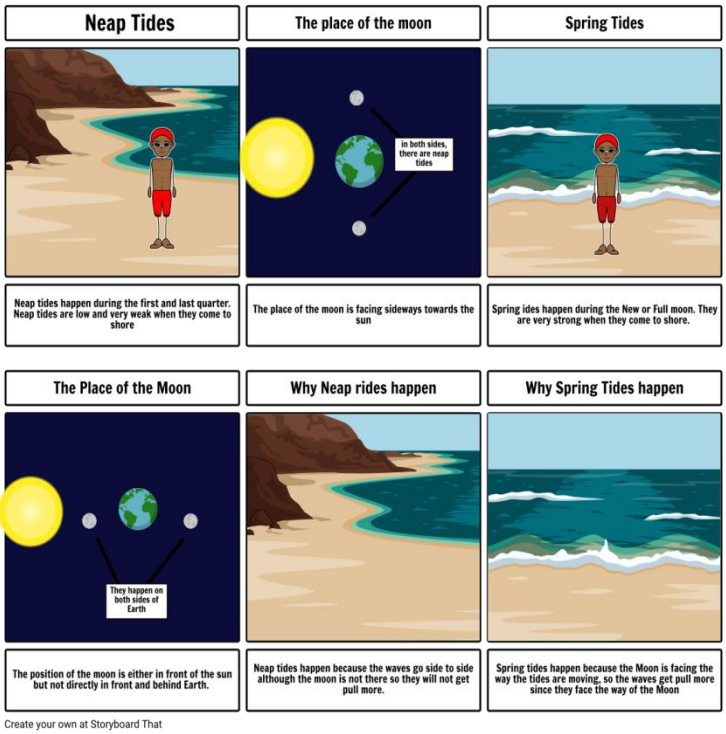
12. **C**
Permanganate ion is represented by the chemical formula MnO_4^-.

13. **B**
A plant material was found under ice in Antarctica. It can be inferred from this that Antarctica was once a tropical region.

“An unexpectedly warm period about 15 million years ago temporarily thawed Antarctica, turning the continent green around its edges, a new study says.” (Dell’Amore, 2012)

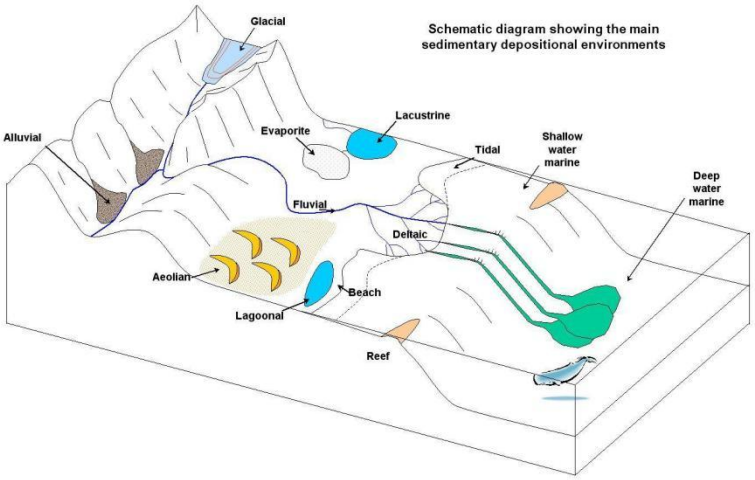
To read more about the article, kindly visit this link:**https://news.nationalgeographic.com/news/2012/06/120620-green-antarctica-trees-global-warming-science-ancient/**

14. **C**



Source: http://sbt.blob.core.windows.net/storyboards/miguelvalenciadamian/spring-and-neap-tides.png
In spring tides, the sun's gravitational pull on Earth is 'added' to the moon's pull causing the oceans to bulge more than usual. This means that high tides are higher and low tides are lower than average

15. **D**

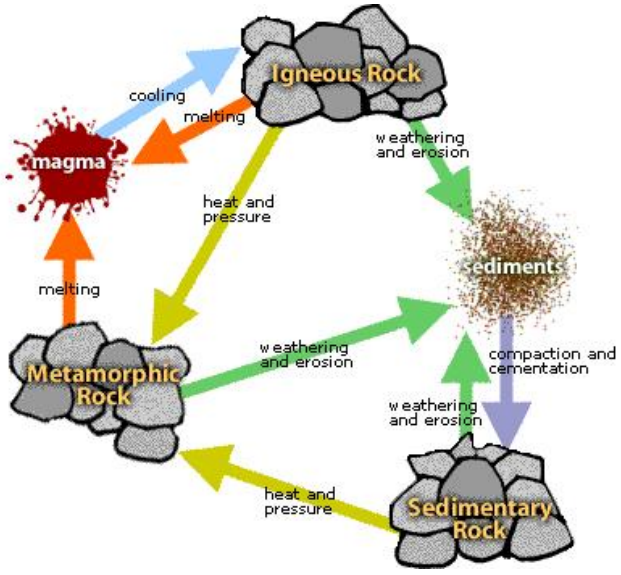


Source: http://opengeology.org/textbook/wp-content/uploads/2017/02/SedimentaryEnvironments.jpg

Mountain > Valley > Gulf > Lagoon

Water is an integral part of all sedimentary rock formation. Weathering and erosion are common predecessors of sediments. Sedimentary rocks can be formed in gulfs and in lagoons because of solidified coal deposits. Erosion causes sediments from mountains to erode into valleys. In the mountains, sedimentary rocks are least likely to be found because they can be made up of a mixture of the three types of rocks.

16. **D**

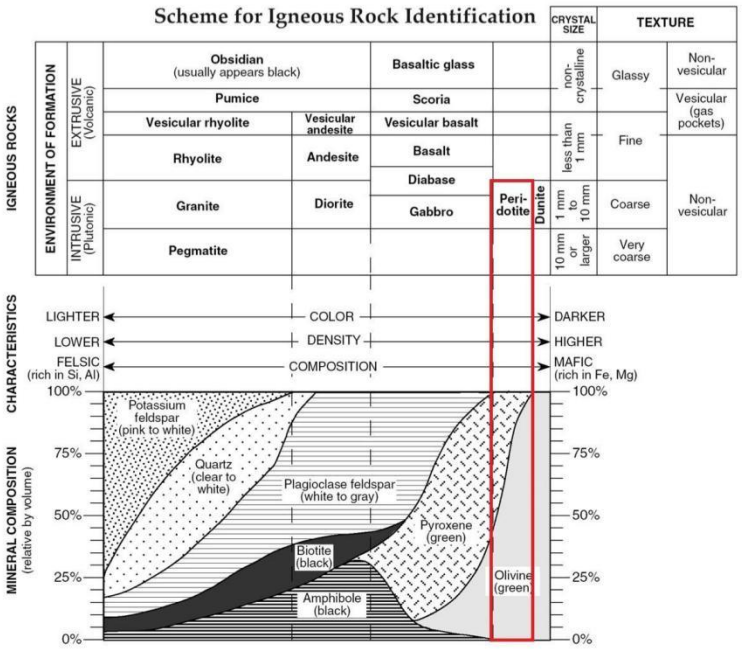


Source: http://www.cotf.edu/ete/images/modules/msese/earthsysflr/EFCycleP2.gif

Igneous rocks can be formed by either melting of metamorphic rocks based on the figure.

As shown in the figure above, there is no direct connection between sedimentary and igneous rocks. Thus, sedimentary rocks cannot be directly transformed into igneous rocks because they have to change into metamorphic rocks first before they change into igneous rocks.

17. **D**



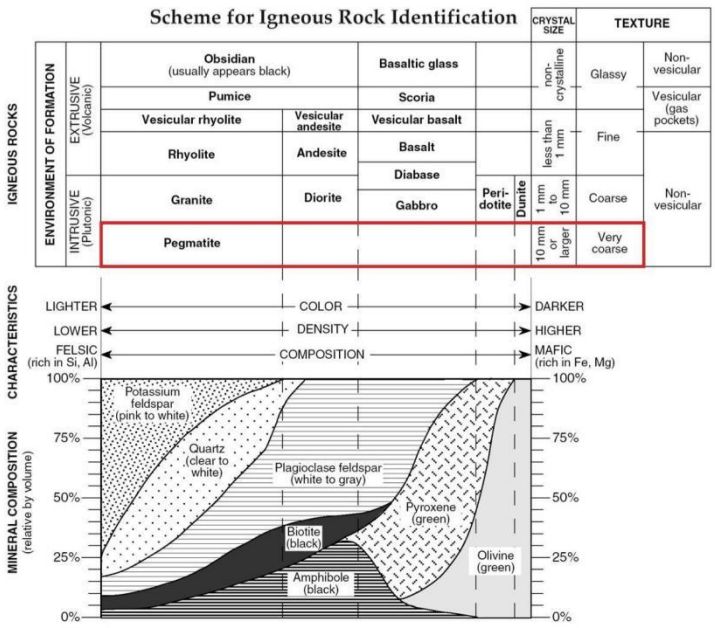
Source: https://cdn.thinglink.me/api/image/720668688289628162/1240/10/scaletowidth

Based on the graph, peridotite is a coarse-grained igneous rock composed of Pyroxene and Olivine.

18. **D**

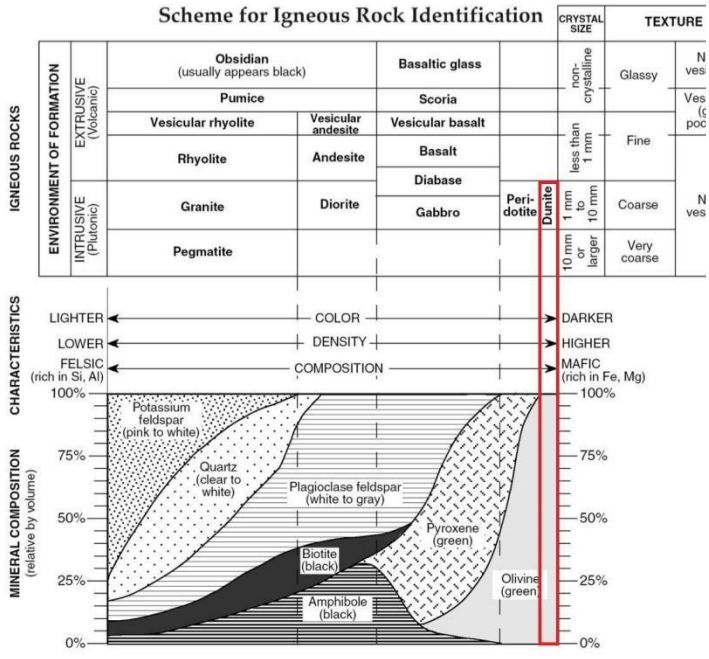
The extrusive igneous rocks (underwent solidification while on the earth's surface) are made up of the minerals plagioclase feldspar, biotite, amphibole, and a little quartz are andesite and vesicular andesite.

