NAME ______________________ CLASS **23S**

JURONG PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2024

CHEMISTRY **9729/01**

Higher 2 **16 September 2024**

Paper 1 Multiple Choice Questions **1 hour**

Candidates answer on the Question paper.

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **12** printed pages.

1 Which statement about relative atomic mass is correct?

A It is the average of the masses of all the isotopes of that element.

B It is the sum of the relative masses of the neutrons and protons in each atom.

C It is the ratio of the average mass of one atom of an element to the mass of one ^{1}H atom.

D It is the ratio of the mass of one mole of atoms of an element to one-twelfth the mass of one mole of ^{12}C atoms.

2 The ionisation energies, IE, in kJ mol^{-1}, of five elements are given in the table.

element	2^{nd} ionisation energy / kJ mol^{-1}	3^{rd} ionisation energy / kJ mol^{-1}	4^{th} ionisation energy / kJ mol^{-1}
F	3370	6040	8410
Ne	3950	6150	9290
Na	4560	6940	9540
Mg	1450	7740	10500
A*l*	1820	2740	11600

Which statement about these ionisation energies is correct?

A The 2^{nd} IE of F is greater than the 3^{rd} IE of A*l* because Al^{2+} ions have more outer shell electrons than F^{+} ions.

B The 3^{rd} IE of all the elements in the table involves the removal of an electron from the same shell.

C The 4^{th} ionisation energy of Na is greater than the 3^{rd} IE of Ne because the nuclear charge of Na is greater than that of Ne.

D The successive ionisation energies of these elements increase as these electrons are being taken from the same shell.

3 Why is the molecule of BCl_3 planar, whereas the molecule of PH_3 is pyramidal?

A The boron atom has no d-orbitals available for bonding.

B The covalent radius of chlorine is greater than that of hydrogen.

C The repulsion between chlorine atoms is greater than that between hydrogen atoms.

D The boron atom in BCl_3 has six electrons in its valence shell, whereas the phosphorus atom in PH_3 has eight.

4 After an oil spillage at sea, a liquid hydrocarbon layer floats on the surface of the water. Which statements help to explain this observation?

1 Hydrocarbon molecules are not solvated by water.

2 There are only instantaneous dipole–induced dipole interactions between hydrocarbon molecules.

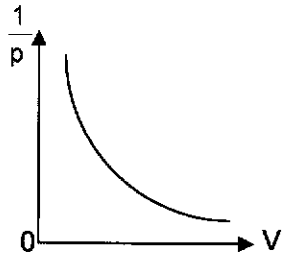
3 Hydrogen bonding between water molecules causes water molecules to be packed closely together.

A 2 only **B** 1 and 2 only

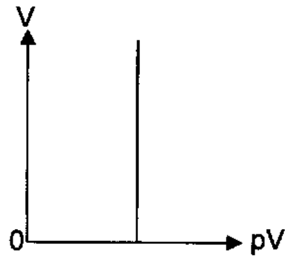
C 2 and 3 only **D** 1, 2 and 3

5 Which diagram correctly describes the behavior of a fixed mass of an ideal gas at constant T (measure in K)?

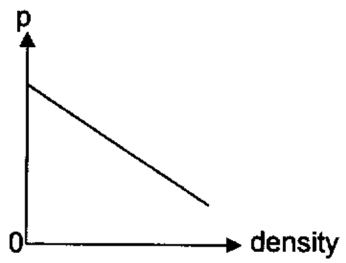
A



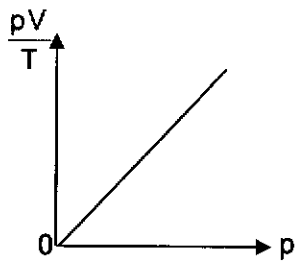
B



C



D



6 A mixture of the three gases, oxygen, nitrogen and argon, is at a total pressure of 500 kPa. There is a total of 1.2 moles of gases in the mixture.

If the oxygen gas alone occupied the entire volume of the mixture, it would exert a pressure of 150 kPa.

At room conditions, the amount of nitrogen gas in the mixture would occupy a volume of 5.76 dm^3.

Using the data from above, what is the partial pressure of the argon gas in the mixture?

A 150 kPa **B** 200 kPa

C 250 kPa **D** 300 kPa

7 When aqueous ammonia is added to a solution containing hexaaquairon(III) ions, $[Fe(H_2O)_6]^{3+}$, a red-brown precipitate is formed which does not dissolve when excess ammonia is added.

Which of the following states the role of ammonia in this reaction?

