Name:		Centre/Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H1 CHEMISTRY 8873/01

Paper 1 Multiple Choice

20 September 2024
1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number, name and class at the top of this page.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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 separate Answer Sheet.

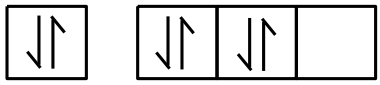
Read the instructions on the Answer Sheet very carefully.

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 **15** printed pages and **1** blank page.

1 Which diagram shows the correct arrangement of valence electrons of a S^+ ion in the ground state?

A



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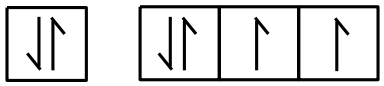

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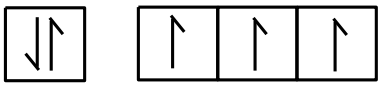

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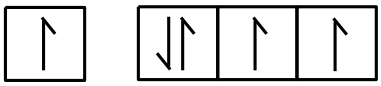


2 The mineral pyrite only contains isotopes of sulfur and iron. A sample of pyrite was analysed and four different types of atom were identified: **V**, **W**, **X** and **Y**.

atom	relative mass	relative % abundance
V	32	63.8
W	34	2.8
X	54	31.4
Y	56	2.0

Which statements are correct?

1 $\mathbf{Y}^{2+}$ is isoelectronic with **X**.

2 **Y** has 14 more neutrons than **V**.

3 The relative atomic mass of iron in this sample is 54.1.

4 $\mathbf{V}^{2+}$ is deflected more than $\mathbf{W}^{2+}$ in the same electric field.

A 1, 2, 3 and 4

B 2, 3 and 4 only

C 2 and 3 only

D 1 and 4 only

3 Which row about the similarity and difference between a $2p_x$ and a $3p_z$ orbital is correct?

	similarity	difference
A	number of lobes per orbital	orientation of orbital in space
B	size of orbital	shape of orbital
C	orientation of orbital in space	size of orbital
D	shape of orbital	number of lobes per orbital

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

What is the order of decreasing enthalpy change for the reactions shown?

$$Si^{+}(g) \rightarrow Si^{2+}(g) + e^{-} \qquad \Delta H_1$$
$$Al^{+}(g) \rightarrow Al^{2+}(g) + e^{-} \qquad \Delta H_2$$
$$Si(g) \rightarrow Si^{2+}(g) + 2e^{-} \qquad \Delta H_3$$

A $\Delta H_1 > \Delta H_2 > \Delta H_3$

B $\Delta H_2 > \Delta H_3 > \Delta H_1$

C $\Delta H_3 > \Delta H_1 > \Delta H_2$

D $\Delta H_3 > \Delta H_2 > \Delta H_1$

5 Which statement helps to explain why iodine has a larger atomic radius than chlorine?

A Iodine is less electronegative than chlorine.

B Iodine has more filled electron shells than chlorine.

C Iodine has a greater number of protons than chlorine.

D Iodine is a solid while chlorine is a gas under room conditions.

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

Which solid has the largest magnitude of lattice energy?

A NaF **B** Na_2O

C MgF_2 **D** MgO

7 How many of the molecules listed are polar **and** have the same shape?

- NCl_3
- HCN
- $BeCl_2$
- $SOCl_2$

A none **B** 2

C 3 **D** 4

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

Which contains the smallest number of the stated particles?

A ions in 80 cm^3 of 0.1 mol dm^{-3} of Na_2SO_4

B molecules in 4 g of liquid bromine

C molecules in 500 cm^3 of hydrogen (measured at r.t.p.)

D atoms in 1 cm^3 of pure water (density = 1 g cm^{-3})

9 Which statement is correct?

A One mole of a compound is the amount that contains the same number of atoms as there are atoms in 12.000 g of carbon-12.

B The relative isotopic mass of lithium-7 is given by the following expression.

$$\frac{\text{average mass of all isotopes of lithium}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$$

C The relative atomic mass of oxygen is given by the following expression.

$$\frac{\text{average mass of one atom of oxygen}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$$

D The relative molecular mass of a compound *E* is given by the following expression.

$$\frac{\text{average mass of one atom of } E}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$$

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

An excess of solid potassium iodide is added to a 25 cm^3 solution containing an unknown amount of dichromate(VI), $Cr_2O_7^{2-}$. During the reaction, dichromate(VI) ions are reduced to chromium(III), Cr^{3+}, while iodine is liberated from iodide ions.

The iodine liberated is then titrated against 0.010 mol dm^{-3} sodium thiosulfate solution, $Na_2S_2O_3$. The following reaction occurs and 22.50 cm^3 of $Na_2S_2O_3$ solution is required to reach the end-point.

