Candidate Name: _____

H

2024 Preliminary Examinations
Pre-University 3

H2 CHEMISTRY   **9729/01**
Paper 1 Multiple Choice   **18 Sep 2024**
                                                                              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.

At the top of this page:
Write your name, class and admission number in the spaces provided.

On the Answer Sheet:
Write your name, class and subject.
Write your identification number and shade the corresponding bubbles.

Ther 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.

FOR EXAMINER'S USE	
TOTAL (30 marks)	

This question paper consists of **12** printed pages and **2** blank pages.

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

1   Which of the following statements are correct about 1 mole of C(s)?

1   It contains 6.02×10^{23} carbon atoms.

2   It has a mass of 12.0 g.

3   It contains 12 moles of electrons.

4   It occupies a volume of 24.0 dm³ at room temperature and pressure.

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

2   A painkiller pill contains 500 mg of acetaminophen, $C_8H_9NO_2$.
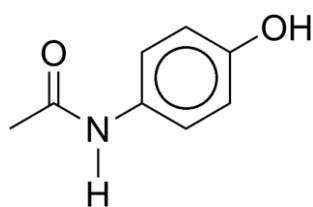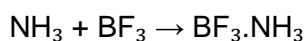

acetaminophen

What is the mass of nitrogen present in one pill?
[1 g = 1000 mg]

A   0.046 g   **B**   0.093 g   **C**   0.151 g   **D**   0.700 g

3   Ammonia reacts with boron trifluoride in the following equation.

$$NH_3 + BF_3 \rightarrow BF_3.NH_3$$

What is the role of NH_3 in the reaction?

A   Brønsted-Lowry acid

B   Brønsted-Lowry base

C   Lewis acid

D   Lewis base

4   When excess potassium iodide, KI, is added to potassium iodate(V), iodine is produced.

$$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$$

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

A   Iodine in IO_3^- was reduced.

B   Iodine in I^- was oxidised.

C   The reaction is a disproportionation reaction.

D   The oxidation number of iodine in I_2 is 0.

5   Which of the following statements is **not** true of an element in Period 3?

A   It has electrons in the spherically shaped orbitals.

B   It has three dumb-bell shaped orbitals in its outermost shell.

C   It has five orbitals with four lobes in each orbital.

D   It is able to accommodate more than 8 electrons in its outermost shell.

6   A beam of $_{11}^{23}Na^+$ ions were passed through an electric field and it was found to deflect by an angle of $+8.5^o$.

What is the angle of deflection for a beam of $_{15}^{31}P^{3-}$ ions travelling at the same speed through the same electric field?

A -34.4^o **B** -18.9^o **C** -18.7^o **D** -3.8^o

7   Which of the following correctly describe the structure and bonding in carbon?

1   It contains strong C–C covalent bonds.

2   It can contain weak instantaneous dipole-induced dipole forces of attraction.

3   It can have a giant lattice structure.

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

[Turn over

8 An unknown element **J** exists as a liquid at 35 ˚C and is electrically conductive in both the solid and liquid states.

Another unknown element **K** exists as a gas at 35 ˚C and does not conduct electricity in both the solid and liquid states.

Which of the following statements are **false** about the compound formed between **J** and **K**?

A It could conduct electricity in the molten state.

B It could exist as non-polar molecules.

C It could have the formula JK_2.

D It could contain delocalised electrons.

9 Which of the following statements correctly describe ideal gas behaviour?

A 1 mol of oxygen gas occupies 22.7 dm³ at room temperature and pressure.

B 1.06 mol of carbon dioxide gas occupies 24.0 dm³ at standard temperature and pressure.

C At low temperatures, nitrogen gas turns into a liquid.

D At constant pressure, concentration of hydrogen gas increases when temperature increases.

10 In an isolated system, a 2.5 dm³ vessel containing neon gas at –43 ˚C and 80 kPa was connected to a 5.5 dm³ vessel containing helium gas at –97 ˚C and 39 kPa. The valve was opened and the gases were allowed to mix.