1 Brønsted-Lowry base
2 Ligand
3 Lewis acid
4 Reducing agent

A 1 only
B 4 only
C 1 and 2 only
D 2 and 3 only

8 *Use of the Data Booklet is relevant to this question.*

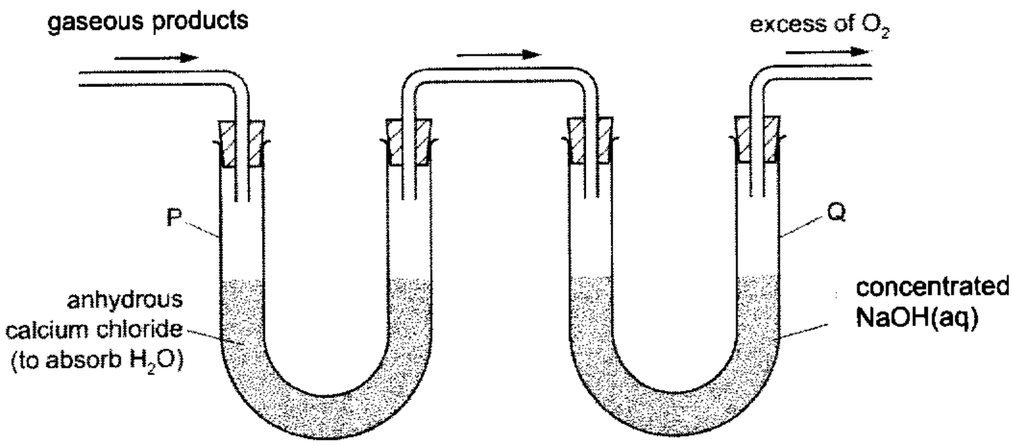
An element **M** can exist in a few oxidation states.

15.00 cm³ of an aqueous solution of 0.100 mol dm⁻³ of $\mathbf{M}^{n+}$ required 20.00 cm³ of 0.0250 mol dm^{-3} of acidified $K_2Cr_2O_7$ solution for a complete reaction.

What is the change in oxidation state of **M**?

A 2 **B** 3 **C** 4 **D** 5

9 A sample of the hydrocarbon C_6H_{12} is completely burned in excess dry oxygen and the gaseous products collected as shown.



The increases in mass of the collecting vessels P and Q are M_P and M_Q respectively.
What is the ratio of M_P / M_Q?

A 0.41 **B** 0.82 **C** 1.2 **D** 2.4

10 *Use of the Data Booklet is relevant to this question.*

A butane burner is used to heat water. The M_r of butane is 58.

- ΔH_c of butane is –2877 kJ mol^{-1}.
- 250 g of water is heated from 12 °C to 100 °C.
- The burner transfers 47% of the heat released from the burning fuel to the water.

Assume that the butane undergoes complete combustion and none of the water evaporates. What is the minimum mass of butane that must be burnt?

A 0.071 g **B** 1.85 g **C** 3.94 g **D** 4.48 g

11 Hydrogen can be made from steam.

$$H_2O(g) + C(s) \rightarrow H_2(g) + CO(g)$$

The Gibbs free energy change of reaction at two different temperatures are shown.

$$\Delta G_1 = +78 \text{ kJ mol}^{-1} \text{ at } 378\text{K}$$
$$\Delta G_2 = -58 \text{ kJ mol}^{-1} \text{ at } 1300\text{K}$$

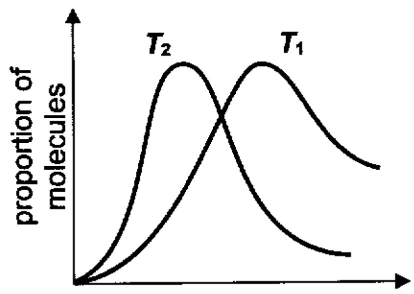
Which row of the table gives the correct signs of ΔH and ΔS for this reaction?

	ΔH	ΔS
A	–	–
B	–	+
C	+	–
D	+	+

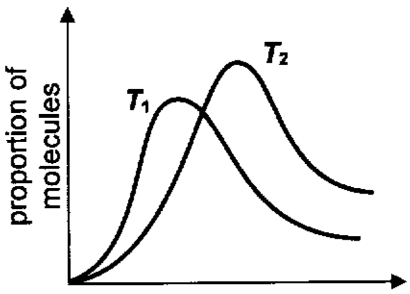
12 One mol of neon gas at temperature T_1 was added to another one mol of neon and the temperature was increased to T_2.

Which of the following diagrams correctly represents the Boltzmann distribution of molecular speeds before and after the changes were made?

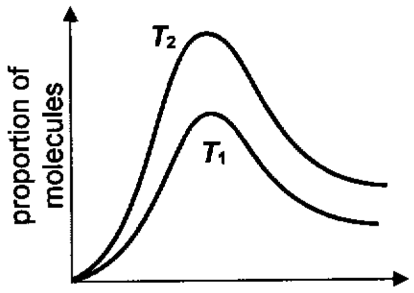
A



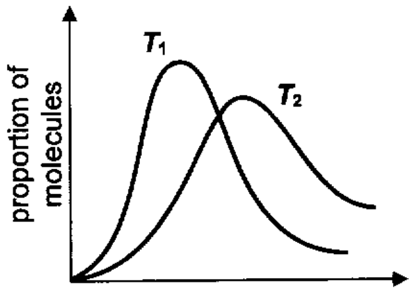
B



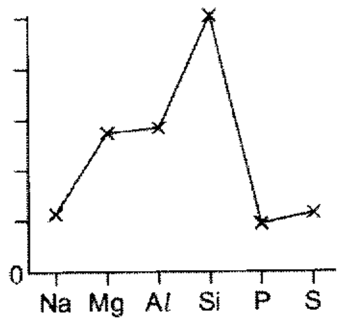
C



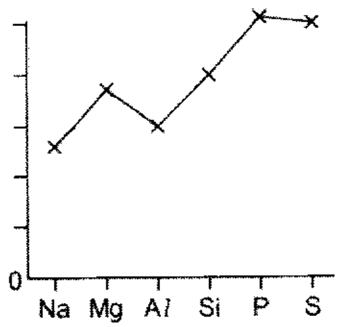
D



13 The trends in two physical properties of the elements Na, Mg, A*l*, Si, P and S are shown in the following graphs.



Graph 1



Graph 2

Which of the following illustrates the correct physical property for the corresponding graphs above?

