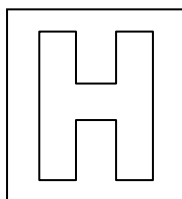


Candidate Name: _____

Class Adm No

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2021 End-of-Year Examinations Pre-University 2

H1 CHEMISTRY

8873/01

Paper 1 Multiple Choice

22 Sep 2021

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not turn over this question paper until you are told to do so.

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and admission number in the spaces provided at the top of this page and on the Multiple Choice Answer Sheet provided.

There are **thirty** questions on this paper. Answer **ALL** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet provided.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

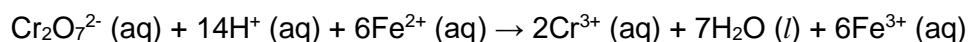
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this question paper.

The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE	
TOTAL (30 marks)	

- 1 Magnetite, Fe_3O_4 , is an equimolar mixture of iron(II) oxide, FeO , and iron(III) oxide, Fe_2O_3 .
 3.48 g of magnetite is dissolved in excess dilute sulfuric acid.
 25.0 cm^3 of $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq})$ exactly oxidises the dissolved Fe^{2+} present according to the equation.



What is the concentration, in mol dm^{-3} , of the $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq})$ used?

- A 0.01 B 0.05 C 0.10 D 0.20

- 2 What are the oxidation states of oxygen in the following compounds?

	O_2	OF_2	H_2O_2
A	0	-2	-1
B	0	+2	-1
C	-2	-2	-2
D	-2	+2	-2

- 3 An acidified solution of the salt KClO_2 oxidises $\text{Ti}^{3+}(\text{aq})$ to $\text{Ti}^{n+}(\text{aq})$ while the chlorine is reduced to $\text{Cl}^-(\text{aq})$. When 0.00245 mol of KClO_2 reacted with 0.400 mol dm^{-3} $\text{Ti}^{3+}(\text{aq})$, 24.50 cm^3 of $\text{Ti}^{3+}(\text{aq})$ was needed for complete reaction.
 What is the value of n ?

- A 1 B 2 C 3 D 4

- 4 An ion X^{2+} contains 24 protons.
 What is the electronic configuration of X^{2+} ?

- A $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$
 B $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
 C $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
 D $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$

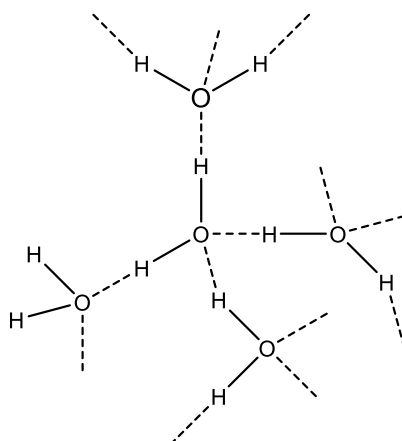
- 5 The table gives the successive ionisation energies for an element **G**.

	1st	2nd	3rd	4th	5th	6th
Ionisation energy / kJ mol^{-1}	750	1800	3700	5600	16000	20300

What is the formula of the chloride of **G**?

- A** GCl **B** GCl_2 **C** GCl_3 **D** GCl_4
- 6 Which of the following pairs of molecules have the same shape?
- A** AlCl_3 and PCl_3
B SO_3 and BF_3
C NH_3 and BCl_3
D SO_2 and CO_2
- 7 Which of the following statements about graphite is **incorrect**?
- A** All the bond angles in it are 120° .
B Each carbon atom is bonded to three other carbon atoms.
C It is able to conduct electricity due to the presence of delocalised electrons that are free to move within each layer.
D It has low melting point due to the weak instantaneous dipole-induced dipole interactions between the layers.

- 8 The diagram shows the structure of part of a crystal of ice.



Which statements about this structure are correct?

- 1 The open structure of ice causes ice to be less dense than water.
- 2 The hydrogen bonds, shown by the dotted lines, are stronger than the O-H covalent bonds.
- 3 All the bond angles surrounding each oxygen atom is 105° .
- 4 Four electrons from each oxygen are involved in forming hydrogen bonds.