The final pressure of the mixture was found to be 59 kPa.

Assuming ideal gas behaviour, what is the final temperature of the mixture?

A –18 ˚C **B** –47 ˚C **C** –70 ˚C **D** –116 ˚C

11 Which of the following equations represents the standard enthalpy change of atomisation of the species?

A $\frac{1}{2}Br_2(g) \rightarrow Br(g)$

B $Hg(l) \rightarrow Hg(g)$

C $H_2O(l) \rightarrow H_2O(g)$

D $Na(s) \rightarrow Na^+(g)$

12 Which of the following statements help to explain why the enthalpy change of solution of sodium chloride is endothermic?

A The lattice energy is more exothermic than the sum of the hydration energies of the ions.

B The lattice energy is less exothermic than the sum of the hydration energies of the ions.

C The energy released from the formation of ion-dipole interactions is sufficient to overcome the ionic bonds.

D The energy released from the formation of ion-dipole interactions is insufficient to overcome the ionic bonds.
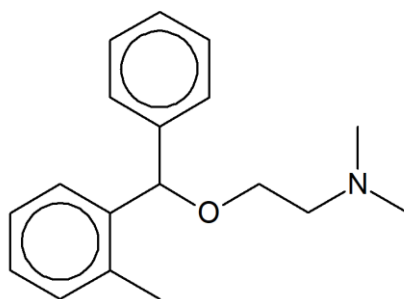
13 Consider the following reaction mechanism.
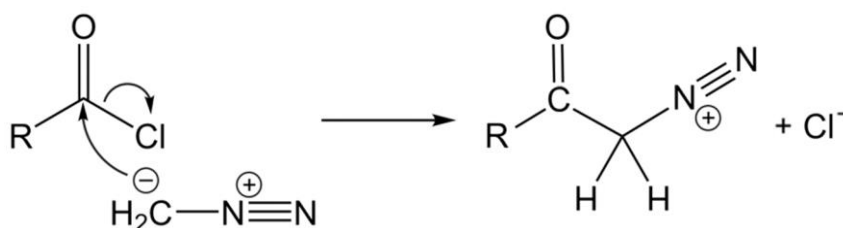
Which of the following statements about the reaction is **incorrect**?

A CH_2N_2 acts as an electrophile.

B CH_2N_2 acts as a Lewis base.

C CH_2N_2 acts as a nucleophile.

D It is a substitution reaction.
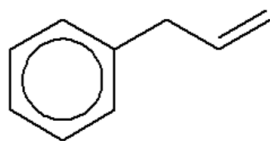
14 Which of the following statements are true about orphenadrine?

orphenadrine

1 It can exhibit enantiomerism.

2 It has a pK_a that is greater than 7 at 25 °C.

3 It has the molecular formula $C_{16}H_{23}NO$.

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

[Turn over

15 Which of the following products will be formed when prop-2-enylbenzene is mixed with cold Br_2 in CCl_4, in the presence of UV light?
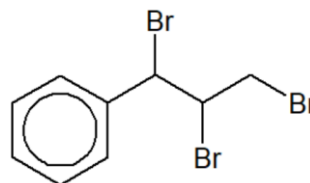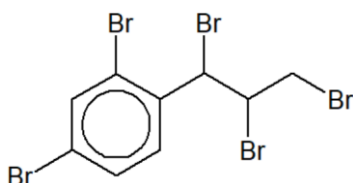

prop-2-enylbenzene

A
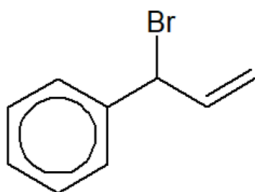
B

C

D

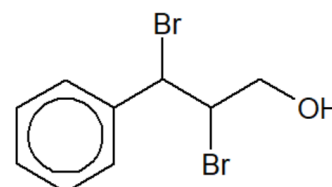**16** Which of the following statements are true about benzene?