19. **D**



The lightest in color, least dense, and coarsest is pegmatite.

20. **A**



Dunite is made up of olivine.

21. **A**

Energy is power multiplied by time. Considering the equal length of time, the appliance with the lowest power requirement will give the least amount of energy use.

22. **C**

A decrease in wavelength results in an increase in energy. Since violet has the shortest wavelength in the visible spectrum, violet must have the highest energy.

23. **A**

Based on Newton's Second Law of Motion, given the same amount of force, a body with less mass will have a higher acceleration.

24. **B**

The air resistance will slow down and decrease the acceleration of an object undergoing free fall. The velocity versus time graph will show velocity approaching a constant value implying a decreasing acceleration.

25. **C**

A lever must satisfy the equation $w_1d_1 = w_2d_2$. To get w_2,

$w_2 = w_1d_1/d_2 = (200N)(3m)/(1.5m) = 400$ N

26. **C**

Due to the Law of Inertia, the sleeping passenger will resist the acceleration and try to stay at rest. So, when the bus moves forward, the sleeping passenger will move backward to resist the change in motion.

27. **B**

The range of a projectile motion can be computed as:

If a = 0°, then the range will have the highest value.

Thus, the ball must be thrown straight horizontally.

28. **C**

Momentum = mv

Body	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)
A	1	5	5
B	2	4	8
C	3	3	9
D	4	2	8

29. **B**

KE = ½ mv^2

Body	Mass (kg)	Velocity (m/s)	KE (J)
A	1	5	12.5
B	2	4	16
C	3	3	13.5
D	4	2	8

30. **D**

Wavelengths are measured from 1 peak to another peak (crest to crest or trough to trough).

31. **D**

Period is the amount of time it takes for one cycle to complete.

Frequency is a measurement of how many cycles can happen in a certain amount of time.

Wavelength is defined as the distance from a particular height on the wave to the next spot on the wave where it is at the same height and going in the same direction. Amplitude is a measure of how big the wave is.

32. **B**

Work = F x d = 1000 N x 4 m = 4000 J

33. **A**

Power = W/s = 4000 J/ 5s = 800 Watts

34. **B**

The voltage in a parallel circuit is just the same.

35. **D**

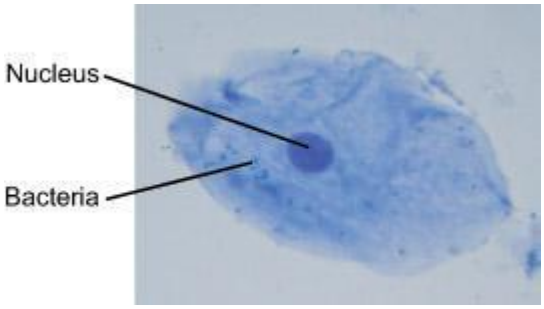
The same magnitude of force in the opposite direction must be applied to stop the box.

36. **B**

Formula: F = ma; a = v/t
thus, F = mv/t
t = mv/F

t = (5kg) x (2m/s) / (10N)
t = 1 second

37. **C**



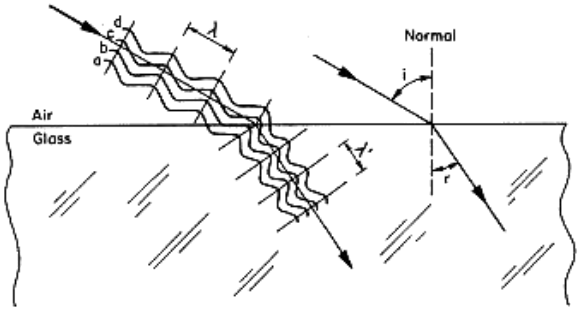
Source: https://www2.mrc-lmb.cam.ac.uk/microscopes4schools/media/cheekcell.jpg

The cells seen are squamous **epithelial cells** from the outer epithelial layer of the mouth. The small blue dots are bacteria from our teeth and mouth.

38. **D. None of these**

It is not polar since there is no net charge due to equal number of protons and electrons. It is not an anion because the atom has no excess negative charge. **It has 17 amu.**

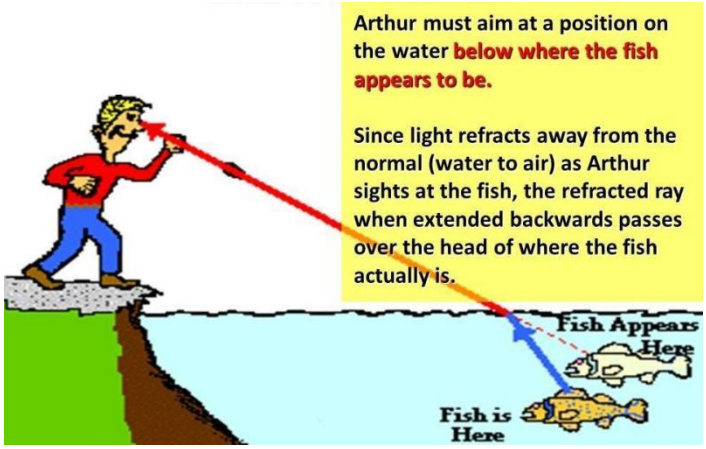
39. **C**



Source: https://www.asu.edu/courses/phs208/patternsbb/PiN/rdg/refraction/figure3.gif

Refraction is an effect that occurs when a light wave, incident at an angle away from the **normal**, passes a boundary from one medium into another in which there is a change in velocity of the light. Light is refracted when it crosses mediums of different densities. Light slows down when it comes from a medium of lower density to a medium of higher density (and vice versa). Since the light speed changes at the interface, the **wavelength** of the light must change, too. The wavelength decreases as the light enters the medium and the light wave changes direction.

40. **D**



Source:https://images.slideplayer.com/29/9482833/slides/slide_8.jpg

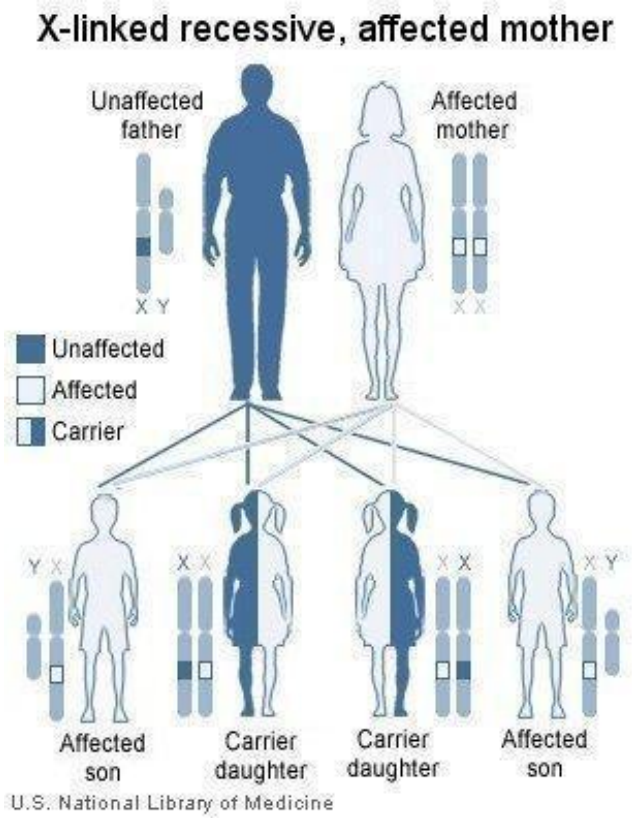
41. **A**

Glass has a Mohs Hardness of 5.5. Calcite has a Mohs hardness of 3. Quartz, Topaz, and Diamond have Mohs hardness greater than 5.5. Since calcite has Mohs hardness lower than glass, it cannot cut through or scratch glass.

42. **C**

The number of atoms is the number of moles multiplied by Avogadro's number. The higher the number of moles of a substance, the higher the number of atoms will be. 4 moles of NaOH will have more atoms than the 1 mole of water, 1 mole of carbon dioxide, and 1 mole of Ammonium carbonate.

43. **A**



All males will have the disease.

Source: http://www.perinatology.com/images/XlinkRecessiveX2.jpg

44. **B**

$g = Gm/r^2$

If mass is constant and G being the universal gravitational acceleration, if the radius is halved, the gravitational acceleration will be four times the original. Since weight is equal to mass times acceleration, the weight of an object will also be four times the original. Therefore, IV is true.

$F = Gm1m2/r^2$

With radius halved and the masses constant, the gravitational force/ gravitational pull will also increase by four times. Therefore, III is true. Density is mass divided by volume. With volume being halved and mass constant, the density will be twice the original.

45. **A**

Mushrooms are an example of fungi. The fungi were once considered to be plants because they grow out of the soil and have rigid cell walls.

Source: https://www.cliffsnotes.com/study-guides/biology/plant-biology/fungi-not-plants/a-kingdom-separate-from-plants

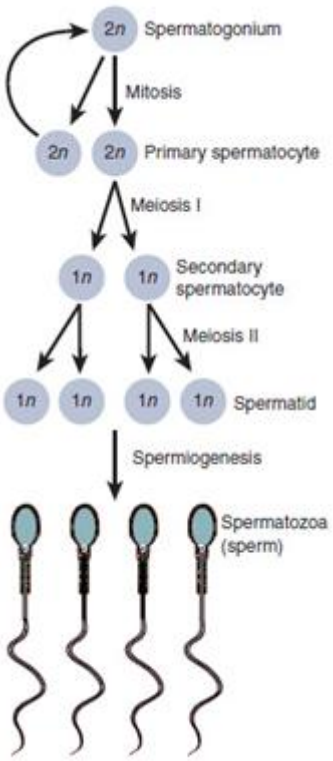
46. **C**

Viruses are not made out of cells, they can't keep themselves in a stable state, they don't grow, and they can't make their own energy. They need a living host to reproduce. Even though they definitely replicate and adapt to their environment, viruses are more like androids than real living organisms.

Source: https://www.khanacademy.org/test-prep/mcat/cells/viruses/a/are-viruses-dead-or-alive

47. **B**

Gametogenesis is the process whereby a haploid cell (n) is formed from a diploid cell (2n) through meiosis and cell differentiation. Gametogenesis in the male is known as **spermatogenesis** and produces spermatozoa. Gametogenesis in the female is known as **oogenesis** and result in the formation of ova.



Source: http://s3.amazonaws.com/teachmeseries/tmphysiology/wp-content/uploads/2017/07/22091127/Spermatogenesis-1.png

Spermatogenesis: spermatogonium (diploid) → primary spermatocyte → 2 secondary spermatocytes (haploid) → 4 spermatids → 4 spermatozoa/sperms

48. **C**
The process in which water is released from the roots to the small spores on the underside of leaves of plants is called **transpiration**.

There are several factors that affect transpiration such as temperature, relative humidity, wind and air movement, soil-moisture availability and type of plant.
Higher temperatures cause stoma to open, increasing the rate of transpiration, whereas colder temperatures cause stoma to close, decreasing the rate of transpiration.