- A** 1 and 4 only
B 2 and 3 only
C 2 and 4 only
D 1, 3 and 4 only

- 9 The lattice energies of rubidium fluoride, RbF , and caesium chloride, CsCl , are -760 kJ mol^{-1} and -650 kJ mol^{-1} , respectively.

Which value is likely to be the lattice energy of caesium fluoride, CsF , in kJ mol^{-1} ?

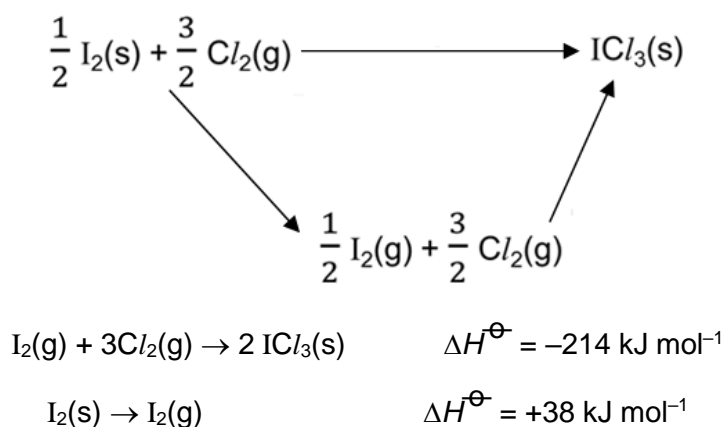
- A** -460 kJ mol^{-1}
B -550 kJ mol^{-1}
C -680 kJ mol^{-1}
D -800 kJ mol^{-1}

- 10 When equal masses of **X** and **Y** absorb the same amount of energy, their temperatures rise by 5 °C and 10 °C respectively.

Which of the following statements is correct?

- A The specific heat capacity of **X** is twice that of **Y**.
- B The specific heat capacity of **X** is half that of **Y**.
- C The specific heat capacity of **X** is one fifth that of **Y**.
- D The specific heat capacity of **X** is the same as **Y**.

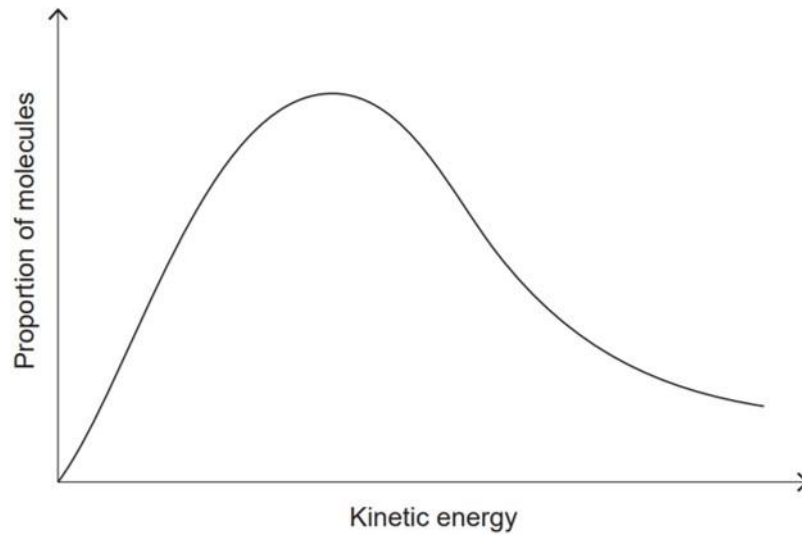
11



What is the standard enthalpy change of formation of iodine trichloride, $\text{ICl}_3(\text{s})$?

