NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION
Higher 1

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

CHEMISTRY **8873/01**
Paper 1 Multiple Choice **19 September 2024**
1 hour

Additional Materials: Optical Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, subject class and registration 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** 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.

Instructions on how to fill in the Optical Mark Sheet
Shade the index number in a 5 digit format on the optical mark sheet:
2nd digit and the last 4 digits of the Registration Number.

Example:

Student	Examples of Registration No.	Shade:
	2305648	**35648**

This document consists of **12** printed pages

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

A sample of 35.6 g of hydrated sodium carbonate contains 25.84% sodium ions by mass. When this sample is heated, anhydrous sodium carbonate and water vapour are formed.

What is the mass lost?

A 7.2 g **B** 10.6 g **C** 14.4 g **D** 21.2 g

2 Diamond is an allotrope of carbon. The mass of a diamond can be measured in carats. One carat is 0.200 g of carbon.

Which expression gives the number of carats that contain 6.02×10^{23} carbon atoms?

A 0.200×12.0

B $\frac{12.0}{0.200}$

C $\frac{0.200}{12.0}$

D $\frac{0.200}{6.02 \times 10^{23}} \times 12.0$

3 One of the main chemicals in air bags in cars is the ionic compound sodium azide, NaN_3.

When the car is in a violent head-on impact, a sensor causes ignition of the sodium azide to form nitrogen gas explosively, rapidly filling the air bag.

I $2NaN_3 \rightarrow 2Na + 3N_2$

Fine particles of potassium nitrate and silicon dioxide are also present to react with the metallic sodium.

II $2KNO_3 + 10\ Na \rightarrow 5Na_2O + K_2O + N_2$

III $K_2O + SiO_2 \rightarrow K_2SiO_3$

IV $Na_2O + SiO_2 \rightarrow Na_2SiO_3$

Which statement is **not** correct?

A Equations III and IV represent acid-base reactions.

B In reaction I, sodium ions are reduced.

C In reaction II, both sodium atoms and potassium ions are oxidised.

D In reaction II, potassium nitrate is an oxidising agent.

4 When iodine is oxidized by nitric acid, a white crystalline solid oxide can be isolated from the mixture.

1 mol of this iodine oxide reacts with 10 mol of acidified potassium iodide to give 6 mol of I_2.

What is the oxidation number of iodine in the oxide?

A +1 **B** +5 **C** +6 **D** +10

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

Sodium and fluorine are both reactive elements.

Which statements are correct?

1 One Na atom has two more protons than one F^- ion.

2 One Na atom has two more neutrons than one F atom.

3 One Na^+ ion has the same number of electrons as one F^- ion.

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

6 Which pair of compounds meets the criteria below?

- The first compound has a larger bond angle than the second compound.
- The second compound is more polar than the first compound.

A CO_2, BCl_3 **B** SF_6, H_2O **C** HCN, SO_3 **D** CO_2, NH_3

7 Which statements about the structure of the $AlCl_3$ molecule are correct?

1 The aluminium atom has an unfilled octet.

2 The molecule is planar in shape.

3 In the molten state, it consists of Al^{3+} and Cl^- ions.

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

8 Consider the following four compounds.

1 $(CH_3)_3CH$

2 $CH_3CH_2CH_2CH_3$

3 $CH_3CH_2CH_2OH$

4 CH_3CH_2Cl

What is the order of increasing boiling point of the compounds?