1   The C–C bond has a bond order of between 1 and 2.

2   It is able to conduct electricity due to delocalised electrons.

3   It is a planar molecule with all bond angles being 120˚.

4   It undergoes addition reactions readily due to its C=C double bonds.

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

17 Chloroethane is heated with NaOH separately in aqueous and ethanolic medium, producing the major products **Q** and **T** respectively.

Which of the following statements is true about **Q** and **T**?

A   The M_r of **Q** is heavier than the M_r of **T** by 18.0.

B   Both **Q** and **T** are polar covalent compounds.

C   **Q** has a non-superimposable mirror image.

D   **T** has hydrogen bonding between its molecules.

18 Miconazole cream is used to treat fungal skin infections.
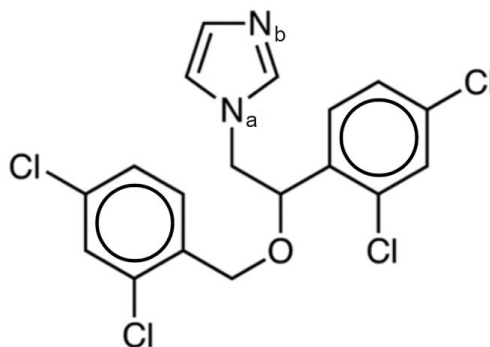
Which of the following statements are true about miconazole?

[The C–O–C group is considered inert.]

A There is p-orbital overlap between the atom N_a and π electron cloud adjacent to it.

B When boiled with NaOH(aq), cooled and neutralised with HNO_3(aq), it gives a white precipitate upon addition of $AgNO_3$(aq).

C The N_a atom on miconazole acts as a stronger base than N_b.

D The product of hydrolysis gives a dark colouration with neutral $FeCl_3$(aq).

19 The radioactive decay of ^{212}Pb into ^{212}Bi has a half-life of 10.6 hours.

Given that radioactive decay observes first-order kinetics, how much time does it take for 85% of a ^{212}Pb sample to be converted to ^{212}Bi?

A 2.5 hours

B 9.0 hours

C 18.0 hours

D 29.0 hours

20 Lactose is a sugar that is usually found in milk. In the human body, the enzyme, lactase, hydrolyses lactose, turning it into galactose and glucose. Lactose intolerance occurs when a person's digestive tract does not produce sufficient lactase to break down lactose.

Which of the following statements is **false** about the hydrolysis of lactose when a lactose-intolerant person drinks milk?

A The substrate concentration far exceeds the enzyme concentration.

B The order of reaction for the hydrolysis of lactose tends to 0.

C The enzyme activity of lactase is specific to lactose only.

D There is a lower average kinetic energy for the hydrolysis to occur.

[Turn over

21 The oxidation of sulfur dioxide in the Contact Process has the following equation.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$
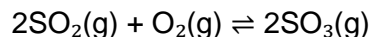
SO_2 and O_2 gas were added to an evacuated vessel in a 2:1 molar ratio and allowed to reach equilibrium.

Given that the equilibrium has a K_p value of 5 atm^{-1} and that the partial pressure of $SO_3(g)$ at equilibrium was 25.6 atm, what is the partial pressure of $SO_2(g)$ in the system at equilibrium?

