Name:_____ **Class:**_____

JURONG PIONEER JUNIOR COLLEGE

JC2 Preliminary Examination 2024

CHEMISTRY **8873/01**
Higher 1 **2024**

Paper 1 **1 hour**

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **30** questions in this section. 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.

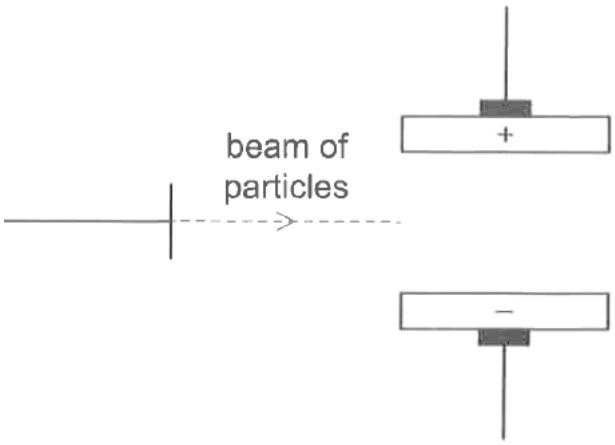
Read the instructions on the Answer Sheet very carefully.

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

[Turn over

1 In two separate experiments a beam of protons and a beam of electrons, travelling at the same velocity, pass through an electric field as shown.



Which statements are correct?

1 The electrons are deflected to a larger extent than the protons.

2 The electron beam is deflected in the opposite direction to the proton beam.

3 The proton beam travels in a straight path towards the negatively charged plate.

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

1	Answer: B (1 and 2 only) ✓**1 Electron has the same magnitude of charge but smaller mass than proton.** **Since ∠ of deflection ∝ $\left\lvert\frac{\text{charge}}{\text{mass}}\right\rvert$, electron is deflected to larger extent than proton.** ✓**2 The relative charge of electron is –1 while that of proton is +1. Hence, electron is deflected towards the positive plate while proton is deflected towards the negative plate.** ✗**3 Under the influence of uniform electric field, the proton beam travels in a curved path. The particle travels in straight path only when** outside of electric field**.**

2 The 7th, 8th, 9th and 10th ionisation energies of four consecutive elements in the Periodic Table, P, Q, R and S are shown.

element	7th ionisation energy / kJ mol^{-1}	8th ionisation energy / kJ mol^{-1}	9th ionisation energy / kJ mol^{-1}	10th ionisation energy / kJ mol^{-1}
P	9941	18580	21610	25180
Q	10530	12140	22480	25860
R	9520	12810	14530	26740
S	10300	11690	15280	17110

Which element has the highest first ionisation energy?

A P **B** Q **C** R **D** S

2 Answer: B

For each element, locate the sharp increase in IE which indicates the number of valence electron (and hence, the Group number) each element has.

Element P is from Group 17 (sharp ↑ from 7th to 8th IE).
Element Q is from Group 18 (sharp ↑ from 8th to 9th IE).
Element R is from Group 1 of the next Period **(sharp ↑ from 9th to 10th IE).**
Element S is from Group 2 of the next Period **(since W, X Y and Z are consecutive elements).**

Since 1st IE increases across the Period and decreases down the Group, element Q has the highest 1st IE.

3 A gaseous mixture containing 10 cm^3 of C_3H_8 and 90 cm^3 of oxygen was sparked and C_3H_8 undergoes complete reaction. The resultant mixture was passed through excess NaOH(aq). What is the final volume of gas remaining after cooling back to room temperature?

A 20 cm^3 **B** 40 cm^3 **C** 60 cm^3 **D** 80 cm^3

3 Answer: B

$$\mathbf{5O_2(g) + C_3H_8(g) \longrightarrow 3CO_2(g) + H_2O(l)}$$

	$5O_2$	C_3H_8	$3CO_2$	H_2O
Initial vol./ cm^3:	**90**	**10**	**0**	**-**
Change:	**-50**	**-10**	**30**	**-**
Final vol./ cm^3:	**40**	**0**	**30(absorbed by NaOH)**	

So final volume of gas (O_2) left = 40 cm^3

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

HFC-134a is a molecule that was developed during the 1980s to replace CFCs that were causing great damage to the ozone layer.