A 1 2 4 3

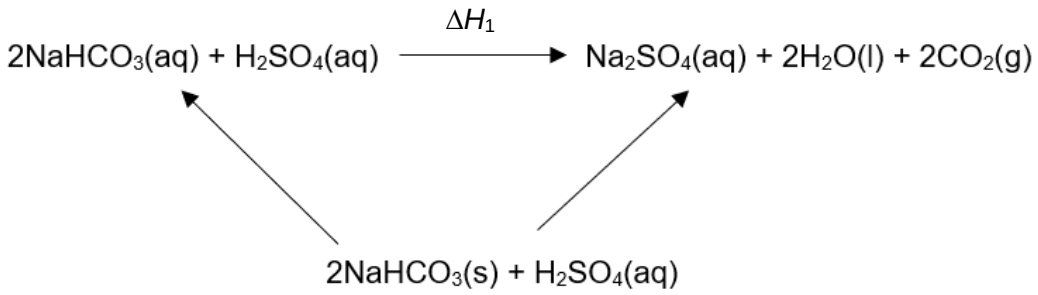
B 2 1 4 3

C 3 4 2 1

D 4 3 2 1

9 The diagram below represents the energy changes associated with $NaHCO_3$ and H_2SO_4.

	ΔH / kJ mol^{-1}
$NaHCO_3(s) + aq \rightarrow NaHCO_3(aq)$	+ 15.0
$2NaHCO_3(s) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l) + 2CO_2(g)$	+ 37.0



Determine the value of ΔH_1.

A + 7.0 kJ mol^{-1} **B** + 22.0 kJ mol^{-1} **C** + 37.0 kJ mol^{-1} **D** +52.0 kJ mol^{-1}

10 In order to determine the enthalpy of neutralisation of a strong acid and a strong alkali, 25.0 cm^3 of 2.00 mol dm^{-3} sodium hydroxide is added to 25.0 cm^3 of 2.00 mol dm^{-3} hydrochloric acid. The increase in temperature is 12°C.

In a second experiment, the same method is used, but 50.0 cm^3 of 2.00 mol dm^{-3} sodium hydroxide is added to 50.0 cm^3 of 2.00 mol dm^{-3} hydrochloric acid.

What is the increase in temperature in the second experiment?

A 6°C **B** 12°C **C** 24°C **D** 48°C

11 What is meant by the term *dynamic equilibrium?*

A An equilibrium that is constantly changing its position

B An equilibrium where the forward and reverse reactions are taking place at different rate

C An equilibrium where the forward and reverse reactions are taking place at the same rate

D An equilibrium which has not yet settled to a constant state

12 X and Y react together to form Z in a reversible reaction.

The equilibrium yield of Z at different conditions are shown in the following table.

Conditions	**Equilibrium yield of Z**
High Temperature	Decreased
High Pressure	Increased

Which equation could represent this reaction?

A $X(g) + Y(g) \rightleftharpoons Z(g)$ $\Delta H = -100$ kJ mol^{-1}

B $X(g) + Y(g) \rightleftharpoons Z(g)$ $\Delta H = +100$ kJ mol^{-1}

C $X(s) + Y(g) \rightleftharpoons 2Z(g)$ $\Delta H = -100$ kJ mol^{-1}

D $X(s) + Y(g) \rightleftharpoons 2Z(g)$ $\Delta H = +100$ kJ mol^{-1}

13 PCl_5 decomposes as shown.

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

1.0 mol of $PCl_5(g)$, 1.0 mol of $PCl_3(g)$ and 1.0 mol of $Cl_2(g)$ are placed in a container of volume 2 dm^3 at 250 °C and allowed to reach equilibrium.

At this temperature, the equilibrium mixture contains 1.8 mol of PCl_3.

What is the value of K_c at 250 °C?

A 0.12 **B** 1.8 **C** 8.1 **D** 16.2

14 Ammonium carbonate is a crystalline solid. On gentle warming a reaction occurs, forming ammonia as one product.

How are the carbonate ions behaving during this reaction?

A Brønsted-Lowry acid

B Brønsted-Lowry base

C oxidising agent

D reducing agent

15 The dissociation constant, K_w, for the ionisation of water, $H_2O \rightleftharpoons H^+ + OH^-$, at different temperatures is given below.

Temperature / °C	K_w / $mol^2\ dm^{-6}$
0	1.15×10^{-15}
25	1.00×10^{-14}
50	5.50×10^{-14}

Which statement is correct?

