2025 TJC H1 Chemistry Prelim Paper 1 Worked Solutions

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

1 Answer: **B**

Al : $1s^2 2s^2 2p^6 3s^2 3p^1$ Al^{3+} : $1s^2 2s^2 2p^6$

Ca : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ Ca^{2+} : $1s^2 2s^2 2p^6 3s^2 3p^6$

Cu : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$
Cu^{2+} : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$

S : $1s^2 2s^2 2p^6 3s^2 3p^4$ S^{2-} : $1s^2 2s^2 2p^6 3s^2 3p^6$

Only options A, B and D have noble gas configuration.

Only options A and B have more protons than electrons

Option A involves removing electron from 3p and 3s orbitals

2 Answer: **A**

Angle of deflection α charge/mass

Option A : 2/4 = 0.5

Option B : 1/19 = 0.05

Option C : 1/28 = 0.036

Option D : 2/32 = 0.06

3 Answer: **C**

Cu: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10} 4s^1$

Mn: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$

Fe: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$

Fe^{2+}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$

4 Answer: **B**

Option A : Water molecules are attracted to other water molecules via hydrogen bonding resulting in a regular three dimensional tetrahedral structure. The arrangement of water molecules in ice create an 'open cage' structure resulting in ice to be less dense than water.

Option B : Both compounds have hydrogen bonding between molecules. However, volatility depends on the electron cloud size (inferred from M_r) which affects the strength of id-id.

Option C : 2-nitrophenol can form intramolecular hydrogen bonding giving rise to less extensive H bonding between molecules and lower melting point.

Option D : Ethanoic acid can dimerise in benzene by forming two hydrogen bonds between two acid molecules. The apparent M_r (120.0) is double than of its actual M_r (60.0).

5 Answer: **A**

A	Sr: giant metallic structure	Al_2O_3: giant ionic lattice structure	I_2: simple molecular structure
B	Be: giant metallic structure	Al_2Cl_6: simple molecular structure	SO_3: simple molecular structure
C	Al: giant metallic structure	C: giant molecular structure	SiO_2: giant molecular structure
D	Ni : giant metallic structure	PCl_3: simple molecular structure	$SiCl_4$: simple molecular structure

6 Answer: **B**

A simple molecular solid should have a lower melting point (due to weak intermolecular forces) and does not conduct electricity (due to lack of mobile charge carriers – ions or free electrons). It may be soluble or insoluble in water depending on the type of intermolecular forces that it can form with water.

Since the unknown compound is a solid at room temperature, the answer cannot be A due to the melting point.

7

Answer: **B**

Option 1 has a dative bond from O to C while option 3 has a dative bond from C*l* to A*l*.

Option 2 has no dative bond present.

8

Answer: **C**

At standard temperature and pressure, graphite is thermodynamically more stable than diamond. However, the conversion from diamond to graphite, has a very high activation energy and therefore, takes place at an extremely slow rate.

9

Answer: **A**

$C_xH_y + (x+y/4)\ O_2 \rightarrow x\ CO_2 + (y/2)\ H_2O$

10	excess	0	0
0		40	

H_2O is a liquid at room temperature, hence does not contribute to gaseous volume.

CO_2 in the residual gas is acidic and is absorbed by KOH.

$x = 40/10$

$\Rightarrow\ x = 4$

Volume of unreacted $O_2 = 80 - 40\ cm^3 = 40\ cm^3$

Volume of reacted $O_2 = 100 - 40\ cm^3 = 60\ cm^3$

$x + y/4 = 60/10$

$4 + y/4 = 6$

$y = 8$

10

Answer: **D**

A: 17 + 4(8) + 1 = 50 e

B: 2 + 16 + 4(8) = 50 e

C: 16 + 4(8) + 2 = 50 e

D: 50 – 2 = 48 e

11

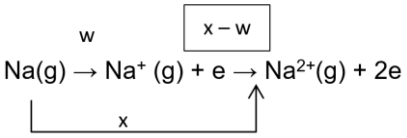
Answer: **B**

During thermal decomposition, heat is absorbed to the reaction, so the reaction is endothermic (option A or B).

The activation energy is twice that of the enthalpy change, so option A is incorrect.

12

Answer: **B**



13

Answer: **C**

Y: standard enthalpy change of combustion is always negative

Z: standard enthalpy change of combustion of C and H_2 are negative

X: by Hess' Law, X = –890 – (–964) = +74

14

Answer: **D**

1: correct as there will be more molecules with energy greater than or equals to E_a.

2: incorrect as E_a is only affected by presence of catalyst.

3: incorrect as total number of molecules remain the same when temperature changes.