The percentage composition by mass of HFC-134a is: C, 23.5%; H, 2.0%; F, 74.5%.

Which structural formula could be that of HFC-134a?

A CH_2FCF_3 **B** CHF_2CF_3 **C** CHF_3 **D** CH_2F_2

4 Answer: A

	C	**H**	**F**
Mole ratio:	**23.5/12 =2**	**2/1 = 2**	**74.5/19 = 4**

Empirical formula: CHF_2
Option A has same empirical formula.

5 A 25.0 cm^3 sample of 0.20 mol dm^{-3} $Tl(NO_3)$ required 25.0 cm^3 of 0.10 mol dm^{-3} acidified $KMnO_4$ to oxidise it to Tl^{3+} in solution.

What is the oxidation state of the manganese in the reduced form?

A +2 **B** +3 **C** +4 **D** +5

5 Answer: B

$Tl^+ \longrightarrow Tl^{3+} + + 2e^-$

Amt of Tl^+ = 0.20 x 25.0/1000 = 5.00 x 10^{-3} mol

Amt of electron lost = 5.00 x 10^{-3} x 2 = 1.00 x 10^{-2} mol

Amt of MnO_4^- = 0.10 x 25.0/1000 = 2.50 x 10^{-3} mol

Thus, MnO_4^- : e^- = 2.50 x 10^{-3} : 1.00 x 10-2 = 1 : 4

Thus, the oxidation state of Mn = (+7) + 4(-1) = +3

6 Silicon carbide, SiC, has the same structure as silicon(IV) oxide, SiO_2. Hence, SiC is used as a major industrial abrasive, and a refractory material which is resistant to decomposition by heat. Which type of structure explains these properties?

A A simple molecular structure with covalent bonds between silicon and carbon atoms.

B A layered structure with covalent bonds between silicon and carbon atoms and weak instantaneous dipole-induced dipole attraction between the layers.

C A giant covalent structure with strong covalent bonds between silicon and carbon atoms forming a 3-dimensional network.

D A giant ionic lattice with strong ionic bonds holding the oppositely charged ions together.

6 Answer: C

SiO_2 exists as giant molecular structure with atoms arranged in tetrahedral manner.

Silicon dioxide, SiO_2

- **High melting point** as **strong covalent bonds** have to be broken.

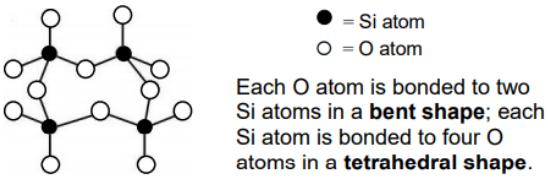


Fig. 28 Structure of silicon dioxide

7 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 **decreasing** boiling point of these compounds?

A 1 → 2 → 4 → 3

B 3 → 4 → 1 → 2

C 3 → 4 → 2 → 1

D 4 → 3 → 2 → 1

7 Answer: C

3: Hydrogen bonding between molecules.
4: Pd-pd
2: Straight chain, bigger surface area of contact between molecules, strong id-id
1: branched, smaller surface area, weaker id-id between molecules

8 Which of the following statement explains why the boiling point of water (100 °C) is higher than that of ammonia (–33 °C)?

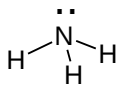
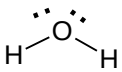
A There are, on average, more hydrogen bonds between water molecules than there are between ammonia molecules.

B The M_r of water is greater than that in ammonia, so instantaneous dipole-induced dipole forces of attraction between water molecules is stronger.

C Ammonia has intramolecular hydrogen bonds, which water does not have.

D The O–H bond in water is stronger than the N–H bond in ammonia.