	Graph 1	Graph 2
A	melting point	1st ionisation energy
B	melting point	electrical conductivity
C	1st ionisation energy	electrical conductivity
D	1st ionisation energy	melting point

14 Which of the following statements are correct for a system at dynamic equilibrium?

1 The rate of both forward and backward reaction is the same.

2 The concentration of reactants is equal to the concentration of products.

3 The rate constant of forward reaction is equal to the rate constant of the backward reaction.

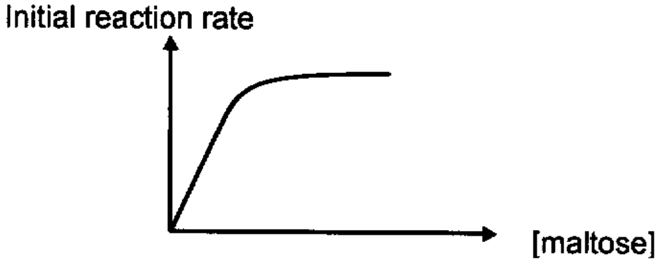
A 1 only

B 1 and 2 only

C 1 and 3 only

D 1, 2 and 3 only

15 The graph shows the result of an investigation of the initial rate of hydrolysis of maltose by the enzyme amylase. In the experiments, the initial concentration of maltose was varied, but that of amylase was kept constant.



Which conclusions can be deduced from these results?

A When [maltose] is low, the rate is zero order with respect to [maltose].

B When [maltose] is high, the rate is independent of [maltose].

C When [maltose] is low, the rate is independent of [amylase].

D When [maltose] is high, the rate is first order with respect to [amylase].

16 A saturated solution of $Ca(OH)_2$ is found to have a pH of 12.3 at 25 °C.
Which of the following statements is **incorrect**?

A The pH of the solution would increase when $Ca(NO_3)_2$ is added

B The solubility of $Ca(OH)_2$ would increase when temperature is raised to 35 °C.

C The solubility of $Ca(OH)_2$ will decrease when solid Na_2O is added.

D The K_{sp} of $Ca(OH)_2$ is 4×10^{-6} $mol^3\,dm^{-9}$.

17 *Use of the Data Booklet is relevant to this question.*

Which of the following solutions would result in a colour change when left to stand in the atmosphere?

A an acidified solution of tin(II) chloride

B an acidified solution of cobalt(II) nitrate

C a solution of potassium manganate(VII)

D an acidified solution of vanadium(II) sulfate

18 Adding concentrated $HCl(aq)$ to $CuSO_4(aq)$ causes the colour of the solution to change from blue to green.

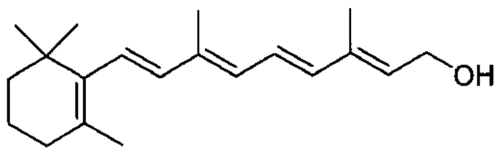
Which of the following row correctly shows the number of d-electrons and the energy gap between the d-orbitals, before and after the reaction?

	number of d-electrons	energy gap between the d-orbitals
A	changes	changes
B	remains the same	changes
C	changes	remains the same
D	remains the same	remains the same

19 How many structurally isomeric secondary alcohols are there with the molecular formula $C_5H_{12}O$?

A 1 **B** 2 **C** 3 **D** 4

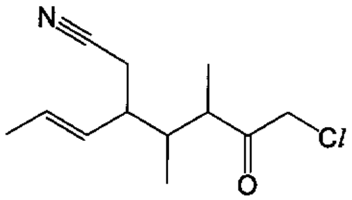
20 When retinol reacts completely with cold alkaline $KMnO_4$, it forms product **E**. How many stereoisomers do retinol and **E** have?



retinol

	retinol	E
A	2^4	2^8
B	2^5	2^8
C	2^4	2^{10}
D	2^5	2^{10}

21 Which of the following options about the structure below is correct?



	Number of *sp* hybridised C	Number of sp^2 hybridised C	Number of sp^3 hybridised C
A	1	3	8
B	1	3	6
C	0	4	8
D	0	4	6