- A +176 kJ mol⁻¹
- B -88 kJ mol⁻¹
- C -176 kJ mol⁻¹
- D -214 kJ mol⁻¹

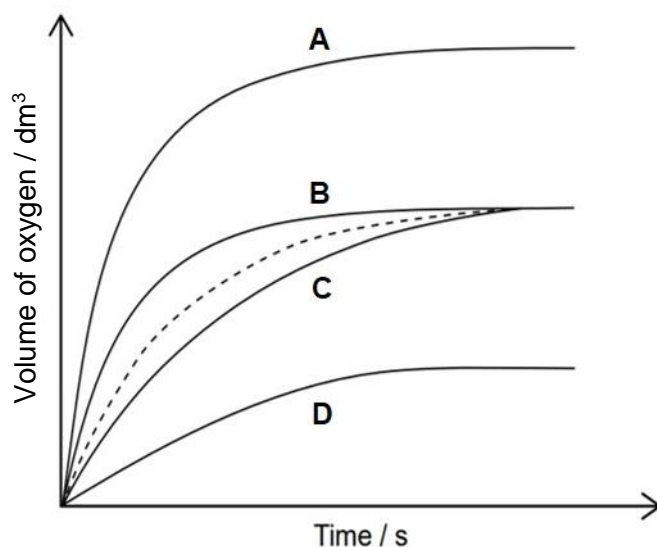
- 12 The graph shows the Maxwell–Boltzmann energy distribution curve for a given gas at a certain temperature.



How will the curve change if the temperature of the gas is increased, while other conditions remain constant?

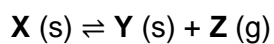
- 1 Maximum becomes higher
 - 2 Graph shifted right
 - 3 Area under the graph becomes larger
-
- A** 1 only
 - B** 2 only
 - C** 1 and 2 only
 - D** 2 and 3 only

- 13 The dotted line represents the formation of oxygen, $\text{O}_2(\text{g})$, from the uncatalysed complete decomposition of hydrogen peroxide, $\text{H}_2\text{O}_2(\text{aq})$.



Which curve represents a catalysed reaction under the same conditions?

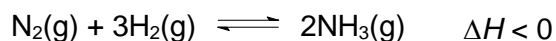
- 14 The equilibrium constant K_c for the following reaction increases with temperature.



What deduction can be made from this information?

- A The yield will increase at higher pressure.
- B The forward reaction is endothermic.
- C The value of K_c depends on the amount of **X** used.
- D The yield is independent of temperature.

- 15 Ammonia is manufactured industrially by the Haber Process as shown.



The operating conditions are:

400 to 450 °C; a pressure of 200 atm; an iron catalyst

Which of the following statements are true about the Haber process for the manufacture of ammonia?

- 1 At higher temperatures, the yield goes down but the rate of production of ammonia is faster.
- 2 At higher pressures, the yield goes down but the rate of production of ammonia is faster.
- 3 The presence of a catalyst shifts the equilibrium position to the right and increases the yield.

- A** 1 only
B 2 only
C 1 and 2 only
D 1, 2 and 3

- 16 Which of the following is a Lewis acid but not a Brønsted–Lowry acid?

- 1 CH_3COOH
- 2 AlCl_3
- 3 HF

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

- 17** Stomach juice has a pH of 1.0.

Aspirin is a monobasic acid represented by HX ($K_a = 10^{-14} \text{ mol dm}^{-3}$) which dissociates into ions of H^+ and X^- .

What are the relative concentrations of H^+ , X^- and HX when an aspirin tablet is ingested and enters into the stomach?

- A** $[\text{HX}] > [\text{H}^+] = [\text{X}^-]$
- B** $[\text{H}^+] > [\text{X}^-] > [\text{HX}]$
- C** $[\text{H}^+] = [\text{X}^-] > [\text{HX}]$
- D** $[\text{H}^+] > [\text{HX}] > [\text{X}^-]$

- 18** Which of the following could act as buffers?

- 1 A 1:2 mixture of HCl and NH_3
- 2 A 2:1 mixture of NaOH and H_2CO_3
- 3 A 1:1 mixture of NaH_2PO_4 and Na_2HPO_4

- A** 1, 2 and 3
- B** 1 and 2 only
- C** 1 and 3 only
- D** 3 only

- 19** Which of the following oxides will dissolve in water to give the solution with the lowest pH?