8 Answer: A

compound	Boiling Point /°C	No. of lone pairs	No. of delta positive H)	No. of Hydrogen Bonds formed per molecule (on *average*)
Ammonia 	**-33.3**	**1**	**3**	**1**
water 	**100**	**2**	**2**	**2 (greatest no.)**

hydrogen fluoride 	**19.5**	**3**	**1**	**1**

Why does H_2O have a **higher boiling point** than NH_3?
=>because **H_2O** on average, forms **2 hydrogen bonds** per molecule whereas **NH_3** forms **1 hydrogen bond** per molecule. H_2O forms **more extensive hydrogen bonds between H_2O molecules**, which need **more energy to overcome**

9 Phosphorus reacts with chlorine to form **both** PCl_3 and PCl_5. However, nitrogen reacts with chlorine, to form **only** NCl_3. Which statement is the best explanation for this?

A Nitrogen cannot attain an oxidation state of +5.

B The N–C*l* bond is weaker than the P–C*l* bond.

C The valence orbitals of P are higher in energy than that of N.

D N does not have vacant low-lying d orbitals to expand octet.

9 Answer: D

N is a **Period 2 element** which **cannot expand its octet electronic configuration** in its valence shell as the next available vacant (3s) orbital is from another principal quantum shell which is not energetically accessible. Hence **NCl_5 cannot exist**.
P can accommodate more than 8 electrons in its valence shell due to **presence of vacant low lying** (or **vacant energetically accessible**) **3d orbitals**. Hence PCl_3 and PCl_5 can exist.

10 Which statements are correct for the sequence of compounds below considered from left to right?

NaF MgO AlN SiC

1 The electronegativity difference between the elements in each compound increases.

2 The compounds are isoelectronic.

3 The bonding becomes increasingly covalent.

A 3 only

B 2 and 3 only

C 1 and 2 only

D 1, 2 and 3

10 Answer: B

×1. The electronegativity difference between the elements decreases as the compounds are from ionic to covalent from left to right.

✓2. Isoelectronic means atoms, ions or molecules containing same number of electrons. The no of electrons in each compound is 18.

✓3. The electronegativity difference between the elements decreases so the compounds became more covalent from left to right.

11 The table shows the thermal decomposition of three hydrogen halides.

	HC*l*	HBr	HI
decomposition temperature / °C	1500	1200	500

Why is there a decrease in the decomposition temperature of the hydrogen halides from hydrogen chloride to hydrogen iodide?

1 Induced dipole forces between molecules decrease in strength.

2 Hydrogen bonds between molecules decrease in strength.

3 Covalent bonds between the atoms decrease in strength.

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

11	Answer: D **The thermal stability of HX depends on the strength of the H–X bond.** **Down the group, as atomic radius increases from C*l* to I, the bond length of H–X bond increases and bond strength decreases. Thus the thermal stability of HX decreases down the group.**

12 Element X reacts with oxygen to form a high melting point solid which is insoluble in water. When X reacts with chlorine, a low melting point liquid is formed which is soluble in water, giving a solution with a pH of 1.

What is X?

A magnesium **B** aluminium

C silicon **D** phosphorus

12	Answer: C **Oxide X is insoluble in water which means it could be SiO_2 or Al_2O_3. X reacts with chlorine to give a low melting point liquid which filts $SiCl_4$ (non polar simple covalent cpd) and it does hydrolyse completely in water to give strong acid, HCl. $AlCl_3$ only partially hydrolyses in water to give a solution of pH 3.**

13 Which difference best explains the variation in melting points across Period 3?

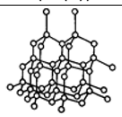
A the difference in structure and bonding

