

DUNMAN HIGH SCHOOL Preliminary Examination Year 6

H2 CHEMISTRY

Paper 1 Multiple Choice

9729/01 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.

1 Use of the Data Booklet is relevant to this question.

Which transition metal ions have the same number of unpaired electrons as a phosphorus atom in its ground state?

- 1 Ti²⁺
- 2 V²⁺
- 3 Cr³⁺
- A
 1 and 2 only
 B
 2 and 3 only
- **C** 1 and 3 only **D** 1, 2 and 3
- **2** Use of the Data Booklet is relevant to this question.

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

$$\begin{split} \text{Si}^{+}(\text{g}) &\rightarrow \text{Si}^{2+}(\text{g}) + \text{e}^{-} & \Delta H_1 \\ \text{A}l^{+}(\text{g}) &\rightarrow \text{A}l^{2+}(\text{g}) + \text{e}^{-} & \Delta H_2 \\ \text{Si}(\text{g}) &\rightarrow \text{Si}^{2+}(\text{g}) + 2\text{e}^{-} & \Delta H_3 \end{split}$$

 $\mathbf{A} \qquad \Delta H_1 > \Delta H_2 > \Delta H_3$

$$\mathbf{B} \qquad \Delta H_2 > \Delta H_3 > \Delta H_1$$

- $\mathbf{C} \qquad \Delta H_3 > \Delta H_1 > \Delta H_2$
- $\mathbf{D} \qquad \Delta H_3 > \Delta H_2 > \Delta H_1$

3 Analysis of a mixture of sulfur-containing gases shows that hydrogen sulfide, H₂S, and carbon disulfide, CS₂, are present in a 2 : 1 mole ratio.

The mixture is burned in excess oxygen.

Which row describes:

- the SO₂ : CO₂ mole ratio in the mixture obtained after complete combustion,
- the relative deviation from ideal behaviour of the gases, CO₂ and CS₂?

	SO ₂ : CO ₂ mole ratio	relative deviation
Α	3 : 1	CS ₂ deviates more than CO ₂
в	4 : 1	CS_2 deviates more than CO_2
С	3 : 1	CO_2 deviates more than CS_2
D	4 : 1	CO_2 deviates more than CS_2

4 The table shows the melting points of two ionic compounds.

compound	melting point / °C
CaO	2613
NaF	993

Which statement helps to explain the relative melting points of CaO and NaF?

- A Ca²⁺ has a larger ionic radius than Na⁺.
- **B** Ca²⁺ has a higher charge density than Na⁺.
- **C** The sum of ionic radii is larger for CaO than NaF.
- **D** The ionic charges are larger in magnitude for CaO than NaF.

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

- NC*l*₃
- HCN
- BeCl₂
- SOCl₂

Α	none	В	2
С	3	D	4

6 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
- 7 Which statement about the behaviour of Group 2 elements from magnesium to barium is correct?
 - A The polarising power of the cations increases.
 - **B** The oxidising power of the elements increases.
 - **C** The covalent character of the metal chlorides increases.
 - **D** The thermal stability of the metal carbonates increases.

8 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
Α	colourless solution remains	cream precipitate formed
В	colourless solution turns orange	cream precipitate formed
С	colourless solution turns orange	white precipitate formed
D	colourless solution turns pale yellow	white precipitate formed

9 Use of the Data Booklet is relevant to this question.

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



D

1, 2 and 3

Which descriptions of the enthalpy changes are correct?

- 1 $\Delta H_1 + \Delta H_2 > +1220 \text{ kJ mol}^{-1}$
- 2 $\Delta H_3 = 10 \times P-Cl$ bond energy
- 3 $\Delta H_4 = 2 \times \Delta H^{\ominus}_{\text{formation}} \text{ of } PCl_5(s)$
- **A** 1 and 2 only **B** 1 and 3 only
- **C** 2 and 3 only

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

Which statement about the forward reaction is correct?

- A It is spontaneous only at low temperature.
- **B** It is spontaneous only at high temperature.
- **C** It is not spontaneous at any temperature.
- **D** It is spontaneous at all temperatures.
- 11 0.02 mol of an iodine oxide reacts with 0.2 mol of acidified potassium iodide to give 0.12 mol of iodine, I₂.

What is the oxidation number of iodine in the oxide?

A +1 B +3	C +5 D +7
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12 An excess of H₂ gas is reacted with Cl_2 gas in a 1 dm³ vessel at constant temperature. The reaction is catalysed by UV light and is found to be zero order with respect to Cl_2 .

Which diagram represents the variation of partial pressure of Cl_2 gas, p_x , with time?