A Only at 25 °C are $[H^+]$ and $[OH^-]$ equal.

B The equilibrium lies furthest to the right at 0 °C.

C The forward reaction is exothermic.

D The pH of water decreases with temperature.

16 The indicator bromophenol blue, HIn, changes colour from yellow to blue over a pH range of 3.0 to 4.6.

Which statements are correct?

1 When bromophenol blue is added to water at 25 °C, [HIn] < [In^-].

2 Bromophenol blue would be a suitable indicator for the titration of a strong base and a weak acid.

3 The In^- ions are yellow.

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

17 Which statement about catalysts is correct?

A Catalysts alter the reaction pathway by increasing the activation energy.

B Catalysts increase the rate of reaction of only the forward reaction of an equilibrium reaction.

C Catalysts ensure reactants have the correct orientation for reaction.

D Catalysts alter the yield of an equilibrium reaction.

18 Potassium – Argon dating is the most widely used technique for determining the absolute ages of crustal geologic events and processes. ^{40}K decays to form ^{40}Ar with a half-life of 1.25×10^9 years.

A rock sample was tested and found to have the ratio of ^{40}K: ^{40}Ar to be 1:7

Determine the age of the rock in years.

A 1.25×10^9 **B** 2.50×10^9 **C** 3.75×10^9 **D** 6.00×10^9

19 Equal amount of two Period 3 oxides were added to water. The resultant solution has a pH below 7.

What are the identities of the two oxides?

A Al_2O_3 and MgO

B Na_2O and MgO

C SiO_2 and Al_2O_3

D Na_2O and P_4O_{10}

20 **X**, **Y** and **Z** are elements all found within Groups 13, 14 and 15 of the Periodic Table.

X is in the same group in the Periodic Table as **Y**.

Y and **Z** are in Period 3.

The first ionisation energy of **X** is greater than the first ionisation energy of **Y**.
The melting point of **Z** is less than the melting point of **Y**.

Y and **Z** both form chlorides which are white solids. These white solids react with water to produce solutions with a pH of less than 4.

Which row of the table shows the possible identities of **X** and **Y**?

	X	**Y**
A	B	A*l*
B	Ge	Si
C	As	P
D	N	P

21 Which factor helps to explain why the reducing power of the Group 1 elements increases from lithium to rubidium?

A The repulsion between paired electrons increases.

B The outer electron is in an ‘s’ subshell.

C The nuclear charge of the elements increases.

D The distance between the nucleus and the valence electron increases.

22 The solids sodium bromide and sodium iodide both react with concentrated sulfuric acid at room temperature.

With NaBr, the products formed are S and Br_2.

With NaI, the products formed are H_2S and I_2.

Which statement can be deduced from the above information?

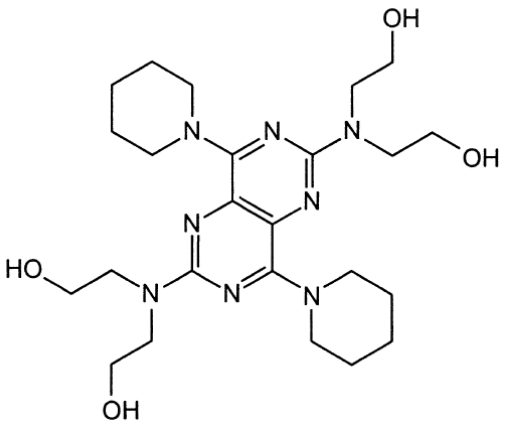
A Iodine will displace the bromide ions from the solution.

B Sodium bromide is more volatile than sodium iodide.

C Iodide ions are stronger reducing agents than bromide ions.

D Sulfuric acid act as a dehydrating agent with NaI.

23 Dipyridamole is a drug that is used to treat recovering stroke patients.



Dipyridamole

What is the empirical formula of this drug?