B the difference in nuclear charge

C the difference in number of unpaired electrons

D the difference in bond energies

13 Answer: A

	Group 1	Group 2	Group 13	Group 14	Group 15	Group 16	Group 17	Group 18
Period 3	Sodium (Na(s))	Magnesium (Mg(s))	Aluminium (Al(s))	Silicon (Si(s))	Phosphorus (P_4(s))	Sulfur (S_8(s))	Chlorine (Cl_2(g))	Argon (Ar(g))
Structure								
Type of structure	Giant metallic	Giant metallic	Giant metallic	Giant covalent	Simple molecular	Simple molecular	Simple molecular	Simple monoatomic
Bonding	Metallic bonds: strong electrostatic attraction between positive metal cations and mobile valence electrons			Covalent bonds: strong covalent bonds between atoms	Within each molecule, atoms are held by strong covalent bonds (except Ar). Between molecules, the molecules are held by weak instantaneous dipole–induced dipole attractions.			
Melting / boiling points	High (increasing from Group 1 to 13)			Very high (maxima at Group 14)	Low (minima at Group 18)			

14 Which equation correctly represents the lattice energy of sodium oxide?

A $2Na(s) + \frac{1}{2} O_2(g) \rightarrow Na_2O(s)$

B $2Na^+(g) + O^{2-}(g) \rightarrow Na_2O(s)$

C $Na(g) + \frac{1}{4} O_2(g) \rightarrow \frac{1}{2} Na_2O(s)$

D $Na^+(g) + \frac{1}{2} O^{2-}(g) \rightarrow \frac{1}{2} Na_2O(s)$

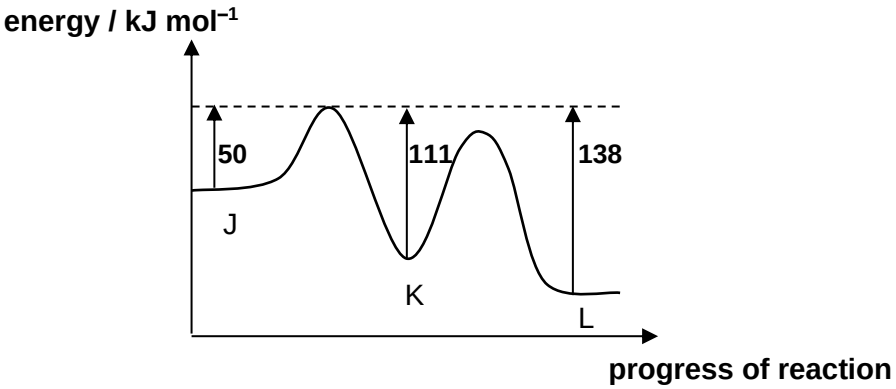
14 Answer: B

Lattice energy is the heat evolved when one mole of ionic solid, Na_2O, is formed from its gaseous ions, Na^+ and O^{2-}.

15 The reaction pathway diagram for a two–step reaction is shown below.

Step 1: J ⇌ K

Step 2: K ⟶ L



Which statement is correct?

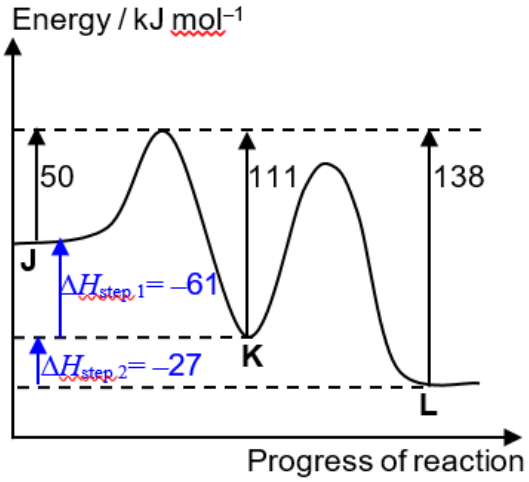
A Step 2 is more exothermic than step 1.

B The enthalpy change for both the forward and backward reactions in step 1 is the same.

C The activation energy for the backward reaction in step 1 is 61 kJ mol^{-1}.

D The enthalpy change of reaction for the conversion of J to L is the sum of the enthalpy changes in step 1 and step 2.