22 Which list contains all compounds that are made during the free radical substitution of chloromethane with chlorine?

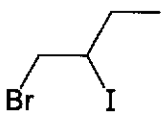
A C_2H_6, CCl_4, CH_2Cl_2

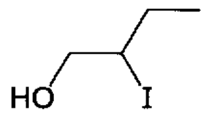
B CH_2CCl_2, CCl_4, $CHCl_3$

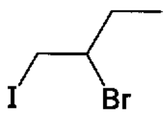
C HCl, CH_3CH_2Cl, $CHCl_3$

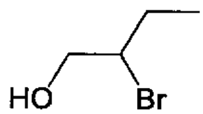
D CH_2ClCH_2Cl, CH_2Cl_2, $CHCl_3$

23 Which of the following **cannot** be formed as one of the products, when but–1–ene reacts with IBr(aq)?

A


B


C


D


24 Which pair of reagents reacts to form a product with a chiral carbon atom?

A $CH_3CH_2CH_2Cl$ + NaOH in ethanol

B $(CH_3)_2C{=}O$ + $NaBH_4$

C CH_3CH_2CHO + HCN

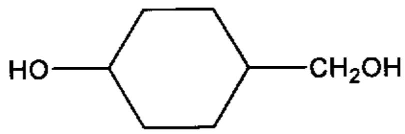
D CH_3COCl + CH_3NH_2

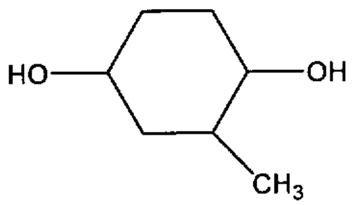
25 Heating compound **F**, $C_7H_{14}O_2$, under reflux with an excess of acidified potassium manganate(VII) produces compound **G**.

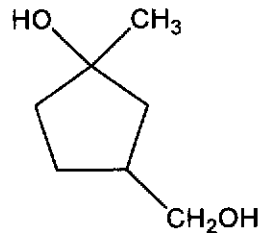
Compound **G** produces hydrogen gas with sodium metal and forms orange crystals with 2,4-DNPH reagent.

What could **F** be?

A $(CH_3)_2C(OH)CH_2CH_2CH_2CHO$

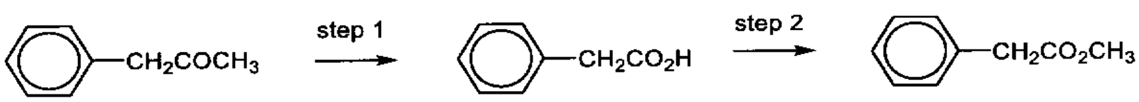
B 

C 

D 

26 Methyl phenylacetate has a strong odour similar to honey. It is used in the flavour industry and in perfumes to impart honey scents.

The following pathway shows the synthesis of methyl phenylacetate via a 2-step pathway.



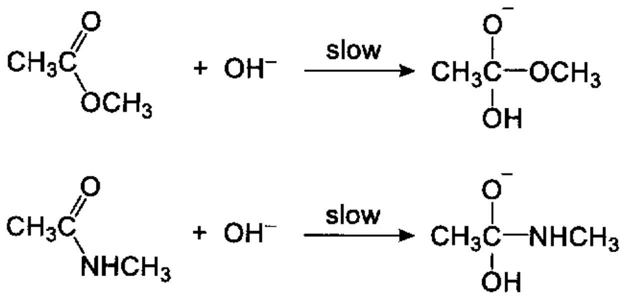
methyl phenylacetate

Which reagents can be used for step 1 and step 2?

	step 1	step 2
A	acidified $KMnO_4$	CH_3OH, concentrated H_2SO_4
B	H_2SO_4 (aq)	CH_3COOH, concentrated H_2SO_4
C	NaOH (aq), I_2	CH_3OH, concentrated H_2SO_4
D	acidified $K_2Cr_2O_7$	CH_3COOH, concentrated H_2SO_4

27 1 mol of an ester ($CH_3CO_2CH_3$) and 1 mol of an amide ($CH_3CONHCH_3$) underwent base hydrolysis separately and the initial rate of reaction was measured. It was found that the ester undergoes hydrolysis approximately three times faster than the amide.

The slow step of the base hydrolysis of the ester and amide is the same and shown below.



Which statements help to explain the faster rate of base hydrolysis of the ester?

1 Oxygen is more electronegative than nitrogen.

2 The lone pair of electrons on the nitrogen atom in the amide interacts more with the carbonyl group.

3 There are two lone pairs of electrons on the oxygen atom in the ester and only one lone pair of electrons on the nitrogen atom in the amide.

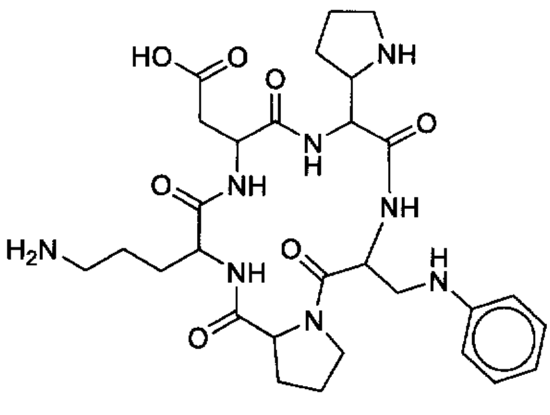
A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

28 Compound **W** is a cyclic oligopeptide.



W

How many amide linkages exist in compound **W**?