As the relative humidity increases, the rate of transpiration decreases since it is difficult for water to turn into vapor when air is more saturated.

Source: https://water.usgs.gov/edu/watercycletranspiration.html

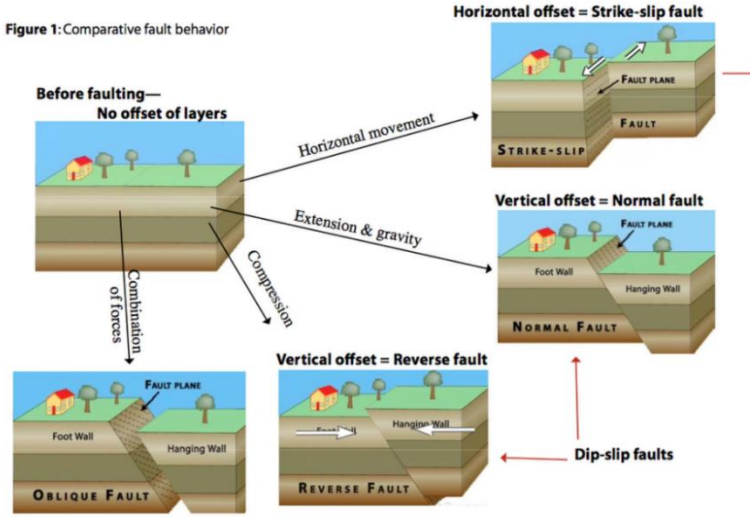
49. **D**
The structure of the Thermos bottle does not allow any of the three modes of heat transfer. The inner bottle contains a silver coating that minimizes heat transfer by radiation. The vacuum between the walls minimizes heat transfer by convection. The glass wall is thin enough to minimize transfer of heat through convection.

50. **C**
There are three types of faults: normal fault, reverse fault and strike-slip fault.

When two plates move in different directions, one plate slides downwards away from the other due to crustal stretching, it is called **normal fault**. This fault is defined when a hanging wall moves downward as a footwall moves upward.

Opposite the normal fault is the **reverse fault**, where two plates move towards each other, causing one plate to slide underneath another or slide upward due to colliding pressure. For this type, the hanging wall moves upward as the footwall moves downward.

One type of reverse fault is the t**rust fault** where plates move at an angle of 30 degrees. **Strike-slip fault**, the third type of fault, occurs when two plates slide side by side instead of going up or down.



Source: https://www.livescience.com/37052-types-of-faults.html

51. **B**

Fossilization is the formation of fossils after an organism dies. Fragments of bone, shell, and such are slowly detached from the organism. Hard parts are buried and changed into new material, usually minerals. Moreover, due to a faster rate of burial of the organism, these body parts are usually destroyed without being altered, leaving an impression of a mold. Due to the continuous movement of plates, some fossils arise to the surface or become discoverable by scientists.

52. **A**

53. **D**

A niche is the functional role of an organism in an ecosystem. If an organism can survive in any type of environment without any problems with food and space it can occupy, we can say that this organism has a broad niche. An organism with a broad niche has many choices for food, meaning it can occupy several trophic levels. In the food web provided, eagles are shown to have the most choices for food, thus having the broadest niche.

54. **D**

Two setups were made for the experiment. Setup A was exposed to sunlight, whereas Setup B was put into darkness. In both setups, gas was shown to be produced. This means that in the presence or absence of light, certain types of gasses can still be produced.

55. **C**

This experiment is called the glowing wood splint test. This is used to detect the presence of oxygen through burning, since combustion requires oxygen, fuel, and heat to produce a fire.

56. **D**

The chemical name of lime water is calcium hydroxide, $Ca(OH)_2$. Since lime water is exposed to Gas B, it forms a cloudy white substance, chalk or calcium carbonate CaCO3, upon reaction with carbon dioxide.

57. **B**

Since right handedness is dominant (R), the genotype of the father could be either RR or Rr. However, since their daughters are left-handed (rr), then the father must have a recessive gene for left-handedness.

58. **C**

In transcription of DNA to RNA, guanine is still paired with cytosine, but adenine is now paired with uracil rather than thymine.

59. **D**

A ratio of 75% dominant trait (black coat) to 25% recessive trait (yellow coat) when simplified is 3:1. This ratio is the genotypic ratio for crossing two heterozygous genes.

60. **A**

Condensation occurs when gasses are cooled down, whereas evaporation occurs when liquids are exposed to higher temperatures. If the dew on the leaf is heated, this will become water vapor due to evaporation.

61. **C**

When two objects are at thermal equilibrium, they are of the same temperature. Therefore, there is no driving force for heat to transfer.

62. **B**

Buffers prevent drastic changes in pH of a system. Buffers neutralize added acid or base inside the body because too much acidity or alkalinity may cause various complications to our body organs, especially to the kidney.

63. **B**

The Law of Acceleration states that the acceleration of an object increases when the force applied is high or the mass of the object is low, thus:

$a = F/m$

$a = \frac{50\text{kg m/s}^2}{5\text{ kg}}$

$a = 10\text{ m/s}^2$

64. **B**

To know how many times would be “halved”, divide 17,190 by 5,730 and we’ll have 3. The 1000 g of carbon-14 will be halved three times:

So $1000 \div 2 = 500$

$500 \div 2 = 250$

$250 \div 2 = 125$

65. **C**

The formula for getting power consumption using Ohm's Law is P=IV. Since the given in the problem are current and resistance, we'll incorporate Ohm's Law (V=IR) to have the formula $P=I^2R = (2A)^2 (25 \text{ ohms}) = 100 \text{ W}$

66. **B**

Ohm's Law is represented by:

$$V = IR$$

Therefore, by looking at this formula, doubling the resistance with constant current, voltage also doubles.

67. **B**

Alpha particles are usually very limited in their ability to penetrate other materials. This means that a sheet of paper, skin or even a few inches of air can block ionizing radiation particles.

68. **C**

Because pitch and frequency are directly proportional and a higher frequency means a lower amplitude, a higher pitch also means a lower amplitude.

Wavelength and pitch are **inversely** proportional.

Amplitude determines the loudness/softness of sound.

69. **B**

A refraction occurs when light passes from one substance to another with a different optical density, changing the speed of light.

70. **A**

Polaris is the tail of the Little Dipper (Ursa Minor).

71. **D**

The gold foil experiment of Rutherford showed that atoms consist mostly of empty space with a small, dense nucleus that is positively charged.

72. **C**

Periodic tables are arranged according to atomic weight and electron valence.

73. **B**

A substance's acidity or basicity can be determined using litmus papers. When it's acidic, the color turns red; when it's alkaline, or basic, it turns blue.

74. **C**

A salt with a neutral pH will be formed when you combine a strong acid, such as HCl, with a strong base, such as NaOH. As a result, it will have an equal proportion of hydrogen

and hydroxyl ions when dissolved in water. Hence, the solution will have a pH scaling of 7, making it neutral.

75. **B**

HCl is a strong acid, followed by the weak acid CH_3COOH, then H_20 for its neutral pH, and a base, NH_3

76. **D**

By understanding the graph. You're just given a graph with volume and temperature so there's no need to generalize anything about the identity of the substance. Just look at the graph from left to right and you will see that V has the highest increase in temperature.

77. **D**

Eliminate statements I and II for these cannot be determined in the given. W is seen to decrease in volume (compress) from 0-4 degrees Celsius and Y seems to decrease also in volume or have a negative expansion or simply compression

78. **C**

Most common metalloids are Silicon and Germanium, which are often used as semiconductors

79. **C**

In the presence of a semi-permeable membrane, only solvent molecules can pass through the membrane.

80. **A**

Volatility means ease of evaporation. This means that substances with higher volatility will be easier to evaporate due to weak attractions between liquid molecules or weaker IMFA.

81. **D**

The amount of energy is directly proportional to the photon's electromagnetic frequency and thus, equivalently, is inversely proportional to the wavelength.

82. **A**

A group is a column of elements in the periodic table.

83. **D**

Based on Avogadro's law, with constant pressure and temperature, if two gases have the same volume, they must necessarily contain the same molecular quantities.

84. **C**

If the boiling point of water is 212 degrees Fahrenheit or 100 degrees Celsius, then, at

low pressure or high altitude, the boiling point is lower than 212 degrees Fahrenheit.

85. **D**

Alkaline Earth Metals are placed in the S-block and second column of the periodic table (s^2).

86. **D**

Kingdom Animalia - Phylum Chordata - Subphylum Vertebrata - Class Aves - Order Galliformes - Family Phasianidae - Genus Gallus - Species – G. domesticus.

MOCK UPCAT 11: ANSWER KEY WITH SOLUTIONS

1. **B**

$16\frac{2}{3}\%$ of N is 35

$16\frac{2}{3}\% = \frac{50}{3}\%$

$\frac{50}{3}$ x N = 35

$\frac{3}{50}\left[\frac{50}{3} \text{ x } N = 35\right]\frac{3}{50}$

$N = \frac{21}{10}$

What percent of *N* is 63?

A% x N = 63

$A \text{ x } \frac{21}{10} = 63$

$\frac{10}{21}\left[A \text{ x } \frac{21}{10} = 63\right]\frac{10}{21}$

A = 30%

2. **C**

Evaluate. Use formulas for Arithmetic Sequence.

a. n = -12 (we cannot have a negative number of terms)

b. n = 9

$a_9 = 2 + (9-1)3 = 26$

$\text{Sum} = \frac{(2+26)}{2}(9) = 126$

sum = $155 \neq 126$

c. **n = 10**

$a_{10} = 2 + (10-1)3 = 29$

$\text{Sum} = \frac{(2+29)}{2}(10) = 155$

$\text{Sum} = 155 = 155$

3. **C**

Use formulas for Geometric Sequence.

$a_4 = 24 = a_1 r^{(4-1)}$

$a_7 = 192 = a_1 r^{(7-1)}$

Since $a_1 = a_1$, then

$\frac{24}{r^3} = \frac{192}{r^6}$

$r = 2$

$a_1 = \frac{24}{2^3} = 3$

4. **D**

Use synthetic division especially when coefficients are involved.

-3	1	a	3	-9
		-3	9-3a	-36+9a
	1	-3+a	12-3a	-45+9a

$-45 + 9a = 0$

$a = 5$

5. **B**

Solve for remainder (Q_1+Q_2).