15 Answer: D



A × **From the diagram, both step 1 and 2 are exothermic reactions.**
Enthalpy change of reaction for the step 1 ($\Delta H_{step\ 1}$) = – (111 – 50) = – 61 kJ mol^{-1}
Enthalpy change of reaction for the step 2 ($\Delta H_{step\ 2}$) = – (138 – 111) = – 27 kJ mol^{-1} (less exothermic than step 1)

B × **As step 1 is a reversible reaction, the forward and backward reaction has the same numerical value for enthalpy change but their signs are different.**

C × **The activation energy for the backward reaction in step 1 is 111 kJ mol^{-1} whereas the forward reaction has activation energy of 50 kJ mol^{-1}.**

D ✓ **Enthalpy change of reaction for conversion of J to L**
= Sum of enthalpy change of reaction for first step and second step
= – 61 – 27 = – 88 kJ mol^{-1}

16 For a reversible reaction, what is the effect of a catalyst on the

- rate constant for the forward reaction, k_1,
- rate constant for the reverse reaction, k_{-1}, and
- the equilibrium constant, K_c?

	k_1	k_{-1}	K_c
A	increases	decreases	no effect
B	increases	increases	increases
C	increases	increases	no effect
D	no effect	no effect	increases

16	Answer: C **Eqm constant K_c is only affected by temp.** **When catalyst is added, both rate constant for forward (k_1) and backward (k_{-1}) will increase.**

17 Radioactive decay is a first order reaction.

The rate of decay of a radioactive isotope decreases from 200 counts per minutes to 25 counts per minutes after 24 hours. What is its half-life?

A 3 hours **B** 4 hours **C** 6 hours **D** 8 hours

17	Answer: D **200 $\xrightarrow{t_{½}}$ 100 $\xrightarrow{t_{½}}$ 50 $\xrightarrow{t_{½}}$ 25** **The duration of 3 half-lives is 24 hours** **Hence, 1 half life is 24/3 = 8 hours**

18 Hydrogen and nitrogen monoxide can react to form nitrogen and steam.

$$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O$$

The rate of this reaction is first order with respect to hydrogen and second order with respect to nitrogen monoxide.

Which of the following conclusions can be drawn from this information?

A The unit of rate constant is $mol^3\ dm^{-9}$.

B Halving the concentration of hydrogen will not change the rate of reaction.

C The value of rate constant depends on the concentrations of hydrogen and nitrogen monoxide.

D Doubling the concentration of nitrogen monoxide increases the rate of evolution of nitrogen gas by 4 times.

18	Answer: D **From the given information, rate equation is Rate=k[H_2][NO_2]^2**

	A **Units of rate constant = mol dm^{-3} s^{-1} / (mol dm^{-3})^3** **×** **= mol^{-2} dm^6 s^{-1}** **B** **As the order with respect to H_2 is order 1, halving the concentration of H_2 will** **×** **halve the rate.** **C** **×** **Rate constant, k is determined by k = A $e^{-\frac{E_a}{RT}}$. Hence rate constant is affected by only temperature and use of catalyst.** **D** **As the order with respect to NO_2 is order 2, hence doubling the concentration** **✓** **of nitrogen monoxide increases the rate of evolution of nitrogen gas by 4 times.**

19 Exhaust fumes from car engines contain the gases carbon dioxide, nitrogen oxides and unburnt hydrocarbons.

Use of a catalytic converter in the car exhaust changes the gases emitted.

Which statements are correct about the reactions occurring in the catalytic converter?

1 Carbon dioxide is removed by reduction.

2 Oxides of nitrogen are removed by reduction.

3 Unburnt hydrocarbons are removed by oxidation.

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

19	Answer: C (2 and 3 only) **×1 CO_2 is formed (not removed) as the non–toxic products of exhaust fume through oxidation of CO and unburnt hydrocarbons.** **✓2 NO_x is reduced to N_2.** **✓3 C_xH_y is oxidised to CO_2.**

20 2.00 mol dm^{-3} of ethanol and 2.40 mol dm^{-3} of ethanoic acid are mixed, and the reaction mixture is allowed to reach equilibrium at constant temperature.

