A: 8 B: 8
C: 7 D: 7

# 2017 JC2 Prelim H1 CHEMISTRY MCQ Worked Solution

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B | C | A | B | A | D | B | D | D | D | D | B | B | C | A |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| C | A | C | A | B | B | A | C | A | C | D | A | D | B | C |

**1 Answer: B**

Since $Ba(NO_3)_2 \equiv N_2$, $M_r$ of $Ba(NO_3)_2$ = 261.3
No. of moles of $N_2$ = No. of moles of $Ba(NO_3)_2$ = $\frac{1}{261.3}$ = $3.83 \times 10^{-3}$ mol
Volume of $N_2$ = $3.83 \times 10^{-3} \times 24000$ = 91.8 $cm^3$

**2 Answer: C**

Definition – Relative molecular mass is the average mass of one molecule of an element or compound on a scale on which one atom of the $^{12}C$ isotope of carbon has a mass of 12 units.

**A** is incorrect. Relative molecular mass is a ratio.
**B** is incorrect. It should be the ratio of the average mass of a molecule to 1/12 the mass of a $^{12}C$ atom.
**C** is correct.
**D** is incorrect. It is the mass of one mole of molecules on a scale where one mole of $^{12}C$ atoms has a mass of 12 units.

**3 Answer: A**

$NH_3 + H_2O \rightarrow NO + 5H^+ + 5e$ x4
$4e + 4H^+ + O_2 \rightarrow 2H_2O$ x5
$4NH_3 + 4H_2O + 5O_2 \rightarrow 4NO + 10H_2O$
$4NH_3 + + 5O_2 \rightarrow 4NO + 6H_2O$

**4 Answer: B**

Positively charged particles deflected towards negative electrode

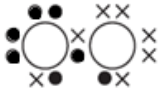
Angle of deflection α $\frac{Charge}{Mass}$

$$\frac{20}{Angle\ of\ deflection\ of\ He^{2+}} = \frac{\frac{+1}{1}}{\frac{+2}{4}}$$

Angle of deflection $He^{2+}$ = +10

**5 Answer: A**

**A**. Disproportionation (self-redox) reaction.
Oxidation state of O changes from -1 in $MO_2$ to -2 in MO and 0 in $O_2$,
**B**. $O_2^{2-}$ contains 8+8+2 = 18e
**C**. lattice energy ∝ $(q+q^-/r^+ + r^-)$ In this case, only $r^-$ is different. Since peroxide ion, $O_2^{2-}$ is bigger than oxide ion, $O^{2-}$ the lattice energy of $MO_2$ is smaller than MO.
**D**: The dot-and-cross diagram of the anion should be



**6 Answer: D**

**A**: Ethene is a planar molecule which has all atoms on the plane

**B**: Tri-iodide has 3 lone pairs and 2 bond pairs, hence the ion is linear and all atoms lie on the same plane

**C**: $XeF_4$ has 4 bond pairs and 2 lone pairs, hence shape is square planar and all atoms lie on the same plane

**D**: $BeCl_4^{2-}$ has a total of 4 bond pairs (2 covalent bonds and 2 dative bonds) around Be atom. The shape is tetrahedral.

**7 Answer: B**

**A**: HF has hydrogen bonding between its molecules and hence require a larger energy to overcome compared to pd-pd between HI molecules.

**B**: MgO has a higher boiling point. MgO has a higher lattice energy than NaCl due to larger charge and smaller ionic radii of $Mg^{2+}$ and $O^{2-}$ ion compared to $Na^+$ and $Cl^-$.

**C**: $SiH_4$ has a higher boiling point as its $M_r$ is larger than $CCl_4$ and thus the id-id interactions are stronger and more extensive than $CH_4$.

**D**: *trans*-$C_2H_2Cl_2$ has a lower boiling point as it has no net dipole moment so the molecule is non-polar and only has id-id interactions between the molecules. *cis*-$C_2H_2Cl_2$ has pd-pd interaction between the molecules and more energy is needed to overcome the stronger pd-pd interactions.