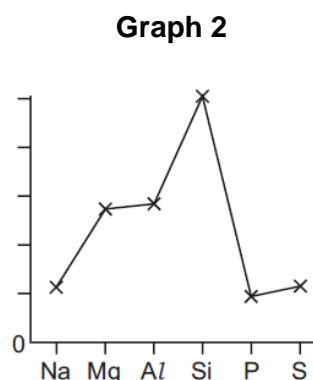
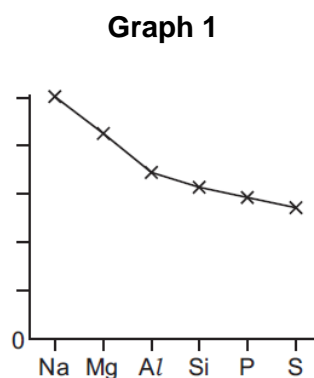
- A** Al_2O_3
- B** MgO
- C** P_4O_{10}
- D** SiO_2

20 Which of the following statements concerning the third period elements (sodium to sulfur) and their compounds is correct?

- 1 The elements become more electronegative from sodium to chlorine.
- 2 Aluminium oxide is the only oxide in Period 3 which is amphoteric.
- 3 pH of the chlorides increases across the Period 3 elements.

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

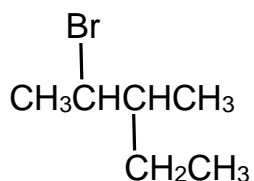
21 The graphs below show the variation in two properties of the elements Na to S.



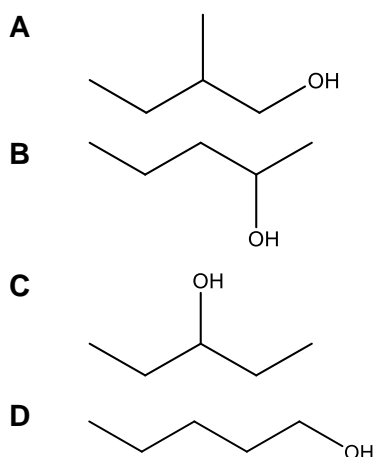
Which properties are illustrated in Graphs 1 and 2?

- | | Graph 1 | Graph 2 |
|----------|-------------------------|-------------------------|
| A | atomic radius | first ionisation energy |
| B | atomic radius | melting point |
| C | electrical conductivity | first ionisation energy |
| D | electrical conductivity | melting point |

- 22 What is the IUPAC name of the following molecule?

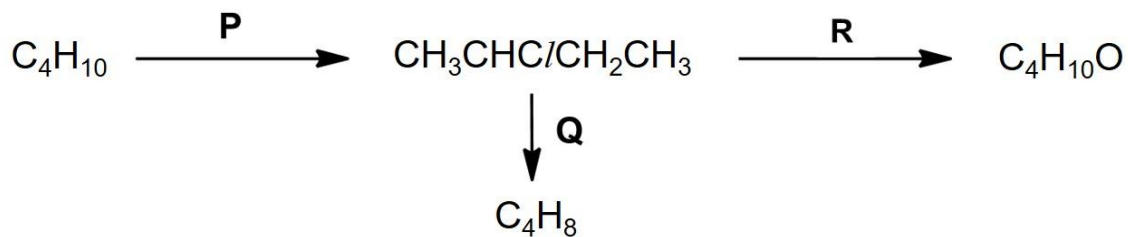


- A 2-bromo-3-ethylbutane
 B 3-methyl-4-bromopentane
 C 2-ethyl-3-bromobutane
 D 2-bromo-3-methylpentane
- 23 Which of the following isomers of $\text{C}_5\text{H}_{11}\text{OH}$ gives, on dehydration, the greatest number of different alkenes (including cis-trans isomers)?