The equilibrium mixture is found to contain 1.45 mol dm^{-3} of ethyl ethanoate.

$$C_2H_5OH(l) + CH_3CO_2H(l) \rightleftharpoons CH_3CO_2C_2H_5(l) + H_2O(l)$$

What is the correct expression for the equilibrium constant K_c?

A $\dfrac{(1.45)^2}{0.55 \times 0.95}$ **B** $\dfrac{1.45}{0.55 \times 0.95}$

C $\dfrac{2 \times 1.45}{2.00 \times 2.40}$ **D** $\dfrac{2 \times 1.45}{1.45 \times 1.45}$

20	Answer: A

	$C_2H_5OH(l)$ +	$CH_3CO_2H(l)$	$CH_3CO_2C_2H_5(l)$ +	$H_2O(l)$
Initial [ ] / mol dm^{-3}	**2.00**	**2.40**	**0**	**0**
Change in [ ] / mol dm^{-3}	**−1.45**	**−1.45**	**+1.45**	**+1.45**
Equilibrium [ ] / mol dm^{-3}	**0.55**	**0.95**	**1.45**	**1.45**

$K_c = \dfrac{[CH_3CO_2C_2H_5][H_2O]}{[C_2H_5OH][CH_3CO_2H]}$

(This is a homogeneous equilibrium, hence K_c expression includes the concentration of water, $[H_2O(l)]$.)

$K_c = \dfrac{(1.45)^2}{0.55\times0.95}$

21 The equilibrium constant for the following reaction is less than 1.

$$HPO_4^{2-}(aq) + H_2BO_3^{-}(aq) \rightleftharpoons H_2PO_4^{-}(aq) + HBO_3^{2-}(aq)$$

Which one of the following gives the correct relative strengths of the acids and bases in the reaction?

	Acids			Bases		
A	$H_2PO_4^-$	>	$H_2BO_3^-$	HBO_3^{2-}	>	HPO_4^{2-}
B	$H_2BO_3^-$	>	$H_2PO_4^-$	HBO_3^{2-}	>	HPO_4^{2-}
C	$H_2PO_4^-$	>	$H_2BO_3^-$	HPO_4^{2-}	>	HBO_3^{2-}
D	$H_2BO_3^-$	>	$H_2PO_4^-$	HPO_4^{2-}	>	HBO_3^{2-}

21 Answer: A

Since the position of eqm of $HPO_4^{2-}(aq) + H_2BO_3^{-}(aq) \rightleftharpoons H_2PO_4^{-}(aq) + HBO_3^{2-}(aq)$ lies to the left (inferred from $K_c<1$), **the acid and base pair on RHS** of eqm arrow are the **stronger acid-base pair** that successfully transferred H^+ from acid on RHS ie. $H_2PO_4^-$ to base HBO_3^{2-} on RHS, to form the of HPO_4^{2-} and $H_2BO_3^-$

22 10 cm^3 of a 0.01 mol dm^{-3} solution of strong acid, HNO_3 is diluted with 90 cm^3 of water. What is the pH of the resulting solution?

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

22 Answer: C

Using $c_1V_1 = c_2V_2$,

$[H^+]$ after dilution, $c_2 = 0.01 \times \dfrac{10}{100} = 0.00100$ mol dm^{-3}

$\therefore$ pH of resulting solution = $-\log_{10}(0.00100) = 3$

23 *The use of the Data Booklet is relevant to this question.*

At 60°C the ionic product of water, K_w, has the value of 9.5×10^{-14} mol^{2}dm^{-6}.

Which statements concerning water at 60°C are correct?

1 $[OH^-] = 4.75 \times 10^{-7}$ mol dm^{-3}

2 heating water from 25°C to 60°C causes water to ionise more

3 the pH is 6.51

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

23 Answer: D (2 and 3 only)

×1 **At 60°C, $K_w = [H^+][OH^-] = 9.5 \times 10^{-14}$ mol^{2}dm^{-6}**
Since water dissociate to give H^+ and OH^-, $[H^+]=[OH^-]= \sqrt{9.5 \times 10^{-14}} = 3.08 \times 10^{-7}$ mol dm^{-3}

✓2 **At** 25°C, **$K_w = 1.00 \times 10^{-14}$ mol^{2}dm^{-6}.**
When temperature increase, the value of K_w increase. This means equilibrium shifts right or there is greater dissociation of water.