-3	1	a	3	-9
		-3	9-3a	-36+9a
	1	-3+a	12-3a	**-45+9a**

2	1	k	-12	6
		2	4+2k	-16+4k
	1	2+k	-8+2k	**-10+4k**

$Q_1 + Q_2 = 20$

$5k - 6 + 4k - 10 = 20$

$k = 4$

6. **C**

Solve for the discriminant.

a. $(-7)^2 - 4(1)(4) = 33$

b. $(-7)^2 - 4(1)(-4) = 65$

c. $(-1)^2 - 4(7)(4) = -111$

d. $(-1)^2 - 4(7)(-4) = 113$

7. **B**

$f(a) - f(a-1) =$

$= a^2 + 4a + 4 - \left[(a-1)^2 + 4(a-1) + 4\right]$
$= a^2 + 4a + 4 - \left[a^2 - 2a + 1 + 4a - 4 + 4\right]$
$= a^2 + 4a + 4 - a^2 - 2a - 1$
$= 2a + 3$

8. **E**

$$\frac{g(m+n)-g(m)}{n} =$$
$$= \frac{(m+n)^2 - 5(m+n) + 6 - \left[m^2 - 5m + 6\right]}{n}$$
$$= \frac{m^2 + 2mn + n^2 - 5m - 5n + 6 - m^2 + 5m - 6}{n}$$
$$= 2m + n - 5$$

9. **B**

Evaluate.

a. $f(x) = x^2 - 16, 0 = (x+4)(x-4)$
Zeroes are 4 and -4.

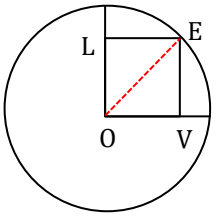
b. The x-intercepts are the value of x when y=0. Thus, x = 4 and x = -4.

10. **A**

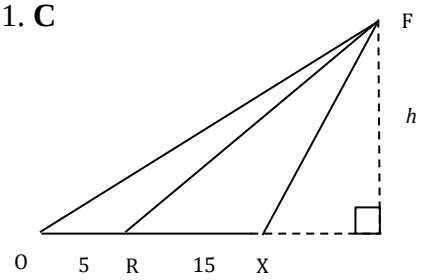
$\text{Area}_{\text{circle}} = \pi r^2 = 64\pi$

r = 8 = diagonal of square(d)

$\text{Area}_{\text{square}} = \frac{d^2}{2} = \frac{8^2}{2} = 32$



11. **C**



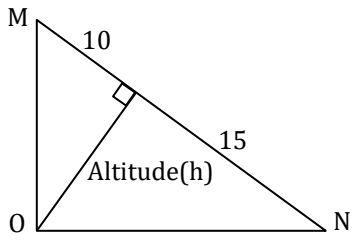
$\text{Area}_{\triangle FOX} = 160 = \frac{bh}{2}$

$160 = \frac{(20)h}{2}$

$h = 16$

$\text{Area}_{\triangle FOR} = \frac{5(16)}{2} = 40$

12. **D**



Using similar triangles.

$\frac{h}{10} = \frac{15}{h}$

$h^2 = 150$

$h = \sqrt{150}$

$h = 5\sqrt{6}$

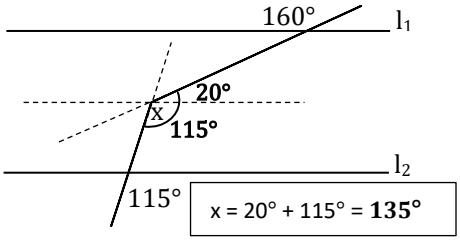
13. **B**

$$\lim_{x\to\infty} \frac{3x^2+1}{4x^3 - x} =$$

$$= \frac{\frac{3x^2}{x^3} + \frac{1}{x^3}}{\frac{4x^3}{x^3} - \frac{x}{x^3}} = \frac{\frac{3}{x} + \frac{1}{x^3}}{4 - \frac{1}{x^2}}$$
$$= \frac{0+0}{4-0} = 0$$

14. **E**

Use properties of transversal.



15. **D**

$$\frac{x^2 - 2xy + y^2}{x^2 - y^2} =$$
$$= \frac{(x-y)(x-y)}{(x-y)(x+y)} = \frac{x-y}{x+y} = \frac{8}{4} = 2$$

16. **C**

$a_n = a_1 r^{(n-1)}$

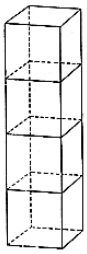
$a_9 = \sqrt{3}\left(\sqrt{2}\right)^8$

$a_9 = 16\sqrt{3}$

17. **C**

$SA = 6s^2 = 54m^2$

$s^2 = 9m^2$

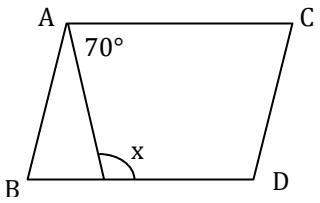


$SA_{rectangularprism} = 18 \times s^2$

$SA = 18 \times 9m^2 = 162m^2$

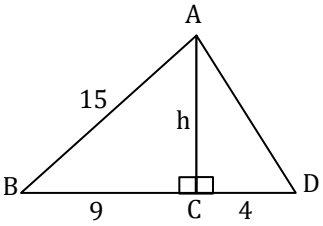
18. **D**

Given $AC \parallel BD$, then $x + 70° = 180$ (property of transversal), $x = 110°$



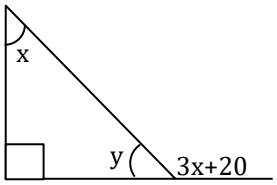
19. **B**

Use pythagorean triples.



a	b	c
3	4	5
5	12	13
7	24	25
9	**h=12**	15

20. **B**



(Sum of remote interior angles = exterior angle)

$3x + 20 = 90 + x$

$2x = 70$

$x = 35$

(Sum of interior angles of a triangle = 180)

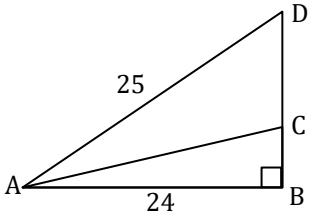
$90 + x + y = 180$

$y = 180 - 90 - 35$

$y = 55$

21. **B**

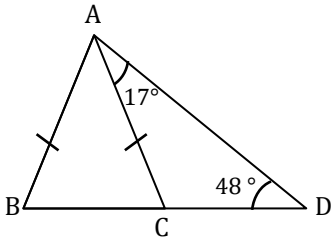
$\overline{DB} = 7$ (pythagorean triples)



$\text{Area}_{ACD} = \text{Area}_{ABD} - \text{Area}_{ABC}$

$\text{Area}_{ACD} = \frac{24(7)}{2} - 25 = 59$

22. **A**



$m\angle ACB = m\angle CAD + m\angle ADC$

$m\angle ACB = 17° + 48° = 65°$

$m\angle ACB \cong m\angle ABC$

$m\angle BAC = 180° - (m\angle ACB + m\angle ABC)$

$m\angle BAC = 180° - 130° = 50°$

23. **B**

$$\frac{1\text{job}}{6\text{days}}+\frac{1\text{job}}{4\text{days}}=\frac{x}{2\text{days}}$$

$$\frac{10}{24}=\frac{x}{2}$$

$$x=\frac{5}{6}$$

24. **D**

(in getting the first digit, we can choose from 3,4, or 5 to have a digit greater than 300)

Repeating: $\underline{3}\times\underline{5}\times\underline{5}=75$

Order is important: 75

25. **C**

Ratio = Filipino:Foreigners

3:2 = **6**:4

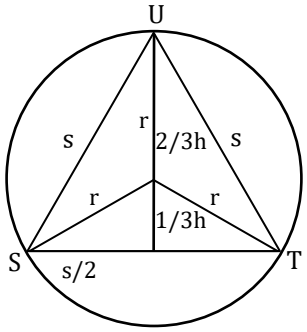
$6=\frac{1}{4}\text{class}$

$\text{class}=24$

$\text{Boys}=\text{Class}-\text{Filipino}-\text{Foreigners}$

Boys = 24 – 6 – 4 = **14**

26. **C**



Since *triangle UST* is equilateral, then

$s=2$

$h=6\sqrt{3}$ (using special right triangle)

radius = (r) = $\frac{2}{3}$h (using median and perpendicular bisector)

$r=\left(\frac{2}{3}\right)\left(6\sqrt{3}\right)=4\sqrt{3}$

$\text{Area}_{\text{shaded}}=\text{Area}_{\text{circle}}-\text{Area}_{\text{triangle}}$

$\text{Area}_{\text{shaded}}=\pi\left(4\sqrt{3}\right)^2-\frac{12\left(6\sqrt{3}\right)}{2}$

$\text{Area}_{\text{shaded}}=48\pi-36\sqrt{3}$

27. **C**

(*Using Midpoint Theorem*)

$\overline{AK}=\overline{AT}=\overline{TK}=\frac{24}{3}=8$

$\overline{AK}\parallel\overline{ED}$ and $\overline{ED}=\frac{1}{2}\overline{AK}$ then $\overline{ED}=4$

$\overline{AT}\parallel\overline{FD}$ and $\overline{FD}=\frac{1}{2}\overline{AT}$ then $\overline{FD}=4$

$\overline{TK}\parallel\overline{EF}$ and $\overline{EF}=\frac{1}{2}\overline{TK}$ then $\overline{EF}=4$

Perimeter$_{\textit{triangle DEF}}$ = 4 + 4 + 4 = **12**

28. **A**

Using corresponding sides of similar triangles are proportional then,

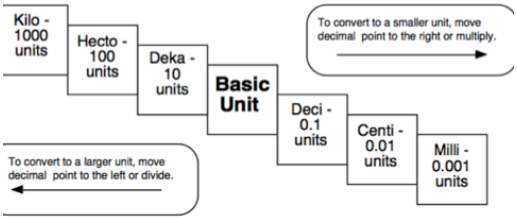
$$\frac{x+2}{6}=\frac{2}{3}$$

$$3x+6=12$$

$$x=2$$

29. **A**

Using Metric Conversion Ladder Method



https://msgeshkesciencehub.wordpress.com/tag/metric-system/

Using elimination of choices, D and E cannot be both correct since they have same unit, then $5\text{km}\neq 500\text{m}$.