A 5 **B** 6 **C** 7 **D** 8

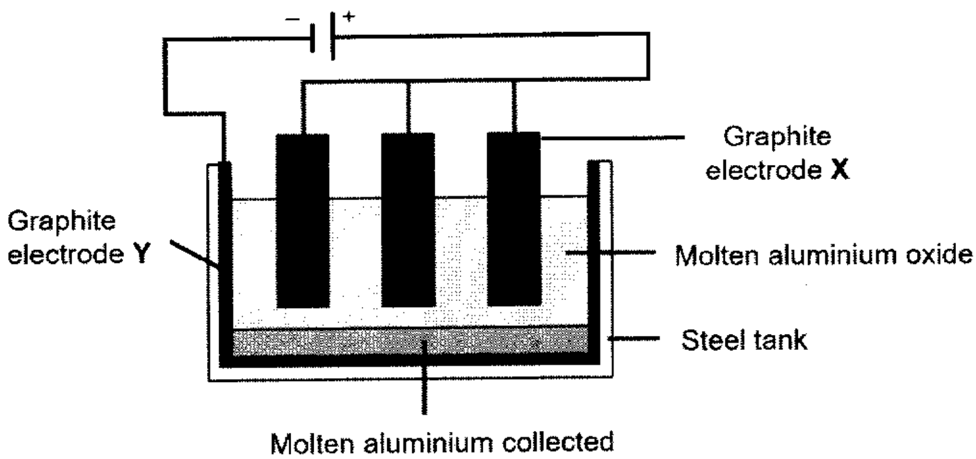
29 An octapeptide was analysed in the chemistry laboratory by treating it with enzymes. The following fragments were obtained after the partial hydrolysis that is catalysed by the enzymes.

ser-arg-pro
cys-pro
pro-ser
pro-ala-phe-gly

Which of the following is the correct sequence of the octapeptide?

A ser-arg-pro-ala-phe-gly-cys-pro
B pro-ser-arg-pro-ala-phe-gly-cys
C cys-pro-ser-arg-pro-ala-phe-gly
D cys-pro-ala-phe-gly-ser-arg-pro

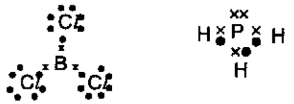
30 Aluminium is extracted from its ore by electrolysis.



Which of the following statements is correct?

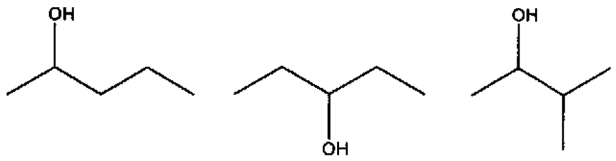
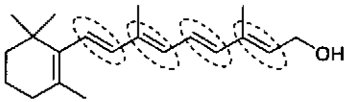
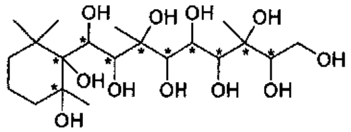
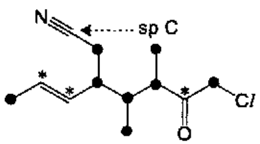
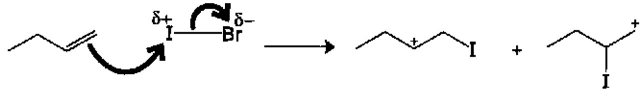
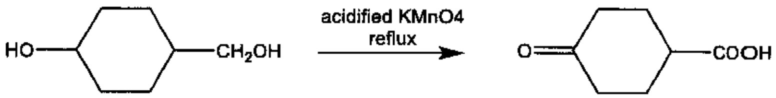
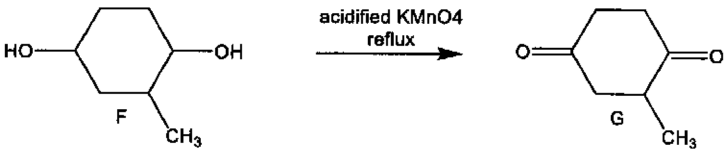
1 Oxygen gas is produced.
2 Aluminum ions migrate to electrode **X**.
3 Electrons move from electrode **X** to electrode **Y** via the external circuit.

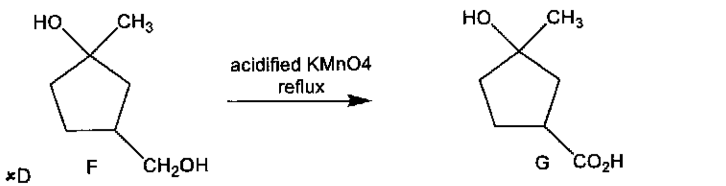
A 1 and 2 only | **B** 1 and 3 only
C 2 and 3 only | **D** 1 only

