Eunoia Junior College
8873 H1 Chemistry
2019 Paper 1 Worked Solutions

1 As Z is not deflected, it is uncharged. Hence, Z is a neutron.

Based on the masses of X and Y, X is an electron and Y is a proton.

Note: Masses of sub-atomic particles are given in the Data Booklet.

⇒ **B**

2 Arsenic is in Group 15 and Selenium is in Group 16.

✓ 1 Atomic radius of selenium is smaller than that of arsenic as atomic radii decreases across period.

✓ 2 1st I.E. of selenium is smaller than that of arsenic as 1st I.E. generally decreases across period.

× 3 Both selenium ($4s^2\ 4p^4$) and arsenic ($4s^2\ 4p^3$) have three 4p orbitals containing one or more electrons.

⇒ **A**

3 Electronic configuration of atom with 21 electrons: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

Total number of electrons in the p orbitals = 6 + 6 = 12

⇒ **B**

4

× 1  only has 1 π bond.

✓ 2 N≡N has 1 σ bond and 2 π bonds in the triple bond.

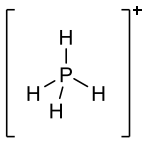
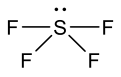
✓ 3 $^{-}$C≡N has 1 σ bond and 2 π bonds in the triple bond.

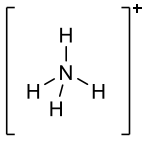
⇒ **C**

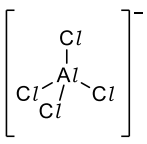
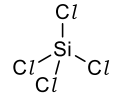
5 There are 4 bond pairs and no lone pair around S. Hence, the shape about S is tetrahedral, and the bond angle is 109.5°.

⇒ **B**

6

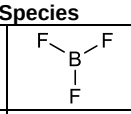
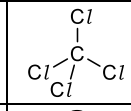
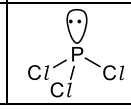
× 1  Tetrahedral  See-saw

✓ 2  Tetrahedral  Tetrahedral

✓ 3  Tetrahedral  Tetrahedral

⇒ **D**

7

Species		Shape	Polarity
BF_3		Trigonal planar	Non-polar
CO_2	O=C=O	Linear	Non-polar
CCl_4		Tetrahedral	Non-polar
PCl_3		Trigonal pyramidal	Polar (due to lone pair)

⇒ **D**

8 Propane is more easily liquefied as it has stronger intermolecular instantaneous dipole-induced dipole (id-id) interactions. The stronger id-id interactions arise due to propane having more electrons, as compared to methane.

Option A is a true statement, but does not explain the phenomenon, although molecular size gives an indication of the strength of the id-id interactions. It is the number of electrons in the molecule that determines the strength of the id-id interactions, not molecular mass/size.

⇒ **C**

9 Intermolecular forces between gaseous oxygen molecules will be greatest when the molecules are closest together.

This occurs at high pressure and low temperature, when the given amount of oxygen molecules occupy the smallest volume.

⇒ **A**

10 R cannot conduct electricity when solid or liquid ⇒ cannot be metallic or ionic

R is a liquid at room temperature ⇒ melting point is below room temperature

R is soluble in water ⇒ cannot be giant molecular

⇒ **D**

11 × A H_2O is acting as an acid as it loses H^+ to form OH^-.

× B This is not an acid-base reaction as there is no transfer of H^+.

× C HCl is acting as an acid as it loses H^+ to OH^- to form H_2O.

✓ D NH_3 is acting as a base as it gains H^+ to form NH_4^+.

⇒ **D**

12 Alkene X undergoes reduction to form Y. Hence, Y is an alkane. With an M_r of 58, Y is C_4H_{10}, and X is C_4H_8.

The product formed when X reacts with liquid bromine (in CCl_4) in the dark is $C_4H_8Br_2$.

M_r of $C_4H_8Br_2$ = 4(12.0) + 8(1.0) + 2(79.9) = **215.8**

⇒ **C**

13 Overall equation:

$$2MnO_4^- + 5SO_2 + 2H_2O \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 4H^+$$

Since there is a net production of H^+ in this reaction, the pH will decrease steadily over time.

⇒ **D**

14 A buffer is formed when there is a mixture comprising a weak acid/base and its conjugate base/acid (salt) in the conical flask.

× A Only weak acid in conical flask

✓ B Mixture of weak acid and conjugate base in conical flask

× C Only salt in conical flask

× D Only salt in conical flask

⇒ **B**

15 × A P is He while Q is Be, which are not in the same group.

× B Q and S are in different periods as they have different number of filled quantum shells. Hence, they cannot be next to each other.

✓ C R and P are both noble gases, and are in Group 18.

× D S and R are in different periods as they have different number of filled quantum shells.

⇒ **C**

16 Since X has the third highest melting point, and the order of melting points of the Period 3 elements is Si > Al > Mg > Na, X is **Mg**.