30. **C**

Standard form for:

i. *Ellipse:* $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ **or** $\frac{y^2}{a^2}+\frac{x^2}{b^2}=1$

ii. *Hyperbola:* $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ **or** $\frac{y^2}{a^2}-\frac{x^2}{b^2}=1$

iii. *Parabola:* $y=ax^2+bx+c$

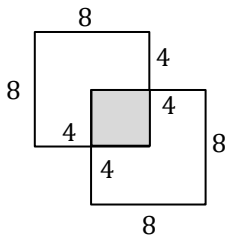
iv. *Circle:* $x^2+y^2=r^2$

Thus, $x^2 - 4y^2 = 4$

$$\frac{x^2 - 4y^2 = 4}{4}$$

$\frac{x^2}{4} - \frac{y^2}{1} = 1$ is a **hyperbola.**

31. C



Area $_{square}$ =s^2=16 m^2
s = 4 m
Perimeter $_{whole\ figure}$ = 8(4) +4(4) = **48 m**

32. B

3 *vacant* : 2 *occupied* = 5 seats
36 *vacant* : **24 *occupied*** = 60 seats

33. C

simple interest: I = Prt

1st year: $I_1 = 1000\left(\frac{10}{100}\right)(1) = 100$

2nd year: $I_2 = 2000\left(\frac{10}{100}\right)(1) = 200$

After 2 years: Total money = P + I_1 + I_2
Total money = 2000 + 100 + 200 = **2300**

34. B

Ratio and Proportion

$$\frac{x}{8} = \frac{6}{9}$$

$$x = \frac{48}{9}$$

$x = 5\frac{1}{3}$ or **5'4"**

35. B

Distance(D) = Speed(s) x Time(t)
D $_{Train\ A}$ = (30kph)(t)= 30t

D $_{Train\ B}$ = (40kph)(t-2) = 40t - 80

NOTE: time for Train B is less two hours since it will leave 2 hours earlier than Train A

Distance $_{Train\ A}$ +Distance $_{Train\ B}$ = 200 km
30t + 40t - 80 = 200
70t - 80 = 200
t = 4
Train A : 8A.M. + 4h = **12P.M.**

36. C

$\log_2 x + \log_2 (x-2) = 3$
$\log_2 x(x-2) = 3$
$\log_2 (x^2 - 2x) = 3$
$x^2 - 2x = 2^3$
$x^2 - 2x - 8 = 0$
$(x-4)(x+2) = 0$
$x = 4$

Note: When x = 2, the value is UNDEFINED

37. D

Use synthetic division.

2	p	-1/2p	-7/2p	2
		2p	3p	-p
	p	3/2p	-1/2p	2-p

↓ remainder

To make the x-2 a factor, the reminder should be zero.

$2 - p = 0$
$p = 2$

38. A

Evaluate choices.

a. $y = \text{UNDEFINED}$, thus discontinuous at $x = 0$
b. $y = 0$
c. $y = 0$
d. $y = 2$

39. **C**

(Rewrite the indeterminate form by factoring both the numerator and denominator.)

$$\lim_{x\to -3}\frac{x+3}{x^2-9}=\frac{0}{0}$$

$$=\lim_{x\to -3}\frac{x+3}{(x+3)(x-3)}$$

(Divide out the factors *x - 3* , the factors which are causing the indeterminate form. The limit can now be computed.)

$$=\lim_{x\to -3}\frac{1}{(x-3)}$$

$$=\frac{1}{(-3-3)}$$

$$=\frac{1}{-6}$$

40. **B**

Power of C!

$$\frac{2}{3}\bullet\frac{3}{4}\bullet\frac{4}{5}\bullet\frac{5}{6}=\frac{2}{6}\text{or}\frac{1}{3}$$

41. **E**

Evaluate choices.

a. $|7|=7$

b. $|-7|=7$

c. $1-|7|=1-7=-6$

d. $|7-1|=6$

e. $|-7|+1=7+1=8$

42. **C**

Use partitive proportion.

Let x be the original piece

$3:4:5=12$

$\_:\_:\underline{2.5\text{m}}=x$

$$\frac{2.5}{5}:\frac{x}{12}$$

$$x=6$$

43. **E**

Let P = original price = 100%

(80%) P = 600

P = 750

44. **D**

Use " $\frac{\text{is}}{\text{of}}$ *" technique.*

$$\frac{\text{vinegar}}{\text{mixture}}=\frac{2}{2+3}=\frac{2}{5}$$

45. **C**

Ratio and Proportion

$$\frac{\text{xfile}}{1\text{min}}=\frac{1\text{file}}{1\frac{3}{4}}$$

$$x=\frac{1}{\frac{7}{4}}$$

$$x=\frac{4}{7}$$

46. **C**

Evaluate

$$\frac{2^{-2}-2^{-3}}{2^{-2}}=$$

$$=\frac{\frac{1}{4}-\frac{1}{8}}{\frac{1}{4}}$$

$$=\frac{4}{8}\text{or}\frac{1}{2}$$

47. **A**

Use special products

$$\frac{x^2-1}{x+1}=$$

$$=\frac{(x+1)(x-1)}{(x+1)}$$

$$=x-1$$

48. **C**

$$\frac{1\text{job}}{2\text{days}}+\frac{1\text{job}}{3\text{days}}=\frac{1\text{job}}{x\text{days}}$$

$$\frac{3+2}{6}=\frac{1}{x}$$

$$x=\frac{6}{5}\text{days}$$

49. **D**

Evaluate

$$\frac{a \bullet a \bullet a}{a+a+a} =$$
$$= \frac{a \bullet a \bullet a}{3a}$$
$$= \frac{a^2}{3}$$

50. **B**

Evaluate

$\log_b(x+y) = z$

$b^z = x+y$

51. **C**

Change to exponential form.

$\log_6(4x - 4) = 2$

$6^2 = 4x - 4$

$36 = 4x - 4$

$40 = 4x$

$10 = x$

52. **D**

Evaluate

$f(x) = y = \frac{7x-5}{4}$

To solve for the inverse function, interchange x and y then solve for y.

$x = \frac{7y-5}{4}$

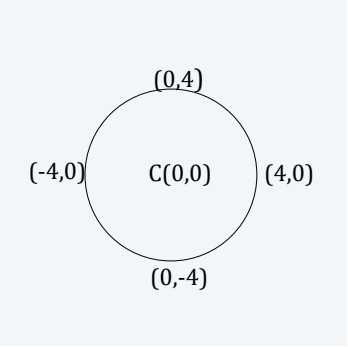
$4x+5 = 7y$

$y = \frac{4x+5}{7}$

53. **A**

$\text{Area}_{\text{circle}} = \pi r^2 = 16\pi$

$r = 4$



54. **B**

$\text{Indigo} + \text{Aqua} = 8\text{blue} + 2\text{violet} + 2\text{green}$

$\text{Indigo} + \text{Aqua} = 12\text{parts}$

$\text{Blue} = \frac{8}{12} \text{or} \frac{2}{3}$

55. **D**

	Number	Amount(pesos)
25 centavos	x	.25x
one peso	2x	2x
five peso	2x-9	10x - 45
	TOTAL	12.5x - 45

$12.5x - 45 = 28.5$

$12.5x = 73.5$

$x = 6$

$\text{Number of five-peso} = 2(6) - 9 = 3$

56. **E**

Solve for the value of a:

$a - 3 = 5$

$a = 5 + 3$

$a = 8$

Substitute the value of a:

$2a - 3$

$2(8) - 3 = 16 - 3 = 13$

57. **E**

Solve for the value of x - y

$x = y - 5$

$x - y = -5$

Substitute the value of x - y

$(x - y)^3$

$(-5)^3 = -125$

58. **B**
Apply Power of C
$\frac{9a^4 - 3a^3 + 6a}{3a}$
$= 3a^3 - a^2 + 2$

59. **B**
$2(x^{12} - 16)$
$2(x + 4)(x - 4)$

60. **E**
Substitution
a) If we substitute 0 as value of t,
$1 - t = \frac{t-1}{t}$ will be undefined.
b) $1 - t = \frac{t-1}{t}$
$1 - 1 = \frac{1-1}{1} = 0$
c) $1 - (-1) = \frac{(-1)-1}{-1} = 2$

-1 and 1 are values of *t*.

MOCK UPCAT 12 (UPDATE): ANSWER KEY WITH SOLUTIONS

1. **D**

$3x + y = 5$ 1st equation
$2x + y = 4$ 2nd equation

Using elimination method, subtract the second equation from the first equation then eliminate y

$$\begin{array}{r} 3x + \cancel{y} = 5 \\ -(2x + \cancel{y} = 4) \\ \hline x \quad = 1 \end{array}$$

Then substitute the value of x

$3x + y = 5$
$3(1) + y = 5$
$3 + y = 5$
$y = 5 - 3$
$y = 2$

Substitute the value of x and y to get x + y

$x + y = 1 + 2 = 3$

2. **B**

$$\frac{x}{x-y} + \frac{y}{y-x}$$

Multiply $\frac{y}{y-x}$ by -1

$$\frac{x}{x-y} + -1\left[\frac{y}{y-x}\right]$$
$$\frac{x}{x-y} + -\frac{y}{-y+x}$$
$$\frac{x}{x-y} + -\frac{y}{-y+x}$$
$$\frac{x}{x-y} - \frac{y}{x-y}$$
$$\frac{\cancel{x-y}}{\cancel{x-y}} = 1$$

3. **C**

$x + y = 1$ 1st equation
$3x + 2y = 5$ 2nd equation

Substitute the values of x and y to the first equation

a) (3, 2)

$x + y = 1$
$3 + 2 = 5$

Since it does not satisfy the first equation, no need to substitute the value of x to the second equation

b) (2, 3)

$x + y = 1$
$2 + 3 = 5$

Since it does not satisfy the first equation, no need to substitute to the second equation

c) (3, -2)

$x + y = 1$
$3 + 2) = (-1$

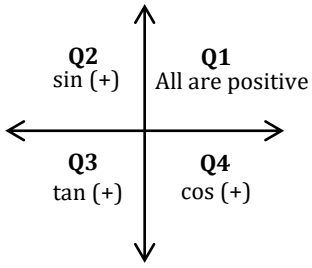
Since it does satisfy the first equation, substitute to the second equation

$3x + 2y = 5$
$3(3) + 2(-2) = 5$
$5 = 5$

No need to check letter d, the answer is C.

4. **B**

$\tan\theta < 0$ and $\cos\theta < 0$



Since $\tan\theta$ and $\cos\theta$ are both negative, the remaining possible quadrant where the θ lies is at quadrant 2 or when $\sin\theta$ is positive.

5. **A**

x and y are integers

$\frac{x}{y}$ is negative

There are two cases:

1. x is positive and y is negative
2. x is negative and y is positive

I) xy

If x = + & y = -

(+)(-) = -

If x = - and y = +

(-)(+) = -

III.

x^5+y^5

Use **S**imple **E**xample **(SE)**

If $x = -1$ and $y = 1$

$x^5 + y^5$

$(-1)^5 + (1)^5 = -1 + 1 = 0$

0 is neither positive nor negative. It is an arbitrary number.

6. **D**

x is between -5 and 7

use **SE**

x = 0, 0 is the best SE between -5 and 7 Substitute the value of x

a) $x = 0$

b) $x + 5 = 0 + 5$

c) $x^2 + 15 = 0^2 + 15 = 15$

d) $x^2 + 30 = 0^2 + 30 = 30$

e) $3x + 10 = 3(0) + 10 = 10$

$x^2 + 30$ has the greatest value

7. **C**

Factor out $x^2 + 8x - 48 = 0$

$(x + 12)(x - 4) = 0$

$(x + 12) = 0$ *and* $(x - 4) = 0$

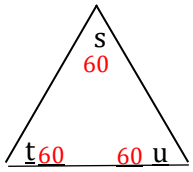
The set of roots of $x^2 + 8x - 48 = 0$ is $\{-12, 4\}$.