1	D	The definition for atomic mass is the ratio of the average mass of one atom of an element to one-twelfth the mass of one atom of ^{12}C. In option **D**, the mass of one mole of atoms of an element has already considered all the isotopes and their relative abundances.
2	C	✗A Al^{2+} ions **$1s^22s^22p^63s^1$**; F^+ ions. **$1s^22s^22p^4$** Incorrect as Al^{3+} has 1 outer shell electron vs F^+ 6 outer shell electron. 2nd IE of F is greater than the 3rd IE of Al as 3s electron is Al^{2+} is higher in energy and further away from the nucleus (hence lower nuclear attraction) then the 2p electron in F^+. ✗B Incorrect as the 3[rd] IE involves the removal of 3[rd] electron from Al is from 3[rd] principal quantum shell as compared to the removal of 3[rd] electrons from the 2[nd] PQM for the remaining 4 species. ✓C **Na^{3+} $1s^22s^22p^{4+}$** vs **Ne^{2+} $1s^22s^22p^{4+}$** Same no of electrons but as Na^{3+} has more protons than Ne, hence higher nuclear charge, thus nuclear attraction of outermost electrons in Na^{3+} is higher, thus higher 4[th] IE for Na compared to 3[rd] IE for Ne . ✗D Incorrect as the removal of electrons are removed from different PQM.
3		 Due to the no of bond pairs and lone pairs of electrons in each molecule – BCl_3: 3 Bond Pairs ; PH_3: 3 Bond Pairs & 1 Lone pair The shape of BCl_3 and PH_3 are trigonal planar and trigonal pyramidal respectively
4	D	(1, 2 and 3) ✓**1**: Only id–id attraction can be formed between hydrocarbon molecules and H_2O molecules which is weaker than the hydrogen bonds between H_2O molecules. Hence, the energy released upon forming the less favourable interaction is not sufficient to compensate the energy required to break the stronger hydrogen bonds. Hence, hydrocarbon molecules are not solvated by water and hence the two layers are immiscible. ✓**2**: See (1). ✓**3**: The stronger hydrogen bonds between H_2O molecules pulls the molecules closer to each other and hence, the volume of water is smaller. Given similar mass, the density of water is higher and hence, it will be below the hydrocarbon layer.
5	B	Under constant n and T, the ideal gas equation is simplified to $pV = k$ (where k is a constant and k = nRT). ✗A Rearranging $pV = k$ such that $y = \frac{1}{p}$ and $x = V$ (*i.e.* $\frac{1}{p} = kV$) , a graph of y = mx is obtained (*i.e.* <u>straight line passing through origin</u>). ✓B Since pV is a constant and x = pV, a graph of x = c is obtained (*i.e.* <u>vertical line</u>) ✗C Rearranging pV = nRT such that y = p and x = ρ (*i.e.* $p = \frac{\rho RT}{M_r}$), a graph of y = mx is obtained (*i.e.* <u>straight line passing through origin</u>). ✗D Rearranging pV = nRT such that $y = \frac{pV}{T}$ and x = p (*i.e.* $\frac{pV}{T}$ = nR = constant), a graph of y = c is obtained (*i.e.* <u>horizontal line</u>)
6	C	Mol ratio of $O_2 = \frac{150}{500} = 0.3$ Hence amt of O_2 = 0.3 x 1.2 = 0.36 mol Amt of $N_2 = \frac{5.76}{24} = 0.24$ mol Hence amt of Ar = 1.2 – 0.36 – 0.24 =0.6 mol Thus $p_{Ar} = \frac{0.6}{1.2} \times 500$ =<u>**250 kPa**</u>
7	A	1 only When aqueous ammonia is added to a solution containing hexaaquairon(III) ions, $[Fe(H_2O)_6]^{3+}$, a red-brown precipitate is formed. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ where NH_3 is **Brønsted-Lowry base** where it accepts proton to release OH^- which will then ppt with Fe^{3+} to form red-brown ppt, $Fe(OH)_3$. $Fe^{3+} + 3OH^- \rightarrow Fe(OH)_3$ Ppt does not dissolve when excess ammonia is added, Indicates that there is **no further reaction or no ligand exchange** to form a soluble complex.
8	A	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ n(**M^{n+}**) used = $0.100 \times \frac{15.00}{1000}$ = 0.0015 mol n($Cr_2O_7^{2-}$) used = $0.0250 \times \frac{20.00}{1000}$ = 0.0005 mol ratio $Cr_2O_7^{2-}$: e^- : M^{n+} 0.0005 : 6(0.0005) =0.003 : 0.003 : 0.0015 2 : 1 Hence, <u>**1 M^{n+} loses 2 electrons and the oxidation state of M changes by 2**</u>.

