MOCK UPCAT 14 (SCIENCE UPDATE): ANSWER KEY WITH EXPLANATIONS

1. **C**

   When two objects are at thermal equilibrium, they are of the same temperature. Therefore, there is no driving force for heat to transfer.

2. **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 organ, especially to the kidney.

3. **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:

$$a = \frac{F}{m}$$

$$a = \frac{50kg\ m/s^2}{5\ kg}$$

$$a = 10\ m/s^2$$

4. **B**
5. **C**
6. **C**
7. **B**
8. **D**
9. **B**
10. **A**
11. **B**
12. **D**
13. **B**
14. **C**
15. **B**
16. **D**
17. **B**
18. **C**
19. **C**
20. **A**
21. **D**
22. **A**
23. **D**
24. **C**
25. **D**
26. **D**
27.

Physics

27. **A.**

When water freezes, the hydrogen form bonds between water molecules. The hydrogen bonds form a pattern called *lattice.* The fixed geometry prevents water molecules from packing close together. Therefore, hydrogen bonds create spaces between molecules.

28. **C.**

Concentration of alcohol 1: 5%
Concentration of alcohol 2: 5%
Assume that each has 1L volume.

The total volume of the solution is 2L and the total concentration is still 5%.

$C_1 \quad V_1 \quad = \quad C_2 \quad V_2$
(5%) (1L) = (5%) (1L)

After adding the same volume of water (2L), the total volume will be 4L

$C_1 \quad V_{1\ (\text{first sol'n})} = \quad C_2 \quad V_{2\ (\text{second sol'n})}$

C_1 = 5% $\qquad$ C_2 = unknown
V_1 = 2L $\qquad$ V_2 = 4L

(5%) (2L) = (C_2) (4L)

C_2 = 2.5%

29. **C.**

Density is a key factor in determining whether a liquid will float or sink.

$\text{Density} = \frac{m}{v}$

Liquid X and Y = 1L

$$\text{Density of liquid x} = \frac{\cancel{10\%}\ of\ 3kg}{\cancel{40\%}\ of\ 1L}$$
$$= \frac{3}{4}\ \frac{kg}{L}$$

Mass of Y: 100% - 10% = 90%

Volume of liquid Y: 100% - 40% = 60%

density of liquid Y $= \frac{^{3}\cancel{90\%\ of\ 3kg}}{^{2}\cancel{60\%\ of\ 1L}}$

$= \frac{9}{2}\ \frac{kg}{L}$

Density of water is 1kg/L.

Liquid Y has the highest density followed by water, and liquid X has the lowest density. The higher the density, the more it will sink, the lower the density, the more it will float and water will stay in the middle.

30. **B.**

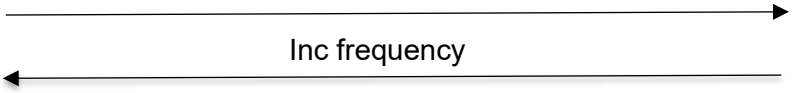
$_{17}C^{1-}$ = 18 electrons
$_{8}O^{2-}$ = 10 electrons
$_{20}Ca^{2+}$ = 18 electrons
$_{31}Ga^{3+}$ = 28 electrons

31. **D.**

Same element but different in mass number.

32. **D.**

Radio microwave infrared visible ultra violet x-ray gamma



Inc frequency

Inc Wavelength

33. **A.**
34. **B.**

Principal (n): 1 to 7
angular momentum (L): 0 to n-1
Magnetic (m_l): - l to +l
Spin (m_s): [illegible]

If n=4, then, l will be from 0 to 3, Therefore, l =2 is possible. If l is 2, then, m_l = -2 to +2, therefore, m_l = -1 is possible, while m_s is either [illegible].

35. **C.**
36. **A.**

Catalyst increases the rate by lowering activation energy.

Temperature affects the kinetic energy of particles, increasing the chance of effective collisions.

Concentration affects the number of reactant particles, thereby increasing or decreasing the role of reaction.

Buffer helps maintain pH in solution. It does not directly affect the rate of a reaction.

37. **B.**

Solids are not part of the equilibrium constant expressions. Concentration of the products are written on the numerator while concentration of reactants will be written on the denominator. The stoichiometric coefficients will be written as exponents of the contained substance.

38. **C.**

In Le Chateliers Principle, if the system experiences stresses, the system will adjust to relieve the stress. If volume decreases, the side of lower moles will be favored.

39. **C.**

In the energy diagram, the product has a higher energy level than the reactants which means the system absorbed energy from the system. This is characteristic of endothermic reaction.

40. **A.**

Alkenes are hydrocarbons with atleast one double bond.

41. **C.**

The hydroxyl group (-OH) is a functional group found in alcohols.

42. **C.**

Isomers have the same molecular formula but different structures.

