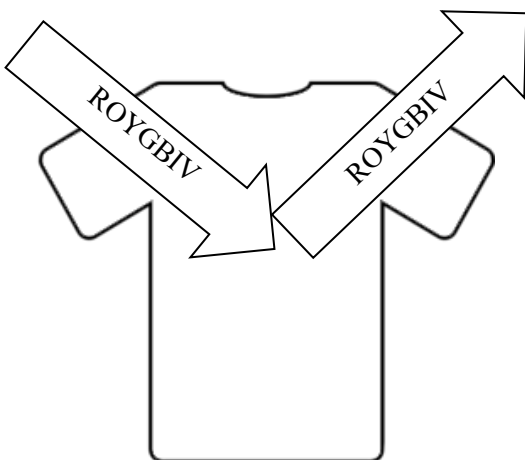
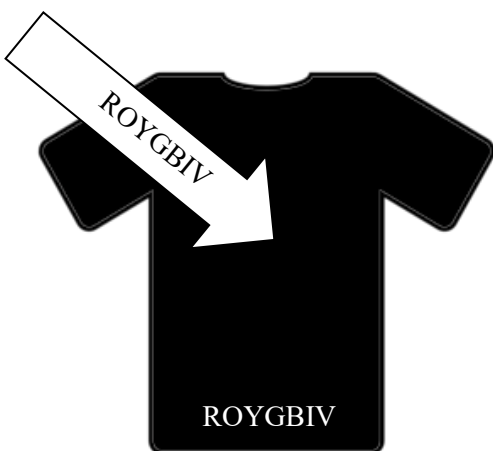


MOCK UPCAT 4: ANSWER KEY WITH EXPLANATIONS

1. **D**



White reflects all colors of light “the presence of all colors”

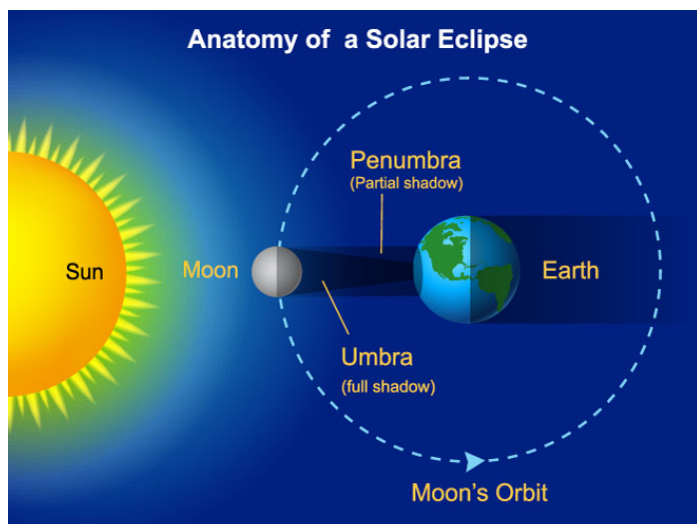


Black absorbs all colors of light “the absence of all colors”



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

2. **B**



Source: <https://cdn.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 ($\cot 0 = \text{undefined} \sim \infty$) and shadows are very long. However, during noon, the sun is directly overhead and angle is about 90° ($\cot 90^\circ = 0$) and shadows are beneath the object. Thus, as time approaches 12 noon, the shadow shortens.