9	A	$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$ Since $6CO_2 \equiv 6H_2O \equiv 1C_6H_{12}$, $n(CO_2)$ formed = $n(H_2O)$ formed = x mol $\frac{M_p}{M_Q} = \frac{\text{mass of } H_2O}{\text{mass of } CO_2} = \frac{(x)\times 18.0}{(x)\times 44.0} = \mathbf{0.41}$
10	C	Energy absorbed by water $= 250 \times 4.18 \times (100 - 12) \times 10^{-3}$ $= 91.96$ kJ Energy evolved by combustion of butane = $91.96 \times \frac{100}{47} = 195.6$ kJ $195.6 = 2877 \times \frac{m(\text{butane})}{58}$ m(butane) = 3.944 ≈ 3.94 g
11	D	$H_2O(g) + C(s) \rightarrow H_2(g) + CO(g)$ $\Delta S > 0$ as there is an increase in disorderliness from 1 to 2 mol of gas particles. $\Delta G = \Delta H - T\Delta S$ (−ve, +ve → −ve) If ΔH **<0, ΔG < 0 at all temperatures**. However, ΔG_1 becomes more negative as temperature increases; hence $\Delta G = \Delta H - T\Delta S$ (+ve, +ve → −ve) When temperature increases, $-T\Delta S$ becomes more negative. At **high enough temperatures**, **ΔG < 0** since **$\lvert -T\Delta S \rvert > \lvert \Delta H \rvert$**. Reaction is **spontaneous at high enough temperatures**.when temperature increases
12	B	With the addition of another mole of gas, the area under the graph increases. When the temperature increased, the Maxwell Boltzmann graph peak will be shifted to the right.
13	A	Graph 1: The melting point increases from Na to *Al* as the metallic bonding is stronger. Si has the highest melting point as it is a giant covalent lattice which requires the largest amount of energy to overcome the strong network of Si-Si bond. S_8 and P_4 are simple covalent molecule. As the number of electrons for S_8 increases, the id-id increases, hence, the melting point increases. Graph 2: Across the period, nuclear charge increases while the increase in shielding effect is insignificant as electrons are added to the same shell. The effective nuclear charge increases, hence, the 1st ionisation energy increases. However, the first ionisation energy for *Al* is lower than expected because less energy is needed to remove the 3p electron which is further away from nucleus and experience additional shielding from 3s electrons.

14	A	1 only When a system is at a state of dynamic equilibrium, • the concentration of all reactants and products **remains constant** and an equilibrium mixture is obtained. • the rate of forward reaction = the rate of the backward reaction. • Equilibrium can only be achieved in a **closed system**, where there is no loss or gain of substances to and from the surroundings.
15	B	When **[maltose] is very low** as compared to [enyzme], **many empty active sites of the enzyme molecules available for binding** so the reaction is approximately **1st order w.r.t. maltose**. As **[maltose] increases, more active sites of enzymes** are occupied by maltose molecules so reaction is **no longer 1st order w.r.t maltose** At **high enough [maltose], all active sites are occupied by maltose molecules** (*i.e.* saturated) so any further increase in $[CO_2]$ will not increase the rate. Hence, the reaction becomes **zero order w.r.t maltose.**
16	A	$Ca(OH)_2 (s) \rightleftharpoons Ca^{2+} (aq) + 2OH^-(aq)$ … (1) ×A INCORRECT. When common ion Ca^{2+} is added, $[Ca^{2+}]$ increases, hence POE in (1) shifts to the left, $[OH^-]$ decreases, hence pH increases ✓B CORRECT. Increasing temperature increases solubility of solids ✓C CORRECT. When Na_2O is added into the solution, NaOH is formed. When common ion OH^- is added, $[OH^-]$ increases, hence POE in (1) shifts to the left, solubility of $Ca(OH)_2$ decreases. ✓D CORRECT. $[OH^-] = 10^{-1.7} = 0.0200$ mol dm^{-3} $[Ca^{2+}] = 0.0100$ mol dm^{-3} $Ksp = [Ca^{2+}][OH^-]^2 = 0.01 \times 0.02^2 = 4 \times 10^{-6}$ mol^3 dm^{-9}
17	D	$O_2 + 4H^+ + 4e \rightleftharpoons 2H_2O$ E° = +1.23V $O_2 + 2H_2O + 4e \rightleftharpoons 4OH^-$ E° = +0.40V $Sn^{4+} + 2e \rightleftharpoons Sn^{2+}$ E° = +0.15V $Co^{3+} + e \rightleftharpoons CO^{2+}$ E° = +1.89V $MnO_4^- + 8H^+ + 5e \rightleftharpoons Mn^{2+} + 4H_2O$ E° = +1.52V $V^{3+} + e \rightleftharpoons V^{2+}$ E° = -0.26V ×A INCORRECT. Sn will not show any colour change even though there is a reaction between $2Sn^{2+} + O_2 + 4H^+ \rightarrow 2H_2O + 2Sn^{4+}$ ($E°_{cell}$ = +1.08V > 0) as Sn ions have no colour ×B INCORRECT. $E°_{cell}$ = +1.23 – 1.89 < 0; not energetically feasible ×C INCORRECT. No reaction as both will undergo reduction reactions. ✓D CORRECT $E°_{cell}$ = +1.23 – (-0.26) > 0; energetically feasible $4V^{2+} + O_2 + 4H^+ \rightarrow 2H_2O + V^{3+}$