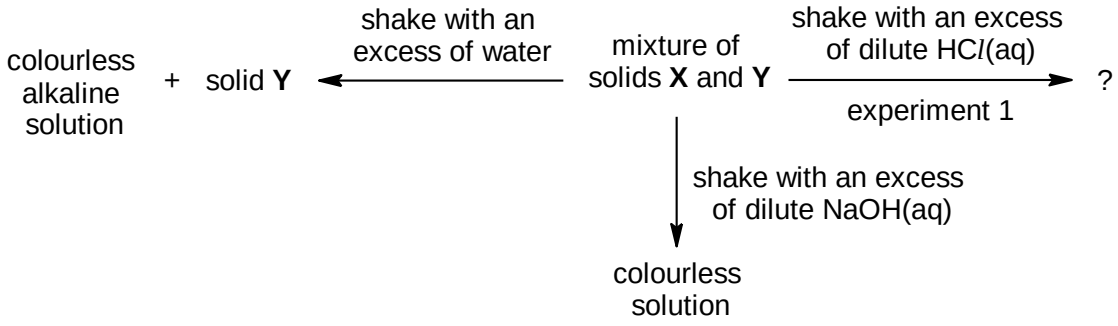
$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$$

What is the concentration, in mol dm^{-3}, of $Cr_2O_7^{2-}$ ions in the original solution?

A 3.75×10^{-5} **B** 1.50×10^{-3}

C 4.50×10^{-3} **D** 1.80×10^{-2}

11 A student carries out an investigation using a mixture of Period 3 oxides, **X** and **Y**. All experiments are carried out at room temperature.



Which observation would the student make of the result of experiment 1?

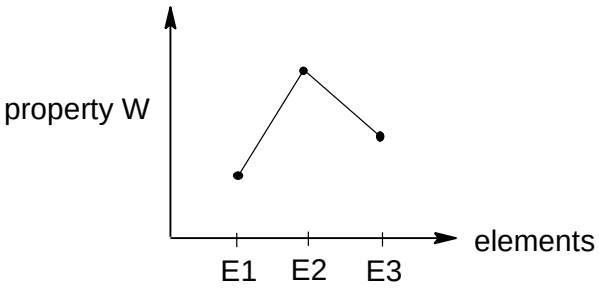
A Colourless solution only

B Colourless solution + solid **X**

C Colourless solution + solid **Y**

D Mixture of solids **X** and **Y**

12 The graph shows how property W varies with the Period 3 elements, E1, E2 and E3.



Which combination of property W and elements is correct?

	property W	E1	E2	E3
A	first ionisation energy	Mg	S	P
B	electronegativity	A*l*	Si	C*l*
C	melting point	A*l*	Na	P
D	electrical conductivity	S	Na	Si

13 Aluminium chloride and phosphorus(V) chloride were separately reacted with water.

Which statement about these reactions is correct?

A The solutions formed turn red litmus paper blue.

B The chlorides react slowly with water, producing acidic fumes.

C The solutions formed have a lower pH than aqueous sodium chloride.

D The chlorides completely hydrolyse in water to produce acidic solutions.

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

An excess of aqueous chlorine was added to a sample of aqueous potassium bromide in a test-tube.

An equal volume of aqueous silver nitrate was then added to the resulting solution.

Which row of observations would be made?

	on adding chlorine	on adding silver nitrate
A	colourless solution remains	cream precipitate formed
B	colourless solution turns orange	cream precipitate formed
C	colourless solution turns orange	white precipitate formed
D	colourless solution turns pale yellow	white precipitate formed

15 N_2O_5 is unstable and decomposes.

$$2N_2O_5 \rightarrow 4NO_2 + O_2$$

An experiment to study this reaction under certain conditions gave the following results.

time / s	$[N_2O_5]$ / mol dm^{-3}
0	0.040
5	0.028
10	0.020
15	0.014
20	0.010

What is the half-life of this reaction and the units of the rate constant, *k*?

	half-life / s	units of *k*
A	10	s^{-1}
B	20	s^{-1}
C	10	mol dm^{-3} s^{-1}
D	20	mol dm^{-3} s^{-1}

16 Under acidic conditions, bromate(V) ions and bromide ions react as shown.

$$BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$$

A chemist performed a series of experiments to investigate the effect of changes in concentration on the rate of this reaction.