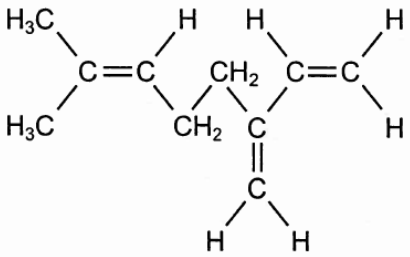
A $C_6H_9N_2O$

B $C_6H_{10}N_2O$

C $C_{11}H_{20}N_4O_2$

D $C_{24}H_{40}N_8O_4$

24 The following unsaturated hydrocarbon is found in the secretion of a termite.

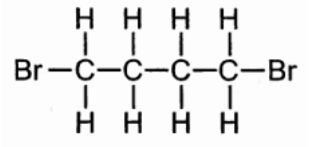


How many pairs of cis-trans isomers of this molecule exist?

A 0 **B** 1 **C** 2 **D** 3

25 Which compound could be formed by the action of bromine on an alkene of formula C_4H_8?

A



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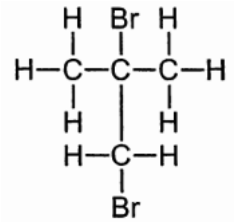

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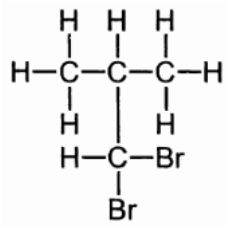

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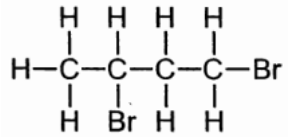


26 Lactic acid accumulates in muscles when oxygen is in short supply. It can cause muscular pain. Part of the reaction sequence is shown.

$$\underset{\text{glyceraldehyde}}{HOCH_2CH(OH)CHO} \rightarrow \underset{\text{pyruvic acid}}{CH_3COCO_2H} \rightarrow \underset{\text{lactic acid}}{CH_3CH(OH)CO_2H}$$

Which statements about the reaction sequence are correct?

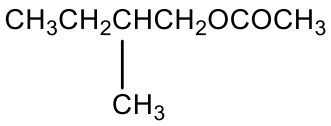
1 An aldehyde is oxidised to a carboxylic acid.

2 A ketone is reduced to a secondary alcohol.

3 A secondary alcohol is oxidised to a ketone.

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

27 An ester with a smell of banana has the following formula.



Which pair of reactants, under suitable conditions, will produce this ester?

A 2-methylbutan-1-ol and ethanoic acid

B 2-methylpentan-1-ol and methanoic acid

C 2-methylbutanoic acid and ethanol

D 2-methylpentanoic acid and methanol

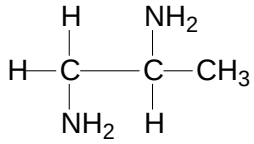
28 Polymers are used extensively in our daily lives. Various polymers have found their way into products such as eye drops and wrinkle free shirts.

Which row best describes the most suitable polymer to use for each type of product?

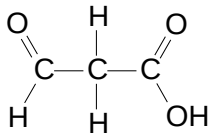
	Eye drops	wrinkle free shirts
A	poly(vinyl alcohol)	polyamide
B	poly(vinyl chloride)	polyester
C	poly(vinyl chloride)	polyamide
D	poly(vinyl alcohol)	polyester

29 Which molecule cannot be used to carry out polymerisation?

A



B



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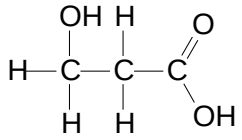

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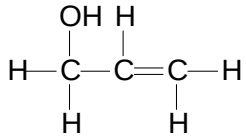

30 Which statements related to nanoparticles and nano-structures are true?

1 Graphene is a nanoparticle.

2 There are permanent dipole-permanent dipole forces of attraction between the wall surface and nano-structures of the gecko's feet.

3 Nanoparticles of smaller diameter allows more sites available for heterogeneous catalysis to take place.

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