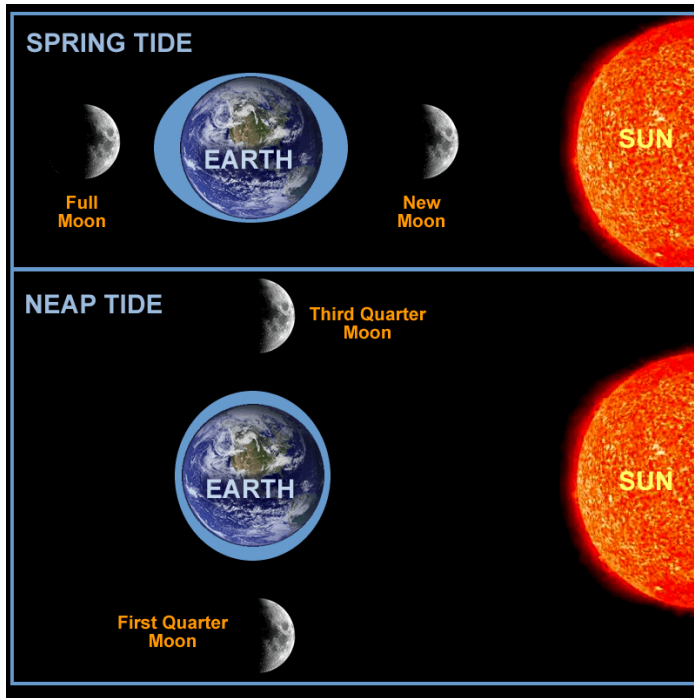
Also, since a shadow appears behind a light obstruction, we can say that its position is on the opposite side of the light source. While the sun rises in the east (morning), shadows point to the west. While the sun sets in the west (afternoon), shadows point to the east.

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

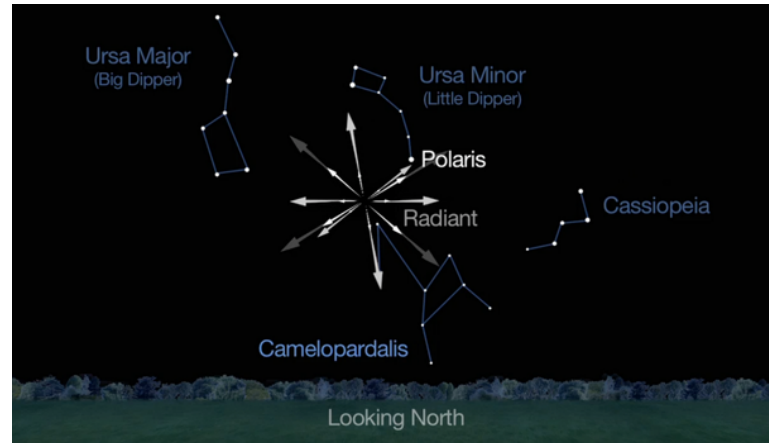


Source: http://www.windows2universe.org/earth/Water/images/tides_lg_gif_image.html&edu=elem

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>

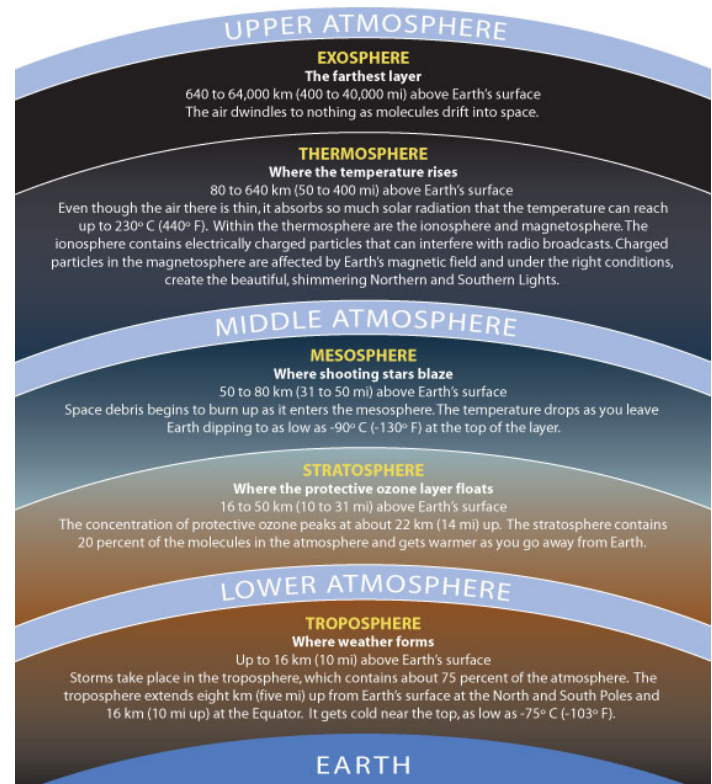
A constellation is a group of stars that, when seen from Earth, form a pattern. The stars in the sky are divided into 88 constellations. There are also asterisms, a group of stars and patterns within a constellation, like the Big Dipper (in Ursa Major), the Little Dipper (in Ursa Minor), Keystone (in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

$$\begin{aligned} 50 &> m; \\ m + m &> 30 + 50; \\ 2m &> 80; \\ m &> 40; \\ 50 &> m > 40; \end{aligned}$$

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.