15

Answer: **D**

Rate = k[**W**][**X**]^2

Using run 1 data, $0.0064 = k(0.02)(0.015)^2$,

k = 1420

16

Answer: **D**

A is incorrect

Rate = k[Br_2][HCOOH]

k = Rate / [Br_2][HCOOH]

For units: mol dm^{-3} s^{-1}/(mol dm^{-3})^2 = mol^{-1} dm^3 s^{-1}

B is incorrect. For overall second order reaction, half-life is not constant.

C is incorrect as the mole ratio of $1Br_2 \equiv 2H^+$, so rate of formation of H^+ should be twice that of disappearance of Br_2.

D is correct.

Rate = k[Br_2][HCCOH]

ate doubles when concentration of methanoic acid doubles so the rate of product formed will also be doubled.

17

Answer: **D**

Options D: By Le Chatelier's principle, when the experiment is conducted at a lower temperature, the position of equilibrium will shift to the right to release heat as forward reaction is exothermic (mole fraction of $I_2(g)$ should be lower).

Option A: Incorrect as catalyst only speeds up the reaction (equilibrium reached in shorter time), there should not be changes in composition (mole fraction of $I_2(g)$ should remain the same).

Option B: Incorrect as the mole fraction of $I_2(g)$ at time = 0 is the same (0.5) as the first experiment.

Option C: Incorrect as change in pressure does not affect the equilibrium position.

18

Answer: **A**

Down the group, atomic radius increases and I.E. decreases

$\Rightarrow$ attraction of the nucleus for the valence electrons decreases

$\Rightarrow$ electrons can be removed more easily through ionisation (i.e. more readily oxidised)

$\Rightarrow$ reducing power increases

19

Answer: **A**

Options C and D: Incorrect as first IE of X is greater than that of Y, X should be above Y in the Periodic Table.

Option B: Incorrect. Since phosphorus has simple molecular structure, the melting point of P is lesser than aluminium which has giant metallic structure.

20

Answer: **B**

Down the group, oxidising power of the halogens decreases

$\Rightarrow$ halogens are less easily reduced

$\Rightarrow$ halides are more easily oxidised

Option A: Incorrect. Chloride ion is less readily oxidised and thus chloride ions are weaker reducing agent.

Option B: Correct. Bromine is less reactive than chlorine and less easily reduced. It is unable to displace chloride. Only the more reactive halogen can displace the less reactive halogen from its aqueous halide ions.

Option C: Incorrect. Down the group, size of electron cloud for the halogens increases, more energy required to overcome the stronger id-id attractions and boiling point increases. Thus volatility of halogens decreases down the group.

Option D: Incorrect. Down the group, the H-X bond energy decreases. Thermal stability of HX decreases down the group.

21

Answer: **C**

No of moles of excess NaOH = 0.0040 – 0.0025 = 0.0015 mol

$[NaOH] = 0.0015/2 = 7.5 \times 10^{-4}$ mol dm^{-3}

$pOH = -\lg(7.5 \times 10^{-4}) = 3.13$

$pH = 14 - 3.13 = 10.88$ (10.9)

22

Answer: **A**

$$H_2O \rightleftharpoons H^+ + OH^-$$

When temperature increases, by Le Chatelier's Principle, position of equilibrium shifts towards endothermic reaction to absorb heat. Since K_w increases with temperature, $[H^+]$ and $[OH^-]$ increase implying that forward reaction is favoured. Therefore, forward reaction (dissociation of water) is endothermic. (Statement 1 is correct)

At 62 °C, $K_w = [H^+][OH^-] = 10^{-13}$ mol^2 dm^{-6}

$[H^+] = [OH^-] = 3.16 \times 10^{-7}$ mol dm^{-3} (Statement 3 is incorrect, water remains neutral)

$pH = -\log [H^+] = 6.5$ (Statement 2 is correct)

23

Answer: **D**

All three compounds are non-polar in nature, and they are constitutional isomers with the same M_r.

The difference in their boiling points is not dependent on the size of electron cloud which is based on M_r.

From the data, increased branching reduces the boiling point.

The polarity of the alkane does not change due to branching.

In fact, increased branching reduces the surface area of contact hence reducing the strength of intermolecular id-id attractions and thereby reducing the boiling point.

24

Answer: **C**

The reaction involves breaking of C–X bond to release free X^- ions which can then combine with Ag^+ ions to form a precipitate of AgX.

The rate of reaction depends on the strength of C–X bond.