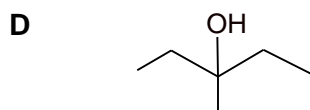
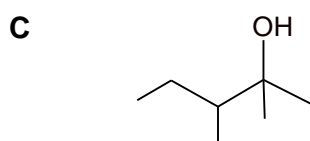
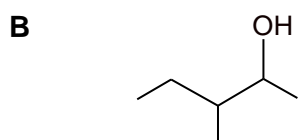
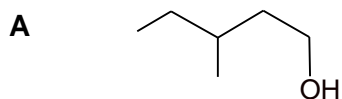
- 24 Methyl ethanoate is prepared by heating a mixture of ethanoic acid, methanol and concentrated sulfuric acid under reflux. Why is concentrated sulfuric acid used?
- A To keep the pH of the solution low
 B To maintain a high temperature
 C To prevent charring of the reaction mixture
 D To provide hydrogen ions to catalyse the reaction

- 25 The diagram shows a reaction scheme involving 2-chlorobutane, $\text{CH}_3\text{CHCl}/\text{CH}_2\text{CH}_3$.

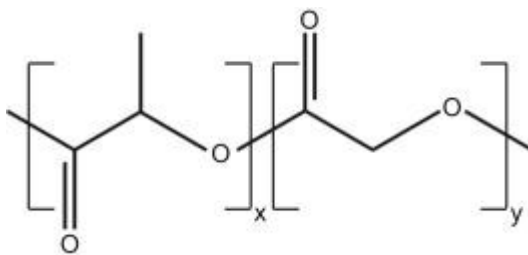


Which of the following statements is **incorrect**?

- A Reactions **P** and **R** are substitution reactions.
 - B Reaction **Q** is a reduction reaction.
 - C The product formed from reaction **R** decolourises purple KMnO_4 .
 - D Sodium hydroxide is a reagent used in both reactions **Q** and **R**.
- 26 Which of the following alcohols can be formed when a ketone is reduced with NaBH_4 dissolved in methanol?



- 27** Polyglactin is a polymer that is used to stitch wounds together during surgery. It is broken down into smaller molecules over three to six months. Patients, therefore, do not have to undergo a second surgery to remove the stitches.



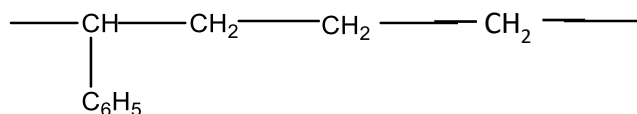
Polyglactin

Which of the following statements explain polyglactin's suitability for this function?

- 1 Polyglactin can be hydrolysed in the body.
- 2 Polyglactin is a thermoplastic.
- 3 The small monomers produced upon hydrolysis are water-soluble.

- A** 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 3 only

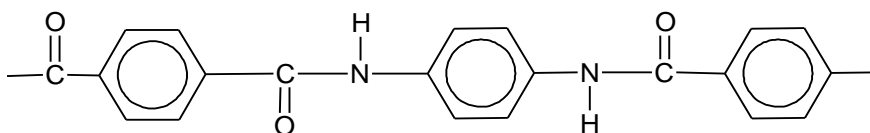
- 28** The diagram shows a repeat unit of a polymer.



What are the monomers for this polymer?

- A** $\text{C}_6\text{H}_5\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_3$
B $\text{C}_6\text{H}_5\text{CH}=\text{CH}_2$ and $\text{CH}_2=\text{CH}_2$
C C_6H_6 and $\text{CH}_2\text{CH}=\text{CHCH}_3$
D $\text{C}_6\text{H}_5\text{CH}=\text{CH}_2$ and CH_3CH_3

- 29 The structure shows part of the Kevlar polymer.



Which of the following correctly describes Kevlar?

	type of polymer	reaction of polymer with strong acid
A	addition	hydrolysis
B	addition	no reaction
C	condensation	hydrolysis
D	condensation	no reaction

- 30 What is the maximum size, in at least one dimension, of a nanomaterial?

A $1 \times 10^{-4} \text{ m}$ B $1 \times 10^{-5} \text{ m}$ C $1 \times 10^{-6} \text{ m}$ D $1 \times 10^{-7} \text{ m}$

END OF PAPER 1

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