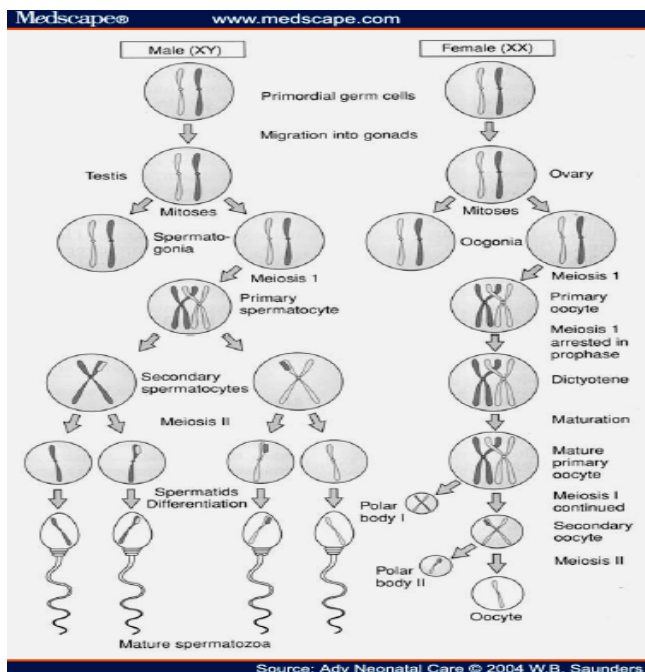
15. **A.**

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



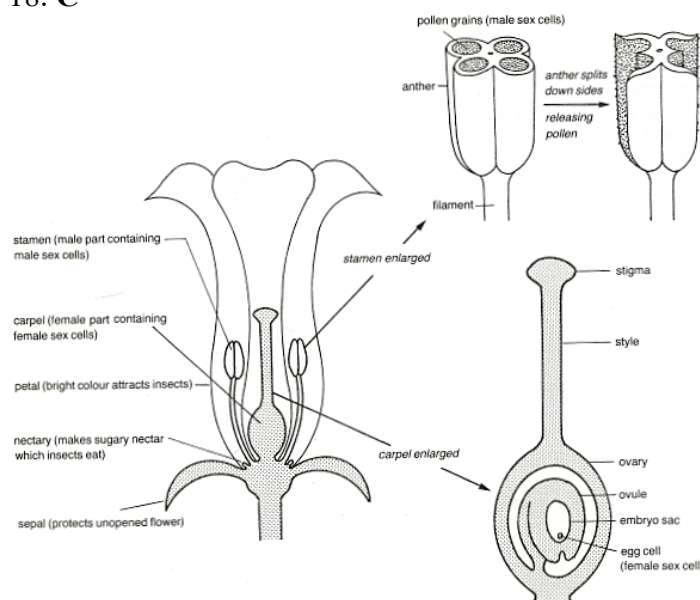
17. B

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 from the father).

As shown in the chart below, a cross between parents with genotypes **BO** and **OO**, will result in 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
<i>Chanos chanos</i>	milk fish (bangus)
<i>Musa squamosa</i>	<i>Musa</i> is the genus that comprise of bananas and plantains.
<i>Pterocarpus indicus</i>	Narra
<i>Livistona rotundifolia</i>	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.