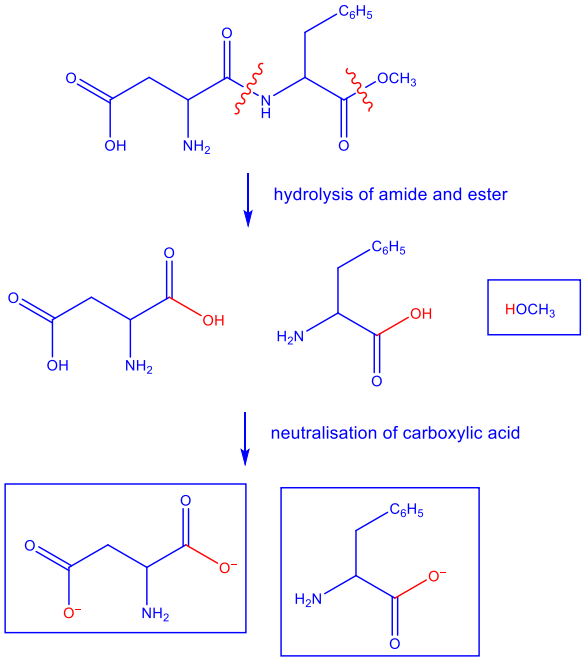
The time taken to observe precipitate for compound 1, 2 and 3 depends on strength of C–Cl, C–Br and C–I respectively and independent of C–F bond.

Since C–I bond is the weakest of the three bonds, it is the easiest to break and will take the shortest time for the formation of precipitate.

Since C– Cl bond is the strongest of the three bonds, it is the hardest to break and will take the longest time for the formation of precipitate.

25 Answer: **B**

The amide and ester functional groups will undergo base hydrolysis in which the C–N and C–O bonds are broken respectively. The carboxylic acid groups formed will undergo neutralisation to form carboxylate ions.

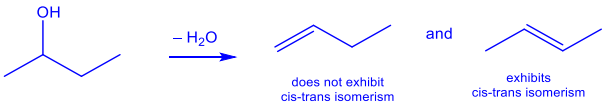


26 Answer: **A**

Butan-1-ol and butan-2-ol are primary and secondary alcohol respectively.

Carboxylic acid and aldehyde can be used to prepare butan-1-ol via reduction using LiA/H_4. Therefore, W is either an aldehyde or carboxylic acid

Butan-2-ol undergoes dehydration to form two possible alkenes.



27 Answer: **D**

1. Civetone contains alkene and ketone functional groups. It does not contain ester functional group.

2. The alkene functional group can react with Br_2 via addition reaction. However, the molecular formula of the product should be $C_{17}H_{30}OBr_2$ not $C_{17}H_{32}OBr_2$ as only Br atoms are added across the C=C bond and there should be no change in number of H atoms.

3. Civetone does not exhibit intermolecular hydrogen bonding since there are no H atoms directly bonded to F, O or N atoms in the molecule.

The dominant type of intermolecular forces should be permanent dipole-permanent dipole attractions.

Statement 3 is correct.

Note: the presence of O atom in civetone can still allow it to form hydrogen bonding with other types of molecules.

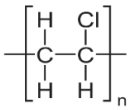
28 Answer: **C**

Platinum nanoparticles have large surface area to volume ratio that improve their efficiency as catalyst.

A single individual nanoparticle with a smaller diameter (smaller size) has smaller absolute surface area (even though the surface area to volume ratio is higher) and hence contain fewer active sites on that single particle. For bulk amount of nanoparticles of the same mass, particles with smaller diameter will have a larger combined surface area and more active sites.

Platinum nanoparticles act as heterogeneous catalyst, allowing reactant molecules to be adsorbed onto the surface. The platinum does not react with carbon monoxide.

29 Answer: **D**

Structure of PVC: 

Option 1: Correct as both LDPE and PVC are formed from addition polymerisation with no loss of atoms.

Option 2: Incorrect. Both polymer chains of LDPE and PVC are unable to form hydrogen bonds with water molecules. Hence both polymers are water resistant.

Option 3: Incorrect. Both PVC and LDPE are thermoplastics as there are no cross links between their polymer chains.

30 Answer: **C**

Option A: Incorect. The two monomers are $HOOC(CH_2)_4COOH$ and $H_2N(CH_2)_6NH_2$.

Option B: Incorrect. Polyamides are more prone to creasing and wrinkling than polyesters such as PET.

Option C: Correct. DCC can be used in the condensation polymerisation of the carboxylic acid and amine functional groups to make the polymer.

Option D: Incorrect. The amide group in the polymer chain will undergo alkaline hydrolysis and hence a container for storing alkaline cleaning solutions cannot be made of this polymer.