**8 Answer D**

Dipoles are present due to the difference in electronegativity between oxygen and hydrogen atoms. There are is a net dipole hence water is polar.

**9 Answer: D**

**A & C**: Wrong as the concentration of manganate would decrease slowly at the start of the reaction before decreasing more quickly as more $Mn^{2+}$ catalyst is generated.

**B**: Wrong as the volume of $CO_2$ cannot be increasing rapidly at the start of the reaction due to slow rate of reaction.

**10 Answer D**

Rate constant is affected by temperature and catalyst.

Rate = k[reactant]

Catalyst increases the rate when concentration is constant hence catalyst increases rate constant.

Energy profile will show NO CHANGE in the ΔH however will lower the $E_a$ of the graph.

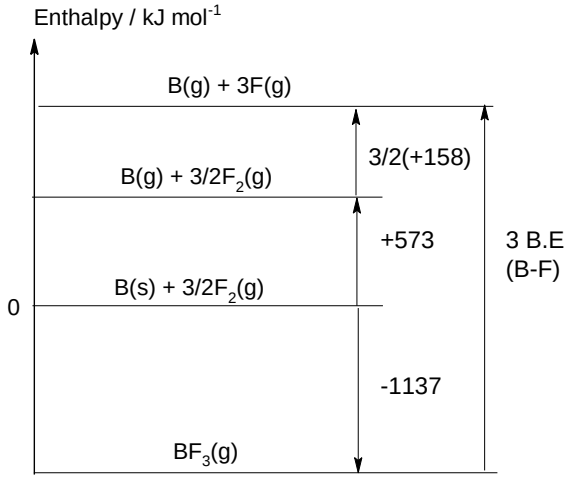
**11 Answer: D**

When temperature increases, Z will drop below the original point.

When concentration increases, the number of molecules with higher energy increases. The total number of molecules will also increase. Thus, the fraction of molecules remained unchanged.

**As the y-axis is the fraction of molecules**, shape of the graph is independent of concentration changes.

**12 Answer: B**




By Hess' Law,

-1137 + 3 B.E (B-F) = +573 + 3/2 (+158)
B.E (B-F) = +649 kJ $mol^{-1}$

**13 Answer B**

Heat released when pentene is burnt
= 200 x 4.18 x 26.4
= 22070 J

$M_r$ of pentene = 5(12) + 10(10) = 70

No. of moles of pentene = 0.47/70 = 0.00671 mol

Enthalpy change of combustion = 22070/00671
= -3290 kJ $mol^{-1}$

Possible errors
**A**: did not divide by number of moles
**C**: Added mass of hydrocarbon in mass
**D**: $M_r$ of pentene is 72

**14 Answer: C**

When the change was introduced, only the concentration of oxygen increased. This implies that oxygen was added. By Le Chatelier's Principle, the position of equilibrium will shift to the right resulting in an increase in concentration of $SO_3$ and decrease in concentration of $SO_2$.

If temperature was increased, there will not be any change in concentration of oxygen.

**15 Answer A**

A buffer must contain the weak acid and its conjugate base (or weak base and its conjugate acid)
**A**:Weak Acid ($HCO_3^-$) + Conjugate base ($CO_3^{2-}$) → Buffer
**B**: Strong Acid + Salt → Not a Buffer
**C**: Strong base + Salt → Not a Buffer
**D**: Weak Acid + Ester → Not a Buffer

**16 Answer C**

Option **A** implies **Y** can be Na, Mg, A*l*, Si, P or S.
Option **B** implies **Y** can be Na, Mg, A*l* or Si.
Option **C** implies **Y** can be P or S.
Option **D** implies **Y** must be Mg.

**17 Answer A**

**B**: electrical conductivity increase across the metals befor dropping to zero for the non metals.
**C**: melting point increase from sodium to silicon before dropping.
**D**: 1st IE generally increase across the period.

**18 Answer: C**

Enthalpy change of combustion is exothermic thus values are negative. The homologous series defer by a $CH_2$ hence enthalpy change varies linearly.