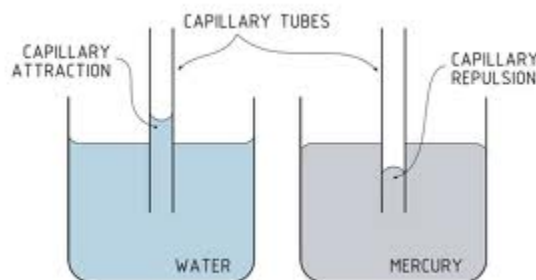
26. A

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

Neutralization Reaction



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

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

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

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

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

$$29 \times 10^{-3}\text{g Mg(OH)}_2 \times \left(\frac{\text{mol Mg(OH)}_2}{58 \text{ g Mg(OH)}_2}\right) \times \left(\frac{2 \text{ mol HCl}}{1 \text{ mol Mg(OH)}_2}\right) \times \left(\frac{36 \text{ g HCl}}{\text{mol HCl}}\right) = 36 \times 10^{-3}\text{g HCl} = 36 \text{ mg HCl}$$

33. D

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

$$\frac{V_1 T_2}{T_1} = \frac{(10 \text{ L})(27+273)}{(2+273)} = 11.90$$

34. D

Ideal Gas Law: $PV = nRT$

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

$$V = \frac{nRT}{P} = \frac{(0.010313821 \text{ M})(8.134 \frac{\text{J}}{\text{mol K}})(596 \text{ K})}{0.5 \text{ atm}} = 100 \text{ L}$$

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.

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

$$x \text{ L} = \frac{(0.350 \text{ M NaOH})(25 \times 10^{-3})}{0.1 \text{ M HCl}} = 87.5 \times 10^{-3} \text{ L} = 87.5 \text{ mL}$$

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 Potential Energy = 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 Work = (Force)(Distance_⊥), 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

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

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

a. If mass is halved

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

b. If mass is doubled

$$M = \frac{1}{2} (2m)(v^2) = mv^2 = 2KE$$

c. If velocity is halved

$$M = \frac{1}{2} (m) \left(\frac{1}{2} v \right)^2 = \frac{1}{8} mv^2 = \frac{1}{4} KE$$

d. If velocity is doubled

$$M = \frac{1}{2} (m)(2v)^2 = 4KE$$

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

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

50. B

Everything falls at a constant acceleration of g (9.8 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. B

$$d = 5 \text{ m}$$

$$a = 10 \text{ m/s}^2$$

$$v_i \text{ at max height} = 0$$

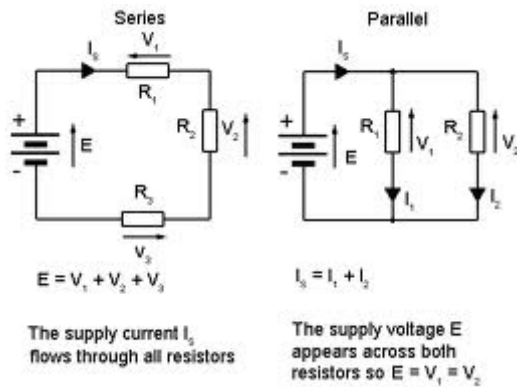
$$v_f^2 = v_i^2 + 2ad$$

$$v_f^2 = 0^2 + 2 \left(10 \text{ m/s}^2 \right) (5.0\text{m}) = 100 \text{ m/s}^2$$

$$\sqrt{v_f^2} = \sqrt{100 \text{ m/s}^2}$$

$$v_f = 10\text{m/s}$$

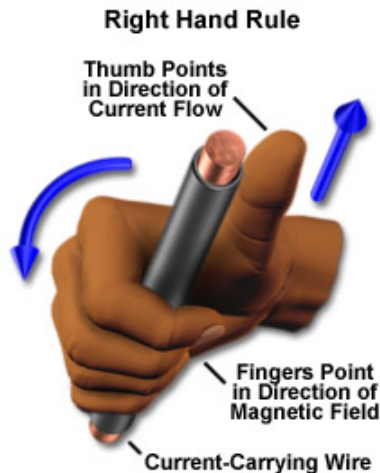
52. B



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

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

56. C

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

$$20\text{m} = (0)(t) + \left(\frac{1}{2}\right)(1.5 \text{ m/s}^2)(t^2)$$

$$20\text{m} = 0.75 t^2$$

$$t^2 = 80/3$$

$$t = 5.164 \text{ seconds} \approx 5 \text{ seconds}$$

57. D

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

58. A

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

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

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

$$t^2 = 1$$

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

59. D

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

60. C

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