13 The kinetics of the following reaction is studied by finding the time taken for a coloured reactant, **A**, to decolourise. The reaction is catalysed by **Y**.

$$A + B \longrightarrow C + D$$

The following results are obtained:

experiment number	volume of A added / cm ³	volume of B added / cm ³	volume of Y added / cm ³	volume of H ₂ O added / cm ³	time taken / s
1	10	20	10	10	20
2	10	10	10	20	40
3	10	20	5	15	40
4	5	20	10	15	10
5	2.5	20	10	17.5	?

Which statements about this reaction are correct?

- 1 Colorimetry can be used to monitor the kinetics of the reaction.
- 2 The rate equation is rate = $k[\mathbf{B}][\mathbf{Y}]$.
- 3 The time taken for experiment 5 is 5 s.
- A
 1, 2 and 3
 B
 1 and 2 only

 C
 1 only
 D
 2 and 3 only

E and **F** are reacted in a closed vessel to form **G** as shown.

E(g) + **F**(g) - **G**(g)

At time **X** min, 1 mol of inert gas **P** is added at constant volume.

Which of the following graphs represents the variation of total pressure of the system with time?



15 A metal hydroxide dissolves partially in water as shown:

 $M(OH)_2(s) + aq \rightleftharpoons M^{2+}(aq) + 2OH^{-}(aq) \qquad \Delta H > 0$

Which statements are correct as temperature increases?

- 1 Equilibrium is reached at a faster rate.
- 2 pH of the solution increases.
- 3 K_{sp} of M(OH)₂ increases.

Α	1, 2 and 3	В	1 and 2 only
С	2 and 3 only	D	1 and 3 only

16 Which of the following pairs can be used to prepare a buffer of approximately pH 6 that has maximum buffer capacity?

Α	NH_4^+ and NH_3	$K_{ m b}$ of NH ₃	= $1.78 \times 10^{-5} \text{ mol dm}^{-3}$
В	H_2CO_3 and HCO_3^-	K _b of HCO ₃ [−]	= $2.38 \times 10^{-8} \text{ mol dm}^{-3}$
С	H_3PO_4 and $H_2PO_4^-$	$K_{\rm b}$ of H ₂ PO ₄ ⁻	= $1.33 \times 10^{-12} \text{ mol dm}^{-3}$
D	CH₃COOH and CH₃COO⁻	<i>K</i> ₀ of CH₃COO	$^{-}$ = 5.71 $ imes$ 10 ⁻¹² mol dm ⁻³

17 A solution contains two anions with the following concentrations:

anion	concentration / mol dm ⁻³	
CrO ₄ ^{2–}	0.200	
C <i>l</i> −	0.0100	

Aqueous AgNO₃ is slowly added to the solution.

Which is the first compound to precipitate and what concentration of Ag⁺ is necessary to begin its precipitation?

Given: $K_{sp}(Ag_2CrO_4) = 1.20 \times 10^{-12} \text{ mol}^3 \text{ dm}^{-9}$, $K_{sp}(AgCl) = 1.80 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$

	first precipitate formed	[Ag ⁺]
Α	Ag ₂ CrO ₄	$6.00 imes 10^{-12}$
В	Ag ₂ CrO ₄	$2.45 imes 10^{-6}$
С	AgC <i>l</i>	$1.34 imes 10^{-5}$
D	AgC <i>l</i>	1.80×10^{-8}

- 18 Which molecule contains a total of four sp-hybridised carbon atoms?
 - $A \qquad HC \equiv C CH = CH CH = CH_2$

B $H_2C=C=C=CH-CH=CH_2$

- C HC=C-CH=CH-CH=CH-CN
- **D** $H_2C=C=C=C=CH-CH_2-CN$

19 Scopolamine is a toxic hallucinogen found naturally in plants such as the deadly nightshade and angels' trumpet.



What is the total number of chiral carbons in this molecule?

Α	5	В	6
С	7	D	8

20 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]

Α	6	В	8	С	9	D	10
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21 But-2-ene-1,4-diol is converted in two steps through an intermediate **H** into ketobutanedioic acid.

What could be the reagent for step 1 and the structure of intermediate H?

	reagent for step 1	structure of H
Α	steam and concentrated H ₃ PO ₄	HOCH ₂ CH ₂ CH(OH)CH ₂ OH
В	HBr(g)	HO ₂ CCH(OH)CH ₂ CO ₂ H
С	cold acidified KMnO4	HOCH ₂ CH(OH)CH(OH)CH ₂ OH
D	warm acidified K2Cr2O7	HO ₂ CCH=CHCO ₂ H

- 22 Which of the following reagents and conditions can be used to distinguish between benzene and cyclohexene?
 - 1 Excess hydrogen gas with nickel at high temperature and pressure.
 - 2 Hot acidified potassium manganate(VII).
 - 3 Aqueous bromine, absence of UV light.
 - A 1 and 2 only B 1 and 3 only
 - C 1 only D 2 and 3 only
- **23** Chlorofluoroalkanes are commonly used as aerosol propellents. However, they cause depletion to the ozone layer when they rise into the stratosphere. It has thus been suggested that fluoroalkanes should be used instead.