18	B	When conc. HC*l* is added to $CuSO_4$ $[Cu(H_2O)_6]^{2+}(aq) + 4Cl^-(aq) = [CuCl_4]^{2-}(aq) + 6H_2O(l)$ ***pale blue solution*** ***yellow solution*** **Oxidation no** of Cu in $[Cu(H_2O)_6]^{2+}$ and $[CuCl_4]^{2-}$ is the **same**, hence no of d-electrons are the same. Since the above is a **ligand exchange reaction** and different ligands have different capacities of splitting the d orbitals of a particular metal ion, this results in a change in the energy gap between the d-orbitals.
19	C	
20	C	The C=C in retinol (except that in the cyclic ring) will exhibit cis-trans isomerism, hence 2^4. After mild oxidation to form the diol, all 5 C=C will undergo addition and give 10 chiral carbons, hence 2^{10}.  retinol  Y
21	A	Refer to diagram below (* represents sp^2 C while • represents sp^3 C). There are <u>**one sp C**</u>, <u>**three sp² C**</u> and <u>**eight sp³ C**</u>. 
22	D	in the reaction between chloromethane and chlorine, all products must come from the simplest radical of $\bullet CH_2Cl$ ×A C_2H_6 cannot be formed as there are no $\bullet CH_3$ ×B $CH_2=CCl_2$ cannot be formed as this is an alkene that is not a product of FRS ×C CH_3CH_2Cl will need $\bullet CH_3$ and $\bullet CH_2Cl$. Since there are no $\bullet CH_3$, thus CH_3CH_2Cl cannot be formed ✓D All can be formed
23	D	Type of reaction: <u>electrophilic addition</u> Since iodine is less electronegative than Br, iodine will bear the δ+ charge and functions as the electrophile.  more stable less stable The <u>product must contain I atom</u>. (reject **D**) Br^- and H_2O can function as nucleophile to attack either carbocation to give the products in Option **A** to **C**.
24	C	×A $CH_3CH_2CH_2Cl$ + NaOH in ethanol → $CH_3CH=CH_2$ (no C*)+ HC*l* ×B $(CH_3)_2C=O + NaBH_4 \rightarrow (CH_3)_2CH(OH)$ (no C*) ✓C $CH_3CH_2CHO + HCN \rightarrow CH_3CH_2C^*H(CN)OH$ ×D $CH_3COCl + CH_3NH_2 \rightarrow CH_3CONHCH_3 + HCl$
25	B	×A $(CH_3)_2C(OH)CH_2CH_2CH_2CHO$ —acidified KMnO4, reflux→ $(CH_3)_2C(OH)CH_2CH_2CH_2CO_2H$ F G H_2 produced with Na no orange crystals with 2,4-DNPH ✓ B  F G H_2 produced with Na orange crystals with 2,4-DNPH ×C  F G no H_2 produced with Na orange crystals with 2,4-DNPH



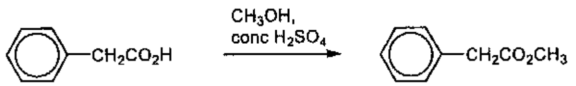
H_2 produced with Na

no orange crystals with 2,4-DNPH

26 C

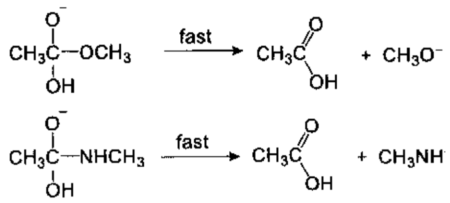
Step 1: positive idoform test as it involves the removal of 1 -CH_3 group. Cannot perform strong oxidation otherwise benzoic acid will be formed.

Step 2: Nucleophilic acyl substitution (formation of ester)



27 B

(1 and 2 only)



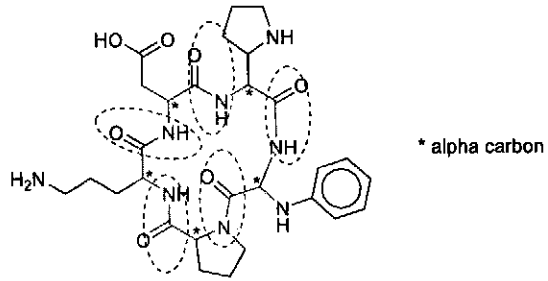
✓**1**: Since O is more electronegative, O of CH_3O^- can bear the negative charge better than N of CH_3NH^-.

✓**2**: The orbital of N is closer in size to that of C and hence, the overlap of orbitals between the C of C=O and N is more effective than that between C of C=O and O.

×**3**: Only one lone pair can be delocalised into the adjacent C=O. Hence, the number of lone pair on O does not affect the rate of hydrolysis.

28 A

Identify the alpha-carbons in the backbone of the oligopeptide (in *). You can then easily identify the amide linkages in compound W (circled below).



29 C

cis-pro

pro-ser

ser-arg-pro

pro-ala-phe-gly

cys-pro-ser-arg-pro-ala-phe-gly

30 B

1 and 3 only

Option 1 is correct.

Electrode **X** is the positive electrode i.e. the anode, anions (i.e. O^{2-}) migrate here and oxidation takes place. O^{2-} is oxidised to $O_2(g)$.

Option **2** is incorrect.

Electrode **Y** is the negative electrode i.e. the cathode, cations (i.e. $A^{\beta+}$) migrate here and reduction takes place.

Option **3** is correct

Electrons move from negative terminal of the battery to electrode **Y**, and electrode **X** to the positive terminal of the battery. Thus, electrons move from electrode **X** to electrode **Y**.