A 3.2 atm   **B** 6.4 atm   **C** 7.2 atm   **D** 9.6 atm

22 Which of the following indicators is the most suitable for determining the end-point of the following titration?
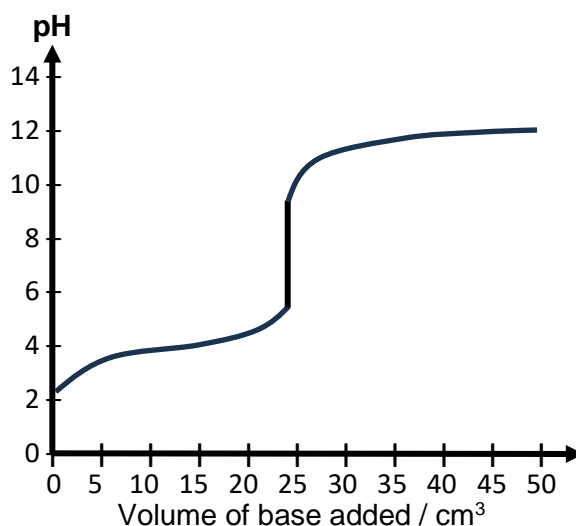
	indicator	working pH range
A	cresol red	0.2 - 1.8
B	methyl yellow	2.9 - 4.0
C	phenol red	6.4 - 8.0
D	alizarin yellow R	10.0 - 12.0

23 30.0 cm³ of 0.100 mol dm⁻³ propylamine, $CH_3CH_2CH_2NH_2$, was titrated against 0.150 mol dm⁻³ HCl(aq) at constant temperature. When half the volume of HCl(aq) needed to reach equivalence point was added, the pH of the solution was 10.54.

Given that the pK_b of propylamine is 3.32 at the temperature in which the reaction was carried out, which of the following statements are correct?

1 The reaction was carried out at a temperature higher than 25 °C.
2 The volume of HCl(aq) needed to reach equivalence point is 20.0 cm³.
3 The initial pH of the propylamine solution was 11.84.

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

24 Solid sodium carbonate, Na_2CO_3, is added gradually added to a solution containing a mixture of Mg^{2+}, Ca^{2+} and Ag^+ ions, each at 0.002 mol dm⁻³.

compound	K_{sp}
$MgCO_3$	3.6×10^{-8}
$CaCO_3$	2.8×10^{-9}
Ag_2CO_3	8.4×10^{-12}

What is the order of precipitation of the carbonates?

	first		last
A	$MgCO_3$	$CaCO_3$	Ag_2CO_3
B	$MgCO_3$	Ag_2CO_3	$CaCO_3$
C	Ag_2CO_3	$CaCO_3$	$MgCO_3$
D	$CaCO_3$	Ag_2CO_3	$MgCO_3$

25 The following graph depicts a physical property belonging to either consecutive Period 3 elements, or the chlorides or oxides of consecutive Period 3 elements.
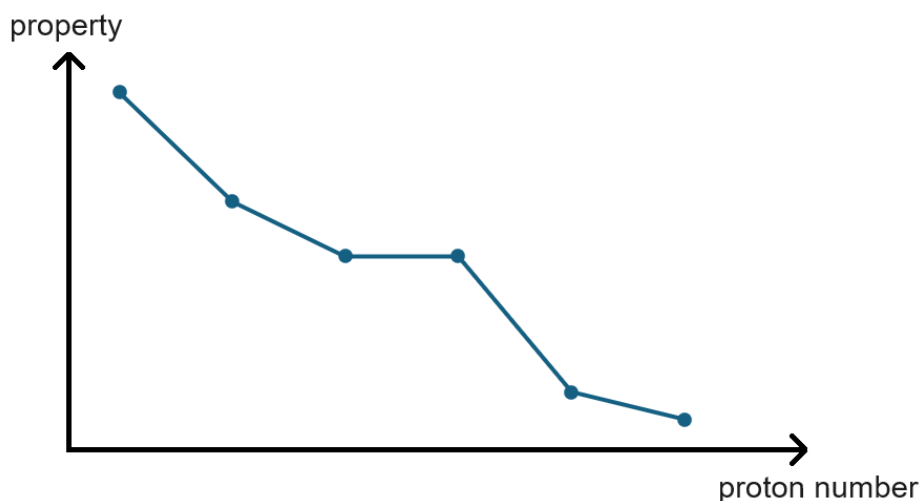
What is the physical property depicted?