*Reference table of values for alcohols.*

| name | alcohol | $\Delta H_{comb}$ |
|---|---|---|
| methanol | $CH_3OH$ | –726 |
| ethanol | $CH_3CH_2OH$ | –1367 |
| propan–1–ol | $CH_3(CH_2)_2OH$ | –2021 |
| butan–1–ol | $CH_3(CH_2)_3OH$ | –2676 |
| pentan–1–ol | $CH_3(CH_2)_4OH$ | –3329 |
| hexan–1–ol | $CH_3(CH_2)_5OH$ | –3984 |
| heptan–1–ol | $CH_3(CH_2)_6OH$ | –4638 |
| octan–1–ol | $CH_3(CH_2)_7OH$ | –5294 |

**19 Answer A**

**B** has an $M_r$ of 98.
**C** will react with 2 HBr to give a compound with $M_r$ = 243.8.
**D** does not react with HBr.

**20 Answer: B**

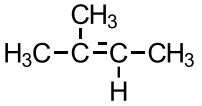
Nucleophilic addition reaction of the C=O.

**21 Answer; B**

**A**: a σ bond formed by $sp^2 – sp^2$ overlap between C3 and C4
**C**: a σ bond formed by $sp – sp^2$ overlap between C5 and C6
**D**: a π bond formed by p – p overlap between C2 and C3

**22 Answer: A**

Elimination of HBr results in 2 alkenes,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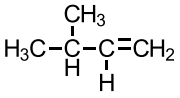

**23 Answer C**

In presence of u.v light, the C-C*l* bond cleaves homolytically to produce Cl radical which can damage the ozone layer through a chain reaction. C-H and C-F bonds are stronger and will not break under u.v. light.

**24 Answer A**

2 –OH groups in 1 mol of EMB react with Na to give 1 mol of $H_2$ gas.

2 R-OH + 2Na → 2 $RO^-Na^+$ + $H_2$

**25 Answer C**

**A**: Orange dichromate turns green for methyl methacrylate as ester bond cleave and the primary alcohol part of the ester gets oxidised. Orange dichromate remains orange for benzophenone.

**B**: orange ppt formed for benzophenone and no orange ppt formed for methyl methacrylate.

**C**: Tollen's reagent is negative for both compounds as both compounds do not have an aldehyde functional group.

**D**: reddish-brown bromine water decolourise for methyl methacrylate due to C=C. Reddish brown bromine remain for benzophenone.

**26 Answer: D (1 only)**

**1** is correct as $H_2S$ (oxidation state of sulfur is -2) is oxidized to S (oxidation state 0).
**2** is incorrect as $SO_2$ is an oxidizing agent and oxidises $H_2S$ in reaction.
**3** is incorrect as reaction II is a comproportionation reaction.

**27 Answer A (1, 2, 3)**

All three have solid lattice structure.

**28 Answer D (1 only)**

Option **1** – cation has more protons mean nuclear charge larger hence the ion is smaller in size.
Option **2** – the shielding is the same since both have the same number of quantum shells
Option **3** – does not explain the size of ions.

**29 Answer: B (1 and 2 only)**

Compound **Y** has 2 C=C, 1 COOH and 1 ketone functional group. Every functional group in Compound **Y** that gets reduced would have 2 H-atoms incorporated per molecule of Compound **Y**.

| | Reducing agent | No. of hydrogen atoms incorporated per molecule of Compound **Y** | Functional group reduced |
|---|---|---|---|
| **1** | $NaBH_4$ in ethanol | 2 | 1 ketone group |
| **2** | $H_2$ / Ni | 6 | 2C=C + 1 ketone |
| **3** | $LiA/H_4$ in dry ether | **4** | 1 ketone and 1 – COOH group |

**30 Answer C (2 and 3)**

**1** is correct. Ketone will form orange crystals with Brady's reagent (2,4 DNPH).

**2** is wrong. C=C in a ring cannot exhibit cis-trans isomerism.

**3** is wrong. Compound Z contains tertiary alcohol which cannot be oxidised hence it does not turn potassium dichromate orange to green.