Y is **Al** as Al_2O_3 does not react with water while P_4O_{10} does.

⇒ **A**

17 The thermal stability of hydrogen halides depends on the strength of the H−X bond. The weaker the H−X bond, the less energy required to break the bond, hence the hydrogen halide is less stable.

⇒ **B**

18 From the options, the compound contains only carbon, hydrogen and oxygen.

	C	H	O
Mass per 100 g/g	60.0	13.3	26.7
Amount/mol	$\frac{60.0}{12.0}$ =5.0	$\frac{13.3}{1.0}$ =13.3	$\frac{26.7}{16.0}$ =1.7
Ratio	$\frac{5.0}{1.7}$ =3	$\frac{13.3}{1.7}$ =8	$\frac{1.7}{1.7}$ =1

Hence, the empirical formula of the compound is **C_3H_8O**.

⇒ **B**

19 $Zn(NO_3)_2 \rightarrow ZnO + 2NO_2 + ½O_2$

When 0.020 mol of $Zn(NO_3)_2$ is fully decomposed, 2.5 × 0.020 = **0.050 mol** of gases are formed.

Total volume of gases formed at r.t.p. = 0.050 × 24 = **1.2 dm³**

⇒ **C**

20 × A Energy is absorbed in endothermic reactions, causing the solution temperature to fall.

× B The reaction is exothermic if the energy absorbed for bond breaking is less than the energy released for bond forming.

× C ΔH should not be negative for endothermic reactions.

✓ D ΔH should be positive for endothermic reactions. The products have a higher energy level (more energy stored in bonds) compared to the reactants.

⇒ **D**

21 P is exothermic while Q is endothermic.

Enthalpy change of formation can be either exothermic or endothermic.

Enthalpy changes of neutralisation and combustion are always exothermic.

⇒ **D**

22 Z is further down Group 1 as compared to lithium. Hence, it is more reactive, resulting to a **faster** reaction.

Z has a larger molar mass as compared to lithium. Hence, 5 g of Z will contain a smaller amount of metal. Since the metal is the limiting reagent in both reactions, the lower amount of Z used will give rise to a **smaller** volume of hydrogen gas evolved.

⇒ **A**

23 Since the breakdown of amoxicillin is a first-order reaction, it has a constant half-life.

$$\frac{1.875}{15.00} = \left(\frac{1}{2}\right)^n$$

$$n = 3$$

Hence, 183 min = 3 half-lives, and each half-life is **61 min**.

$$\frac{2.50}{10.0} = \left(\frac{1}{2}\right)^n$$

$$n = 2$$

Total time required = 2 × 61 = **<u>122 min</u>**

⇒ **C**

24 As K_w increase as temperature increases, the reaction is **endothermic**.

At 50 ºC,

$$\left[H^+\right] = \sqrt{5.48 \times 10^{-14}}$$

$$pH \text{ of neutral water} = -\lg\sqrt{5.48 \times 10^{-14}}$$

$$= 6.63$$

Hence, water with a pH of 7.0 at 50 ºC is **alkaline** (higher pH ⇒ lower $[H^+]$ or higher $[OH^-]$)

⇒ **A**

25 Structure of ethyne: H—C≡C—H

Hence, the distance between the two nuclei of the hydrogen atoms is 0.109 + 0.120 + 0.109 = **<u>0.338 nm</u>**

⇒ **B**

26 Nanoparticles are discrete particles with all three dimension in the size range between 1 to 100 nm.

Hence, only the buckminsterfullerene molecule and the cold virus are nanoparticles.

⇒ **C**

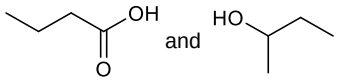
27 Graphene has a giant covalent structure, with each carbon atom bonded to three other carbon atom by strong covalent bonds, giving rise to high tensile strength.

⇒ **A**

28 All three pairs of molecules have the same molecular formula, but different structural formula.

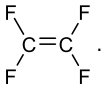
⇒ **A**

29 The ester is formed from:



Note: the alcohol is not 2-methylbutanol as it only has 4 carbon atoms, with the –OH group on the second carbon.

⇒ **A**

30 Each monomer of Teflon is 

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M_r of each monomer
= 2(12.0) + 4(19.0) = **100.0**

Since the M_r of the polymer is approximately 200 000,

Number of monomers joined together
= 200 000 ÷ 100.0 = **<u>2000</u>**

⇒ **C**

<u>Answer Key</u>

Qn	Ans
1	B
2	A
3	B
4	C
5	B
6	D
7	D
8	C
9	A
10	D

Qn	Ans
11	D
12	C
13	D
14	B
15	C
16	A
17	B
18	B
19	C
20	D

Qn	Ans
21	D
22	A
23	C
24	A
25	B
26	C
27	A
28	A
29	A
30	C