8. **E.**

$(4.8x10^{-12})(0.8x10^{-20}) = N$

$(3.84x10^{-32}) = N$

9. **D**



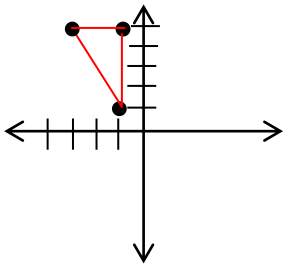
equilateral: all sides are equal

equiangular: all angles are equal

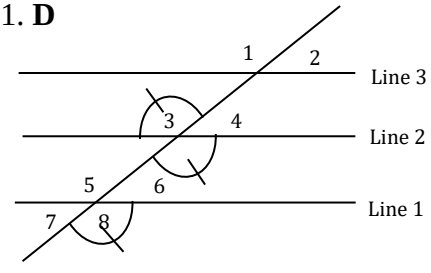
The sum of the angles of a triangle is 180o.

8. **C**

Plot the points (-1,5), (-1,1), and (-3,5) on the cartesian plane as vertices of a triangle.

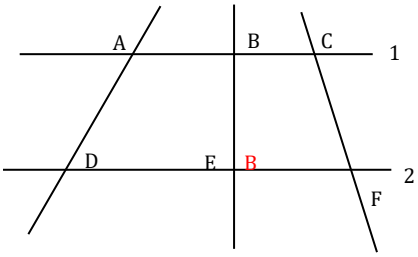


11. **D**



Line 3 and 8 are vertical angles.

12. **D**



a) $\angle A \cong \angle E$ FALSE
b) $\angle C \cong \angle F$ FALSE
c) $m\angle D + m\angle E = 90°$ FALSE
d) $m\angle B + \angle E = 180°$ TRUE
$\angle B$ and $\angle E$ are supplementary angles
e) $m\angle D + m\angle F = 180°$ FALSE

13. **A**

To get the number of posts needed, divide 114m by 6cm,

$\frac{114}{6} = 19$

Subtract 1 from 19 because 1st post and last post are not connected.

$19 - 1 = 18$ posts

14. **C**

$495 = \ 100\%P + 10\%P$

$495 = P + \frac{10}{100}P$

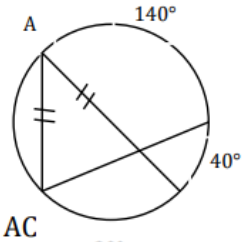
$495 = \frac{100}{100}P + \frac{10}{100}P$

$495 = \frac{110}{100}P$

$\frac{10}{11}\left[\frac{45}{495} = \frac{11}{10}P\right]\frac{10}{11}$

Get the 10% of 450
450 x 0.10 = 45
450 – 45 = 405
The salesman should have sold the book at ₱405.00.

15. **A**



$AB = AC$
$\widehat{AE} = 140°$
$\widehat{ED} = 40°$

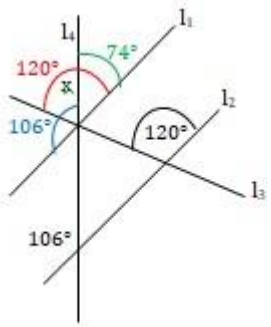
$\angle B = \frac{1}{2}m\widehat{AE}$
$\angle B = \frac{1}{2}(140°)$
$\angle B = 70°$

Since $AB = AC$,
$\triangle ABC$ is an isosceles triangle.

The bases of $\triangle ABC$ are also equal.

Since the sum of the angles of a triangle is 180°,
$\angle A = 180 - 70 - 70 = 40°$
$\widehat{BD} = 2 \text{ x } m\angle A$
$\widehat{BD} = 2 \text{ x } 40°$
$\widehat{BD} = 80°$
One complete rotation of a circle is 360°.
To get the measurement of $\widehat{AB} = 360 - m\widehat{AE}$
$m\widehat{ED} - m\widehat{BD} = 360 - 140 - 40 - 80 = 40°$
$\widehat{AB} = 40°$

16. **A**



$\angle x = 120 - 74 = 46°$

17. **D**

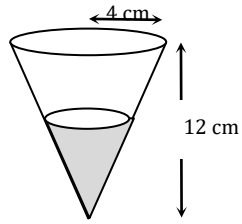
Since n is a positive number, the problem can be translated into this equation,

$$\frac{(n)(n)}{n+\cdots+n}$$

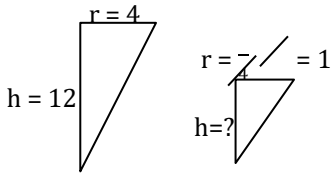
wherein n+...+n has n terms. We can simply rewrite it as

$$\frac{n^2}{n(n)} = \frac{n^2}{n^2} = 1$$

18. **A**



The radius of the water is ¼ of that of the cone.



To get the height of the water, use Ratio and Proportion (RAP)

$$\frac{4}{12} = \frac{1}{h}$$
$$\frac{4h}{4} = \frac{12}{4}$$
$$h = 3$$

The height of the water is 3. Now use the formula to get the volume of a cone to get the volume of the water.

$r = 1$

$h = 3$

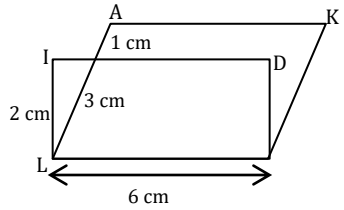
$V_{cone} = \frac{\pi r^2 h}{3}$

$V_{cone} = \frac{\pi(1)^2(3)}{3}$

$V = \pi cm^3$

The volume of the water inside the cone is πcm^3.

19. **B**



$12cm^2$

$A_{RectangleLODI} =$

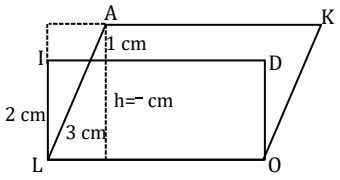
$l \times w = 12cm^2$

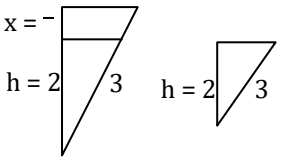
$l \times 2 = 12$

$\frac{2l}{2} = \frac{12}{2}$

$L = 6$

Create a right triangle





Using the concept of similar triangle by apply Ratio and Proportion (RAP)

$$\frac{2}{3} = \frac{x+2}{4}$$

$$8 = 3x + 6$$

$$8 - 6 = 3x$$

$$\frac{2}{3} = \frac{3x}{3}$$

$$x = \frac{2}{3}$$

To get the height,

$$h = \frac{2}{3} + 2$$

$$h = \frac{2+6}{3} = \frac{8}{3}$$

$$\frac{2L}{2} = \frac{12}{2}$$

$$L = 6$$

20. **B**

$P(\text{twins}_{\text{GIRLS}}) = 0.42$

$P(\text{twins}_{\text{BOYS}}) = 0.30$

The three possible cases are:

1) The twins are two boys.
2) The twins are two girls.
3) The twins are one girl and one boy.

The probability of having twins is 1.

$P(\text{twins}) = 1$

To get the probability that there are one boy and one girl is,

$$P(\text{twins}_{\text{EitherBoyOrGirl}}) = P(\text{twins}) - P(\text{twins}_{\text{GIRLS}}) - P(\text{twins}_{\text{BOYS}})$$

$$P(\text{twins}_{\text{EitherBoyOrGirl}}) = 1 - 0.42 - 0.30 = 0.28$$

The probability that there are one boy and one girl is 0.28.

21. **D**

$P(1, 1)$

$Q(2, y)$

The slope of line PQ is d.

$m = d$

To get the value of y, use "two-point slope form"

$y_2 - y_1 = m(x - x_1)$

$P(1,1)\ P(x_1, y_1)$

$Q(2,y)\ Q(x_2, y_2)$

$y - 1 = d(2 - 1)$

$y = 2d - d + 1$

$y = d + 1$

The value of y is $d + 1$.

22. **D**

Use synthetic division especially when coefficients are involved.

-2	1	0	r	0	-8	40
		-2	4	-8-2r	16+4r	-16-8r
	1	-2	4+r	-8-2r	8+4r	24-8r

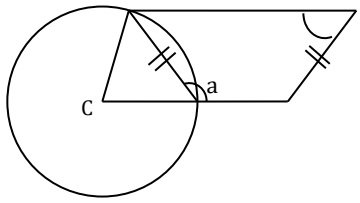
$24 - 8r = 0$

$$\frac{-8r}{-8} = \frac{-24}{-8}$$

$r = 3$

The value of *r* is 3.

23. **B**



Since we have a trapezoid where two sides are equal,

The sum of the angles of a trapezoid is 360°.

$360 - 60 - 60 = 360 - 120 = 240$

$m\angle a = \frac{1}{2}(240)$

$m\angle a = 120°$

$\frac{1}{2}m\angle a = \frac{120}{2} = 60°$

The measure of half of $\angle a$ is $60°$.

24. **C**

Symmetry	Test of Symmetry
x-axis	f(-y) = f(y)
y-axis	f(-x) = f(x)
At the origin	f(-x) = -f(x)
Diagonal	f(x → y) = f(y → x)

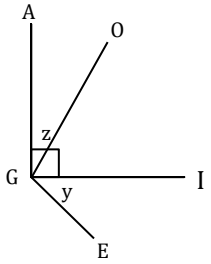
Test of Symmetry

$y = f(x) = \frac{-2}{x^3}$

$f(-x) = \frac{-2}{(-x)^3} = \frac{-2}{-x^3} = \frac{2}{x^3} = -f(x)$

The function has symmetry at the origin.

25. **E**



$\angle OGI = a$

$\angle AGE = b$

$\angle z = 90 - a$

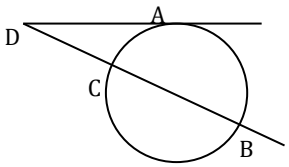
$\angle y = b - 90$

$z - y = (90 - a) - (b - 90)$

$z - y = 90 - a - b + 90$

$z - y = 180 - a - b$

26. **D**



To get the measurement of $\overset{\frown}{AC}$,

$\angle ADB = \frac{1}{2}(\overset{\frown}{AB} - \overset{\frown}{AC})$

$2\left[20 = \frac{1}{2}(160 - \overset{\frown}{AC})\right]2$

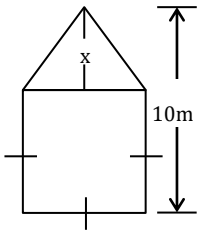
$40 = 160 - \overset{\frown}{AC}$

$\overset{\frown}{AC} = 160 - 40$

$\overset{\frown}{AC} = 120°$

The measurement of $\overset{\frown}{AC}$ is $120°$.

27. **A**



$Area_{square} + Area_{triangle} = 48m^2$

$s^2 + \frac{bh}{2} = 48m^2$

$(10 - x)^2 + \frac{(10 - x)(x)}{2} = 48$

$2\left[100 - 20x + x^2 + \left(\frac{10x - x^2}{2}\right) = 48\right]2$

$200 - 40x + 2x^2 + 10x - x^2 = 96$

$2x^2 - x^2 - 40x + 10x + 200 - 96 = 0$

$x^2 - 30x + 104 = 0$

$(x - 26)(x - 4) = 0$

$(x - 26) = 0 \quad (x - 4) = 0$

The value of x is 4m. It is not possible to be 26m because the total height of the figure is just 10m.