Which of the following could be a possible reason for the suggestion?

- A Fluoroalkanes are less volatile than chlorofluoroalkanes and are less likely to reach the stratosphere.
- **B** Fluorine radicals may be produced, but unlike chlorine radicals, do not react with ozone.
- **C** Fluorine radicals are not produced as the C–F bonds are stronger than the C–C*l* bonds.
- **D** Fluorine radicals may be produced, but unlike chlorine radicals, will not generate more radicals after reacting with ozone.
- 24 An organic chemist treated compound **R** with a catalytic amount of H⁺(aq) to yield compounds **S** and **T**.



How many different isomers will be formed after ${\bf T}$ has been reacted with excess hot concentrated sulfuric acid?

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

25 Compounds X, Y and Z all react with 2,4–dinitrophenylhydrazine but only two of them will cause a reduction in the oxidation number of the metal present in the Tollens' reagent. Which combination is X, Y and Z?

	X	Y	Z
Α	CH_3CONH_2	C ₆ H₅CHO	CH ₃ COCH ₃
В	CH ₃ CH ₂ CHO	$C_6H_5CH_2CHO$	CH ₃ CH ₂ COOCH ₃
С	CH ₃ CH ₂ CHO	C_6H_5CHO	CH ₃ COCH ₃
D	CH ₃ CH ₂ CHO	$C_6H_5CH_2CHO$	CH₃CHO

26 Orsellinic acid is found in some species of fungus.



orsellinic acid

0.1 mol of orsellinic acid is reacted with excess $Na_2CO_3(aq)$ and the gaseous product formed is passed through a bottle of excess concentrated NaOH.

What is the increase in mass in the bottle of concentrated NaOH?

- **A** 1.1 g
- **B** 2.2 g
- **C** 4.4 g
- **D** 6.6 g

27 A tripeptide, thr-his-arg, is analysed using electrophoresis. The tripeptide is hydrolysed and the resulting solution is then placed at the centre of the plate in a buffer solution of pH 7.0. A potential difference is then applied across the plate. Isoelectric point refers to the pH at which an amino acid is electrically neutral.

amino acid	$OH \rightarrow OH \rightarrow$	OH H H N N N N N N N N N N N N N N N N N	OH NH ₂ OH NH ² NH ² arginine
isoelectric point	5.60	7.59	10.76

Which statements are correct?

- 1 Arginine is a more basic amino acid than threonine.
- 2 Histidine will migrate towards the anode while arginine will migrate towards the cathode.
- 3 The predominant species of threonine at pH 7.0 is

`ОН '

Α	1, 2 and 3	В	1 and 2 only
С	1 only	D	2 and 3 only

28 The standard electrode potentials for metals **J** and **K** are given below.

The electrochemical cell shown in the diagram below is set up.



Which of the following statements are correct descriptions of this cell?

- 1 The e.m.f. of the cell is +1.24 V.
- 2 The anions from the salt bridge will enter the $K^{2+}(aq) | K(s)$ half cell.
- The e.m.f. of the cell will decrease when the concentration of \mathbf{K}^{2+} ions increases. 3

Α	1, 2 and 3	В	1 and 2 only
С	1 only	D	2 and 3 only

29 Use of the Data Booklet is relevant to this question.

A student carried out an experiment involving the electrolysis of aqueous copper(II) sulfate in Cell I and aqueous sulfuric acid in Cell II.



0.00417 mol of copper is deposited at electrode **B** after electrolysis. What is the volume of gas formed at electrode **C** when measured at r.t.p.?

- **A** 0.050 cm³
- **B** 0.050 dm³
- **C** 0.10 cm³
- **D** 0.10 dm³
- **30** An electrically neutral, red, octahedral complex **W** is formed when ligand **P** is added to an aqueous solution of Fe³⁺ ions. **W** does not contain water ligands.



Ρ

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

- **A P** is a stronger ligand than water.
- **B P** acts as a bidentate ligand in **W**.
- **C** The coordination number of **W** is the same as that of $Fe^{3+}(aq)$.
- **D** The oxidation states of iron in **W** and Fe^{3+} are different.