A   electrical conductivity

B   electronegativity

C   melting point

D   pH in water

26 Compounds **X** and **Y** are either oxides or chlorides of Period 3 elements. Both **X** and **Y** exist as white solids at room temperature.

X is highly soluble in water, forming a solution which turns litmus red.

Y is slightly soluble in water, forming a solution which turns litmus blue.

What are the likely identities of compounds **X** and **Y**?

	X	Y
A	sodium chloride	phosphorus pentoxide
B	magnesium oxide	aluminium chloride
C	magnesium chloride	silicon dioxide
D	aluminium chloride	magnesium oxide

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

A metallic trophy was to be electroplated with a thin layer of gold with a thickness of 6×10^{-5} cm in an electrolyte consisting of Au^{3+} ions.

Given that the surface area of the trophy is 1381 cm², and that the density of gold is 19.3 g cm^{-3}, how much time would it take to complete the electroplating using a current of 1 A?

A 783 s

B 2350 s

C 27200 s

D 81600 s

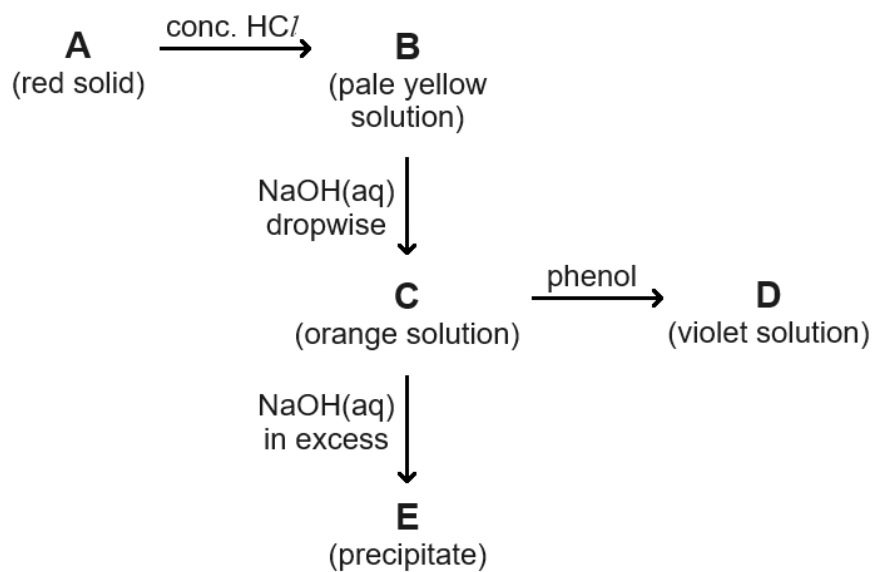**28** Which of the following statements are **not** true about the anodisation of aluminium?

1 Aluminium is oxidised by oxygen.

2 Al atoms are oxidised to Al^{3+}(aq) ions.

3 The mass of the Al layer that was oxidised increases by 88.9%.

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

29 Which of the following statements about transition metals is **not** true?

A Transition metals typically have lower melting and boiling points compared to s-block metals.

B Transition metals and their compounds often act as catalysts due to their variable oxidation states.

C Transition metals form coloured ions due to the presence of partially filled d-orbitals.

D Transition metals are less reactive than Group 1 metals towards air and water.

[Turn over

30 Consider the following reactions.

$$\textbf{A} \xrightarrow{\text{conc. HC}l} \textbf{B}$$

A
(red solid)

B
(pale yellow
solution)

NaOH(aq)
dropwise ↓

C $\xrightarrow{\text{phenol}}$ **D**

C
(orange solution)

D
(violet solution)

NaOH(aq)
in excess ↓

E
(precipitate)

What is the identity of **B**?

A $CrO_4{}^{2-}$ **B** $[CuCl_4]^{2-}$ **C** $[FeCl_4]^-$ **D** $[Fe(H_2O)_6]^{3+}$

END OF PAPER 1

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