28. **A**

$$P(GIRL) = \frac{9}{20}$$

Let x be the number of girls

$$\frac{9}{20} = \frac{x}{120}$$
$$\frac{1080}{20} = \frac{20x}{20}$$
$$54 = x$$

There are 54 girls.

Let N be the number of students from NAGA
Let M be the number of students from MAYON

$$\frac{1}{3}N + \frac{1}{2}M = 54$$
$$N + M = 120$$
$$M = 120 - N$$
$$6\left[\frac{1}{3}N + \frac{1}{2}(120 - N) = 54\right]6$$

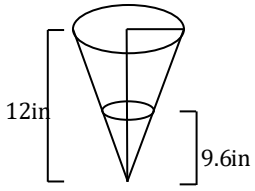
$$2N + 3(120 - N) = 324$$
$$2N + 360 - 3N = 324$$
$$-N = 324 - 360$$
$$-N = -36$$
$$N = 36$$

To get the probability that a student from NAGA will be randomly chosen:

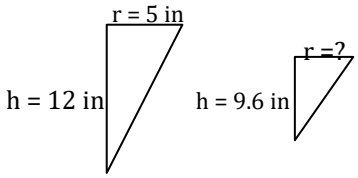
$$P(NAGA) = \frac{N}{120} = \frac{36}{120} = \frac{3}{10} = 0.3$$

The probability that a student from NAGA will be randomly chosen is 0.3.

29. **B**



To get the radius of the water, use Ratio and Proportion (RAP)



$$\frac{5}{12} = \frac{r}{9.6}$$
$$\frac{48}{12} = \frac{12r}{12}$$

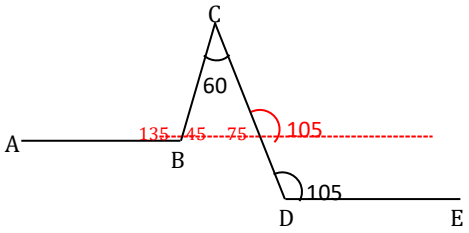
To get the area of the circular surface of the water, use the formula to get the area of circle where r = 4.

$$A_{circle} = \pi r^2$$
$$A_{circle} = \pi(4)^2$$
$$A_{circle} = 16\pi \text{ in}^2$$

The area of the circular surface of the water is 16π in^2.

30. **C**

Extend $\overline{AB}$



The measurement of $\angle ABC$ is$135°$.

31. **D**

Take note that the given numbers are the first 100 odd numbers, it means that it is all odd numbers from 1 – 199 and these numbers form an arithmetic sequence. Thus, applying the formula:

$$sum = \left(\frac{1st + last}{2}\right)n$$

$$sum = \left(\frac{1+199}{2}\right)100$$

$$sum = \left(\frac{1+199}{2}\right)100$$

$$sum = (100)100$$

$$sum = \mathbf{10,000}$$

32. **B**

Let us just use the formula of an arithmetic sequence.

$$A_n = A_1 + (n-1)d$$

$$A_7 = 2 + (7-1)\left(\frac{1}{2}\right)$$

$$A_n = 2 + 6\left(\frac{1}{2}\right)$$

$$A_n = \mathbf{5}$$

33. **C**

Let M be a male person

Let >20 be a person having an age greater than 20

$$P(M \cup > 20) = P(M) + P(> 20) - P(M \cap > 20)$$

$$= \frac{3}{4} + \frac{3}{4} - \frac{3}{4} = \mathbf{\frac{3}{4}}$$

34. **D**

This is a permutation problem since order is important.

$${}_8P_3 = \frac{8!}{(8-3)!} = \frac{8!}{5!} = \frac{8x7x6x5!}{5!} = 8x7x6$$

$$= \mathbf{336}$$

35. **C**

This is a permutation problem since we are talking about arrangements, thus order is important. Since there is a restriction, we need to be cautious in answering.

We will make A & B as one entity since they are must be beside each other, same as D & E, resulting to a scenario that arranges 3 objects only. The formula for that is

3 x 2 x 1 = 6

But we need to take account that the merged A & B can change places so we will multiply the previous answer to 2!. And since D & E were considered to be one as well, we will multiply the new answer by 2! again.

Final solution is given by (3 x 2 x 1) x 2! x 2! = 6 x 2 x 2 = **24**.

36. **D**

We need to solve the values of x.

Let us express first the equation into a single trigonometric variable, we will use the identity $\sin^2 x + \cos^2 x = 1$, manipulating this equation we can get $\cos^2 x = 1 - \sin^2 x$.

Substituting,

$$2(1 - \sin^2 x) - \sin x = 1$$

$$2 - 2\sin^2 x - \sin x = 1$$

$$1 - \sin x - 2\sin^2 x = 0$$

Let y be sin x,

$$1 - y - 2y^2 = 0$$

$$(1-2y)(1+y) = 0$$

$$(1-2y) = 0\,;\ (1+y) = 0$$

$$y = \frac{1}{2};\ y = -1$$

Substituting back the value of y,

$$\sin x = \frac{1}{2}; \sin x = -1$$

Since the values of x must come from the interval $[0.2\pi)$, we need to find all values of x that will satisfy the sin equation in this interval only. When is $\sin x = \frac{1}{2}$, it is when $x = \frac{\pi}{6}, \frac{5\pi}{6}$. When is $\sin x = -1$, it is when $x = \frac{3\pi}{2}$. **Based on the choices, we can say that D is the only one that does not satisfy the given equation.**

37. **A**

Simplify first the expression equal to f(x)) before plugging in the expression of g(x)

$$f(x) = \frac{x-1}{x^2-1} = \frac{\cancel{x-1}}{\cancel{(x-1)}(x+1)} = \frac{1}{x+1}$$

Thus,

$$f(g(x)) = \frac{1}{g(x)+1} = \frac{1}{\frac{6x-9}{2x+1}+1}$$

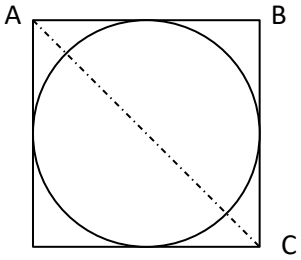
$$= \frac{1}{\frac{6x-9}{2x+1}+\frac{2x+1}{2x+1}} = \frac{1}{\frac{6x-9+2x+1}{2x+1}}$$

$$= \frac{1}{\frac{8x-8}{2x+1}}$$

$$= \boldsymbol{\frac{2x+1}{8x-8}}$$

38. **A**

This figure is easier to solve if we make it to of it and combine to form a square since the triangle is an isosceles right triangle (half of a square).



Thus, we can say that the area inside the triangle but outside the semi-circle in the original figure is half the area of the difference of the square having a diagonal of $4\sqrt{2}$ and a circle having a diameter of 4 (4 is the side of the square having a diagonal of $4\sqrt{2}$; it is a property of a square that the diagonal is $s\sqrt{2}$).

$$A = \frac{1}{2}(A_{square} - A_{circle})$$

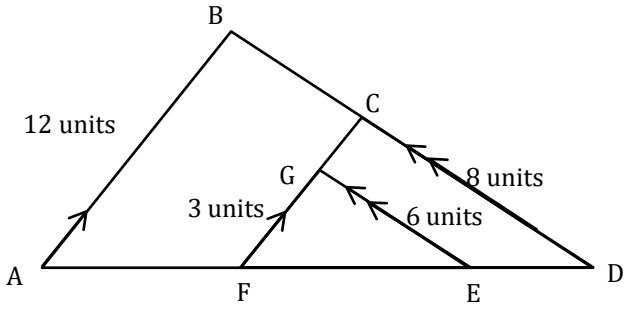
$$A = \frac{1}{2}(s^2 - \pi r^2)$$

$$A = \frac{1}{2}(4^2 - (\pi)2^2)$$

$$A = \frac{1}{2}(16 - 4\pi)$$

$$\boldsymbol{A = 8 - 2\pi}$$

39. **E**



Let us look at □FCD and □FGE first since they are similar triangles. Using RAP, we can say that:

$$\frac{FC}{FG} = \frac{CD}{GE}$$

$$\frac{FC}{3} = \frac{8}{6}$$

$$FC = 4$$

Since we now know the measure of FC, we now find the measure of BD so that we can solve BC by subtracting the measure of CD from BD. We will use the □ABD and □FCD since they are similar triangles as well.

$$\frac{BD}{CD} = \frac{AB}{FC}$$

$$\frac{BD}{8} = \frac{12}{4}$$

$$BD = 24$$

Therefore, BC = BD – CD = 24-8 = **16 units**

40. **E**

If you are given an equilateral triangle circumscribed in a circle, there is a formula $r = \frac{s}{\sqrt{3}}$ wherein r is the radius of a circle and
s is the side of the equilateral triangle.

Given R as the radius of the circle, we can say that $s = R\sqrt{3}$. Thus the perimeter is $\boldsymbol{P = 3s = 3\left(R\sqrt{3}\right) = 3\sqrt{3}\,R}$

41. 2, 3, 5, 7

I. Non-repeating
2 x 1 x 1 = 2

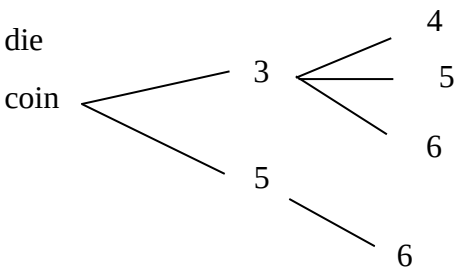
7 3 5
3 7 5

II. Order is important; though answer is in I (2). To know if the number is divisible by 15, it should be divisible by 3, 8, 5.

The number is divisible by 5 if it ends with 0 or 5 while it is divisible by 3 if the sum of the digit is multiple of 3.

Answer: B 2

42.



P (die > coin) = $\frac{desired}{total} = \frac{4}{12} = \frac{1}{13}$

Answer: D

Total:

2 x 6 = 12 using fundamental counting principle

outputs of coins

outputs of die

43. x, y, z

x and y are element of integers
(z)

$x - y > 2$ $\quad$ $x < 8$
$7 - y > 2$
$7 - 2 > y$
$5 > y$

4 is the greatest integer that is less than 8

4 is the largest value of y

Largest value of x + y
7 + 4 = 11

Answer: B

44. origin: (0, 0)
m = $-\frac{1}{3}$; use point slope form
$y - y_1 = m(x - x_1)$
$y - 0 = -\frac{1}{3}(x - 0)$
$y = -\frac{1}{3}x$ then substitute from the choices that will satisfy the equation.

x, y
a.) ~~(6, 2)~~ wrong
b.) ~~(2, -6)~~
c.) ~~(2, 6)~~
d.) (6, -2)
e.) ~~(-6, -2)~~

Answer: D

45. $\frac{(xy^{-2})^3 z^5}{x^{-6}yz^3} = \frac{x^9 y^b}{z^c}$

a + b + c = 7

$\frac{x^3 y^{-6} z^5}{x^{-6}yz^3} = \frac{x^3 \cdot x^b \cdot z^5}{y \cdot y^6 z^3} = \frac{x^9 z^2}{y^7} = \frac{x^9 y^{-7}}{z^{-2}}$

a = 9 b = –7 c = –2
a + b + c = (9) + (–7) + (–2) = 0

since the given function is a rational, the denominator should not be equal to 0.