The initial concentration and rate data obtained for each experiment is given in the table below.

experiment	initial $[BrO_3^-]$ / mol dm^{-3}	initial $[Br^-]$ / mol dm^{-3}	initial $[H^+]$ / mol dm^{-3}	initial rate / mol dm^{-3} h^{-1}
1	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}
2	4.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	6.0×10^{-3}
3	2.0×10^{-3}	4.0×10^{-3}	6.0×10^{-3}	5.4×10^{-2}

What is the order of reaction with respect to each reactant?

	order of reaction with respect to		
	BrO_3^-	Br^-	H^+
A	0	1	2
B	1	1	2
C	1	2	1
D	2	2	1

17 Nitric acid reacts with phosphorus as described by the equation below.

$$P_4 + \boldsymbol{a}HNO_3 \rightarrow \boldsymbol{b}H_3PO_4 + \boldsymbol{c}H_2O + \boldsymbol{d}NO_2$$

Which statements are correct?

1 Nitric acid acts as an oxidising agent in this reaction.

2 $\boldsymbol{a} = \boldsymbol{d} = 20$ and $\boldsymbol{b} = \boldsymbol{c} = 4$ in the balanced equation.

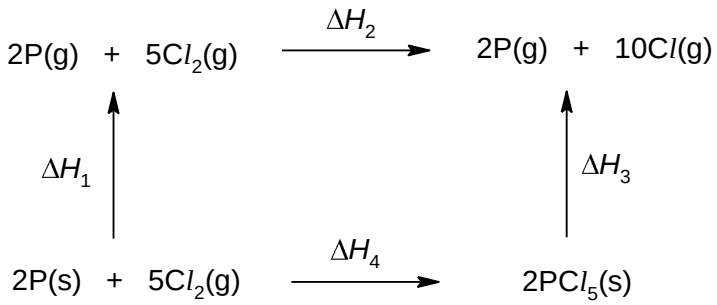
3 HNO_3 and H_3PO_4 each contains an element in the +5 oxidation state.

A 1 and 2 only **B** 1 and 3 only

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

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

The following reactions at 298 K, form an energy cycle.



Which descriptions of the enthalpy changes are correct?

1 $\Delta H_1 + \Delta H_2 = \Delta H_3 + \Delta H_4$

2 $\Delta H_2 = +1220 \text{ kJ mol}^{-1}$

3 $\Delta H_4 = 2 \times \Delta H^{\ominus}_{\text{formation}}$ of $PCl_5(s)$

A 1, 2 and 3 **B** 1 and 2 only

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

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

For the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta H^{\ominus} = -92$ kJ mol^{-1}.

Which conclusion **cannot** be drawn from the information provided?

A $\Delta H^{\ominus}_{formation}$ of $NH_3(g) = -46$ kJ mol^{-1}

B $\Delta H^{\ominus} = +92$ kJ mol^{-1} for the reverse reaction.

C The average bond energy in $NH_3(g)$ is +391 kJ mol^{-1}.

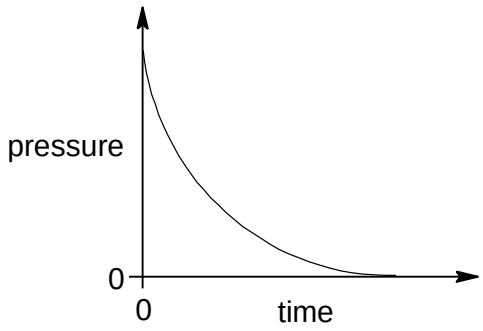
D None of the above.

20 Phosphorus pentachloride, PCl_5, dissociates when it is warmed in a closed 1 dm^3 vessel. The reaction eventually reaches equilibrium.

$$PCl_5(s) \rightleftharpoons PCl_3(l) + Cl_2(g)$$

Which graph shows the pressure of chlorine gas from the start of warming until the reaction reaches equilibrium?

A



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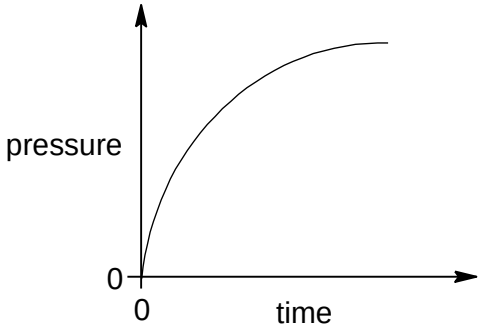

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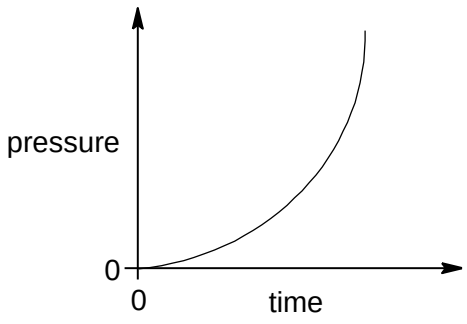
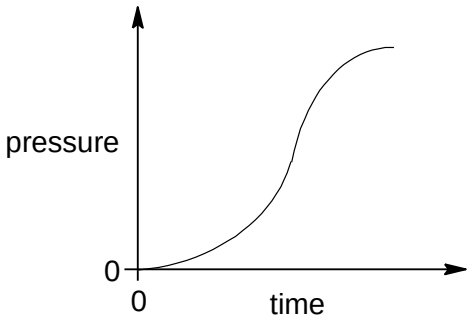


D



21 A weak acid, HX, partially dissociates in water. At equilibrium, 1 out of 100 HX molecules is dissociated to form H^+ and X^- ions.