43. **A.**

Mass of $CaCo_3$ = 10g

Molar mass of $CaCo_3$ = 100g/mole

$$Moles = \frac{Mass}{Molar\ Mass}$$
$$= \frac{10g}{100g/mole}$$
$$= \frac{1}{10}\ mole\ or\ 0.1\ mole$$

44. **B.**

Mass = moles x MM

Mass = 1.5 moles x 100 g/mole

Mass = 150g

45. **C.**

Downstream speed = 30 km / 2 hr = 15km/hr

Upstream speed = 30 km / 3 hr = 10km/hr

Speed in still water $= \frac{(15\frac{km}{hr}+10\frac{km}{hr})}{2}$

$= 12.5\frac{km}{hr}$

46. **B.**

Total resistance of parallel:

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_T} = \frac{1}{2\Omega} + \frac{1}{3\Omega} + \frac{1}{4\Omega}$

$\frac{1}{R_T} = \frac{6+4+3}{12\Omega}$

$\frac{1}{R_T} = \frac{13}{12\Omega}$

$R_T = \frac{12\Omega}{13\Omega}$

47. **C.**

d = 8.45 m $\qquad$ d_2 = 6.05 m

$\frac{a}{g} = 10\frac{m}{s^2}$ $\qquad$ $V_1 = 0\frac{m}{s}$ $(velocity\ at\ the\ \max height)$

$V_f^2 = \cancel{V_f^2} + 2\ ad$

$V_f = \sqrt{2\ ad}$

$V_f = \sqrt{2\ (10\frac{m}{s^2})\ (8.45m)}$

$V_f = \sqrt{169\ \frac{m^2}{s^2}}$

$V_f = 13\frac{m}{s}$

48. **B.**

$V_f = \sqrt{2\ ad}$

$V_f = \sqrt{2\ (10\frac{m}{s^2})\ (6.05m)}$

$V_f = \sqrt{121\ \frac{m^2}{s^2}}$

$V_f = 11\frac{m}{s}$

49. **C.**

$\Delta\alpha\ (change\ in\ acceleration) = \frac{\Delta v}{\Delta t}$

$$= \frac{V_{FINAL} - V_{INITIAL}}{\Delta t}$$
$$= \frac{(11-(-13))}{0.05\ s} \quad * 0.05\ to\ fraction\ is\ \frac{1}{20}$$
$$= \frac{24\ m/s}{\frac{1}{20}s}$$
$$= 480\frac{m}{s^2}$$

50. **A.**

Due to refraction, the fish appears higher than the actual position. In this case, you should aim below the observed position.

51. **B.**

The bulb in circuit X receives the full voltage of the battery.

Circuit I:

The voltage will be divided in the two bulbs in series.
Circuit I is dimmer than Circuit X.

Circuit II:

If each battery has 1V, the total voltage of the three batteries in series is 3V. The two bulbs in series will divide the 3V. Each bulb gets 1.5V. Therefore, the bulbs in circuit II are brighter than Circuit X.

Circuit III:

If each battery has 1V, the total voltage of the two batteries in series is 2V. The three bulbs in series will divide the 2V. Each bulb gets ⅔ V. Therefore, the bulbs in circuit III are dimmer than Circuit X.

Circuit IV:

There is one battery and two bulbs in series. Each bulb receives full voltage just like if it were alone. This circuit glow as bright as circuit X.

Circuit V:

Two batteries are in parallel, so the total voltage will only be 1V. The bulbs in series will divide the voltage. Circuit V is dimmer than circuit X.

52. **C.**

a. $R_{T\ (series)}$ = 2Ω + 2Ω +2Ω

R_T = 6Ω

b. $\frac{1}{R_T}(parallel) = \frac{1}{2\Omega} + \frac{1}{3\Omega} + \frac{1}{4\Omega}$

$$\frac{1}{R_T} = \frac{3}{2\Omega}$$

$$\frac{1}{R_T} = \frac{2}{3\Omega}$$

c. $R_{T\ (series)} = 2\Omega + 2\Omega$

$= 4\Omega$

$$\frac{1}{R_T} = \frac{1}{4\Omega} + \frac{1}{2\Omega}$$

$$\frac{1}{R_T} = \frac{1+2}{4\Omega}$$

$$\frac{1}{R_T} = \frac{3}{4\Omega}$$

$$R_T = \frac{4\Omega}{3}$$

53. **A.**

Q = mC∆T
Q(heat) = unknown
m(mass) = 1L of water is 1kg
C(specific heat) = 4.19 kJ/kg.K
∆T(change in temperature) = 50 - 30 = 20K

Q = (1kg) (4.19 kJ/kg.K) (20K)
Q = 83.8 kJ

54. **D.**

N (number of turns)
V (Voltage)

N_1 = 300 turns N_2 = 600
V_1 = 150 V V_2 = unknown

$$\frac{N_1}{V_1} = \frac{N_2}{V_2}$$

$$V_2 = \frac{N_2\ V_1}{N_1}$$

$$V_2 = \frac{600\ X\ 150\ V}{300}$$

$$V_2 = 300\ V$$

$$V = IR$$

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

$$P = IV$$

$$P = \frac{V}{R} \cdot .V$$
$$P = \frac{V^2}{R}$$
$$P = \frac{(300\ V)^2}{90\Omega}$$
$$P = \frac{90000}{90}$$
$$P = 1000W$$

55. **D.**

T = r . F (sinΘ)

Torque is maximum when Θ=90°, meaning the force is perpendicular to the wrench.

56. **D.**

During constant acceleration, the graph increases linearly. During constant velocity, the velocity stays the same.

57. **B.**

The potential energy (PE = mgh) depends on the height. In a parabola, the maximum height is where the highest PE is.

58. **C.**

In Hooke's Law for elastic materials:
Stress is directly proportional to strain. If you increase stress, strain also increases proportionally.