Answer: B 0

46. f (x) = $\frac{x-2}{3(x^2-1)-8x}$

$3(x^2 - 1) - 8x = 0$
$3x^2 - 8x - 3 = 0$ use AC method in factoring

A = 3 B = 8 C = −3

1. $AC = 3(3 - 3) = -9$
2. Factors $-9 \quad 1$

$(-9 + 1) = 8$

3. $\frac{A}{factors}$ $\frac{3}{-9}$ $\frac{3}{1}$; $\frac{1}{-3}$ $\frac{3}{1}$

(x−3) (3x + 1) = 0
X−3 = 0 3x + 1 = 0

x = 3 3x = −1
$x = -\frac{1}{3}$

Domain: IR $-\left\{\frac{-1}{3}, 3\right\}$

Answer: D

47. y = $log_b 11$ x = $log_b 2$

$$log_b \frac{64}{121} = log_b 64 - log_b$$
$$= log_b 2^6 - log_b 11^2$$
$$= 6log_b 2 - 2log_b 11$$
$$= 6x - 2y$$

Answer: D

48. $\frac{F(x)}{x-1} = Q(\text{x})r.\ R(x), F(3) = 15\ \&\ Q(3) = 7$

$x = 3$

$\frac{F(3)}{3-1} = Q(3)r \cdot R(3)$

$\frac{15}{2} = 7remainder.1$

Answer: C

49. center: (h, k)

$(3, -2)$

$r = 2$

$(x-h)^2 + (y-k)^2 = r^2$

$Ax^2 + Cy^2 + Dx + Ey + F = 0$

$h = \frac{-D}{2}\ k = \frac{-E}{2}$

$3 = \frac{-D}{2}\ -2 = \frac{E}{2}$

$-6 = D\ 4 = E$

$r^2 = h^2 + k^2 - F$

$F = h^2 + k^2 - r^2$

$F = (3)^2 + (-2)^2 - (2)^2$

$F = 9 + 4 - 4$

$F = 9$

Answer: B

$x^2 + y^2 - 6x + 4y + 9 = 0$

50. A shaded region = O – I

r = 2

$= A_A - A_o$

$= \frac{\pi r^2}{2} - \pi r^2$

$= \frac{\pi\,(2r)^2}{2} - \pi(r)^2$

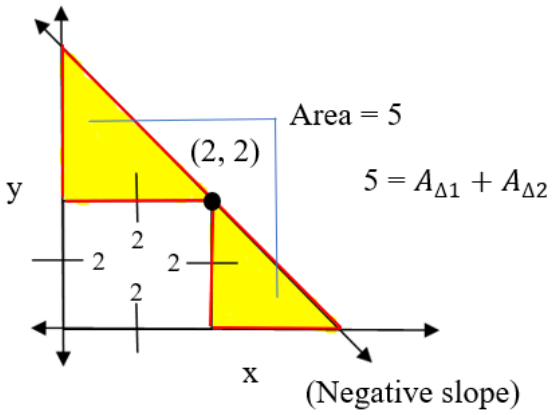
$= \frac{4\pi r^2}{2} - \pi r^2$

$= 2\pi r^2 - \pi r^2$

$= \pi r^2$

Answer: A

51.



Area of the square = 4. Therefore, the area of the shaded region is 5.

(9 – 4)

area of the square

total area

$A_{\Delta 1} + A_{\Delta 2} = 5$

$\frac{bh}{2} + \frac{bh}{2} = 5$

$\frac{2\,(y-2)}{2} + \frac{(x-2)(2)}{2} = 5$

$\frac{2(y-2)}{2} + \frac{(x-2)(2)}{2} = 5$

$(y-2) + (x-2) = 5$

$y + x = 9$

$x + y = 9$

Answer: C

52. P (0, 5), Q (3, 0), and B (-1, -2)

A (0, 5) B (3, 0) C (-1, -2)
Ax, Ay Bx, By Cx, Cy

A_Δ

$$= \left| \frac{Ax(By - Cy) + Bx(Cy - Ay) + Cx(Ay - By)}{2} \right.$$

$$= \left| \frac{0\big(0 - (-2)\big) + 3(-2 - 5) = (-1)(5 - 0)}{2} \right|$$

$$= \left| \frac{3(-7)+(1)(5)}{2} \right|$$

$$= \left| \frac{-21-5}{2} \right| = \frac{26}{2} = 13\ sq.units$$

Answer: A

53. A shaded region = $A_{\square} - A_0 + A_{\square}$

$$= s^2 - \pi r^2 + \frac{d^2}{2}$$

$$= 4^2 - \pi(2)^2 + \frac{4^2}{2}$$
$$= 16 - 4\pi + 8$$
$$= 24 - 4\pi m^2$$

Answer: E

54. A_{figure}= 24 square units
A_{figure}= $A_{\square}$ + A_Δ

$24 = s^2 + \frac{bh}{2}$

Since the choices are arranged from least to greatest, just use TAE (trial and error) and start from the middle value which is C4.

$24 = s^2 + \frac{bh}{2}$
$24 = 4^2 + \frac{4(4)}{2}$ → 2
$24 = 16+8$
$24 = 24$

Since 4 already satisfied the equation, the value of h is 4.

55. Use Ratio and Proportion (RAP)

Let ? be the cost of y mangoes

$\frac{?}{y} = \frac{d}{x}$

$\frac{cost}{\#\ of\ mangoes}$ $? = \frac{dy}{x}$

Answer: A

56. $x > 4$

Use Simple Example (SE)
x = 5

a.) $\frac{4}{x} = \frac{4}{5}$
b.) $\frac{x}{4} = \frac{5}{4}$
c.) $\frac{4}{x-2} = \frac{4}{5-2} = \frac{4}{3}$
d.) $\frac{4}{x+2} = \frac{4}{5+2} = \frac{4}{7}$
e.) $\frac{x+2}{4} = \frac{5+2}{4} = \frac{7}{4}$

Eliminate all the improper fractions because their values are always greater than 1
compare $\frac{4}{5}\ vs.\frac{7}{4}$

The trend in fraction is the greater the denominator, the lesser the value. Therefore, $\frac{4}{7}$ is the least.

Answer: C

57. zeroes of $f(x) = 72x^2 - 9x$

$72x^2 - 9x = 0$
$9x(8x - 1) = 0$
$9x = 0$ $8x - 1 = 0$
$x = 0$ $8x = 1$
$x = \frac{1}{8}$

0 and $\frac{1}{8}$

Answer: C

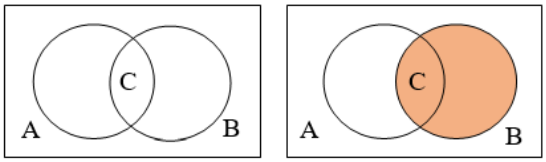
58.

$$\begin{array}{rl} & x + y = 6p \\ + & x - y = 8q \\ \hline & \frac{2x}{2} = \frac{6p+8q}{2} \end{array}$$

$x = 3p + 4q$
$or \quad 4q + 3p$

Answer: D

59. A∩B = C
(A∩C)∪B = ?



(A∩C)∪B = C∪B = B

Answer: B

60. Use Decarte's Rule of Sign

Positive Roots (k is negative)
P(z) =
$-kz^5 - 2z^4 + 3z^3 + 5z^2 - 32 - 8$

x ✓ x ✓ x

# of positive roots: 2 or 0

Negative roots
$P(-z) = -k(-z)^5 - 2(-z)^4 + 3(-z)^3 + 5(-z)^{-2} - 3(-z) - 8$
$= +kz^5 - 2z^4 - 3z^3 + 5z^2 + 3z - 8$

✓ x ✓ x ✓

# of negative roots: 3 or 1

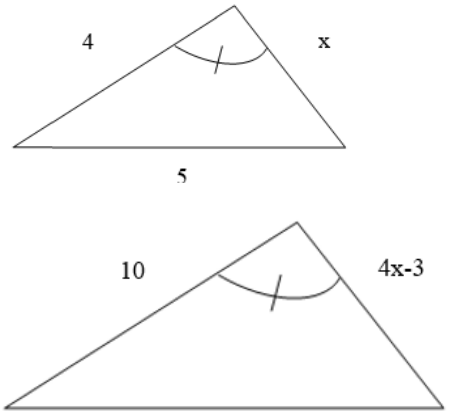
Answer: E

2 or 0 positive roots, 3 or 1 negative roots

61. $f(x) = 7x - 5$
g (x) = 2x + 3
$g\,[f(x)] = 2\,(7x - 5) + 3$
$= 14x - 10 + 3$
$= 14x - 7$

Answer: D

62.



Use Ratio and Proportion (RAP)

$$\frac{x}{4x-3} = \frac{4}{10}$$

$10x = 4(4x - 3)$
$10x = 16x - 12$
$12 = 16x - 10x$
$\frac{12}{6} = \frac{6x}{6}$

$2 = x$

Answer: A

63. $P_{\square} = Co$

Use Simple Example (SE)

$P_{\square} = Co = 4$

$4s = 2\pi r = 4$

$\frac{4s}{4} = \frac{4}{4}$ | $\frac{2\pi r}{2\pi} = \frac{4}{2\pi}$

s = 1 | $r = \frac{2}{\pi}$

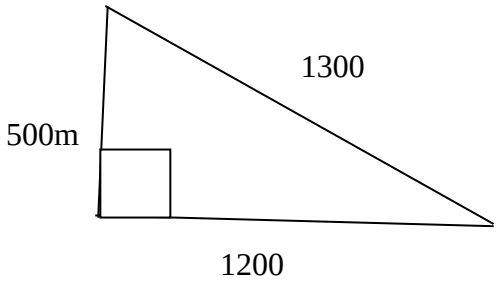
$\left(\frac{4}{\pi^2}\right)$

$\left(\frac{2}{\pi}\right)^2$

A vs. Ao
s^2 πr^2
s = 1 $r = \frac{2}{\pi}$
1^2 $\pi =$
1 $\pi =$
$\frac{4}{\pi}$
1 vs $\frac{4}{\pi}$
$A_{\square} < Ao$

If $P_{\square} = Co$, the area of the circle is always greater than the square.

64.



Use Pythagorean Triple (500, 1200, 1300)

(5, 12, 13)

$\times 100$ $\times 100$

$\times 100$

Answer: D