A 4 dm^3 sample of HX(aq) is found to have a pH of 3.2 at equilibrium.

How many moles of HX does this sample contain **initially**?

A 6.31×10^{-4} **B** 2.52×10^{-3}

C 2.52×10^{-1} **D** 1.26×10^{-1}

22 The concentration of carbon dioxide in the blood is regulated by the following equilibria.

$$CO_2 + H_2O \rightleftharpoons H_2CO_3$$

$$H_2CO_3 \rightleftharpoons HCO_3^- + H^+$$

Which statements about these equilibria are correct when the pH of the blood decreases?

1 Both equilibria shift to the left-hand side.

2 HCO_3^- acts a Brønsted-Lowry base.

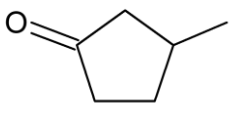
3 The $[CO_2]$ in the blood decreases.

A 1 and 2 only **B** 1 and 3 only

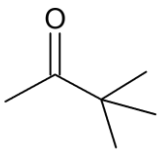
C 2 and 3 only **D** 1, 2 and 3

23 Which compound has the molecular formula $C_6H_{10}O$?

A



B



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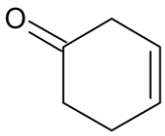

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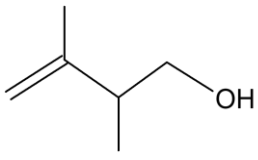


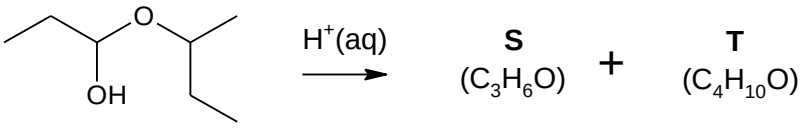
24 Which types of bonds are broken and formed in the reaction of ethene and bromine?

	types of bonds broken	types of bonds formed
A	σ	π
B	π	σ
C	σ and π	π
D	σ and π	σ

25 What is the total number of different chloroethanes with the formula $C_2H_{6-n}Cl_n$?
[n can be any integer from 1 to 6]

A 6 **B** 8 **C** 9 **D** 10

26 An organic chemist treated compound **R** with a catalytic amount of $H^+(aq)$ to yield compounds **S** and **T**.



R
$(C_7H_{16}O_2)$

How many different isomers will be formed after **T** has been reacted with excess hot concentrated sulfuric acid?

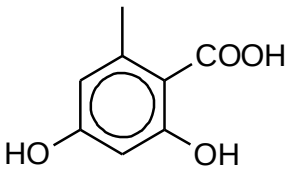
A 1

B 2

C 3

D 4

27 Orsellinic acid is found in some species of fungus.



orsellinic acid

Orsellinic acid is reacted with ethanol in the presence of concentrated sulfuric acid.

What is the molecular mass of the organic product formed?

A 168 g mol^{-1}

B 196 g mol^{-1}

C 224 g mol^{-1}

D 252 g mol^{-1}

28 $HO–CH_2CH_2–OH$ and $HOOC–C_6H_4–COOH$ are two monomer units used to form polymer **P**.

Which statement about polymer **P** is correct?

A **P** is rigid in its semi-crystalline form.

B **P** dissolves readily in water.

C **P** can be classified as a thermoset.

D A container made of **P** can be used to store strongly alkaline cleaning solutions.

29 The diagram shows a section of a polymer molecule.

$$–CH_2–CH=CH–CH_2–CH_2–CH=CH–CH_2–$$

Which monomer will produce this polymer?

A $CH_2=CH_2$

B $CH_3CH=CH_2$

C $CH_3CH=CHCH_3$

D $CH_2=CH–CH=CH_2$

30 Graphene is a nanomaterial with unique properties due to its structure.

Which statements correctly describe the structure of graphene and its physical properties?

1 Graphene consists of multiple layers of carbon atoms stacked in a hexagonal lattice.

2 Its high electrical conductivity is due to the presence of delocalised electrons.

3 Its exceptional tensile strength is attributed to the weak intermolecular forces between layers.

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 only

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