✓3 **$[H^+]=[OH^-]= \sqrt{9.5 \times 10^{-14}} = 3.08 \times 10^{-7}$ mol dm^{-3}**
pH = -lg (3.08×10^{-7}) = 6.51

24 Which pairs of organic compounds contain the same number of **hydrogen** atoms in each of their molecules?

1 butanone and 2-methypropanal

2 ethylpropanoate and butane-1,2-diol

3 2-aminopropane and 2-bromo-2-methypropane

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

24 **1** Answer: B (1 and 2 only)

✓ $CH_3CH_2\overset{\overset{O}{\|}}{C}CH_3$ butanone ($C_4\underline{\mathbf{H_8}}O$)

$CH_3\underset{\underset{CH_3}{|}}{C}HCHO$ 2-methylpropanal ($C_4\underline{\mathbf{H_8}}O$)

2
✓ $CH_3CH_2\overset{\overset{O}{\|}}{C}-OCH_2CH_3$ ethylpropanoate ($C_5\underline{\mathbf{H_{10}}}O_2$)

$CH_3\overset{\overset{OH}{|}}{C}H\overset{\overset{OH}{|}}{C}HCH_3$ butane-1,2-diol ($C_4\underline{\mathbf{H_{10}}}O_2$)

3
✓ $CH_3\underset{\underset{NH_2}{|}}{C}HCH_3$ 2-aminopropane ($C_4\underline{\mathbf{H_9}}N$)

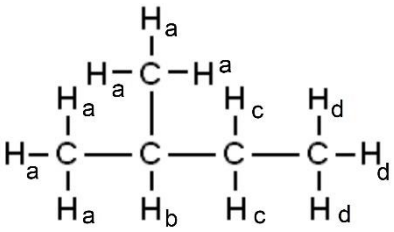
$CH_3\underset{\underset{CH_3}{|}}{C}BrCH_3$ 2-bromo-2-methylpropane ($C_4\underline{\mathbf{H_9}}Br$)

25 In the substitution of 2-methylbutane with bromine, a mixture of mono-brominated compounds were obtained.

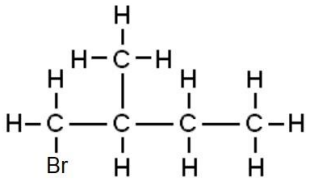
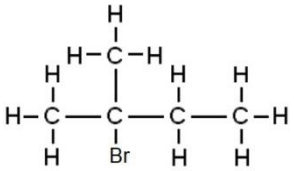
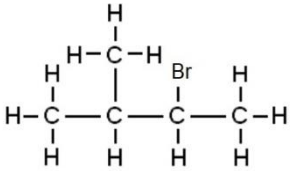
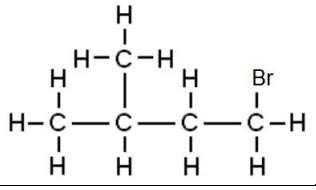
What is the statistical ratio of the two mono-brominated compounds with the highest yields?

A 1 : 2 **B** 1 : 3 **C** 1 : 4 **D** 1 : 6

25 Answer: A



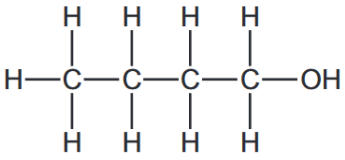
There are 4 possible ways you can substitute a hydrogen atom with bromine. Hydrogens with same chemical environments are labelled above.

Monobrominated product	**Number of H that can be substituted to get the same product**
	**6**
	**1**
	**2**
	**3**

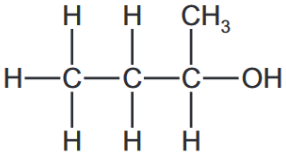
Hence the 2 products with highest yield is 3 : 6 (1 : 2).

26 Which of the following isomers of $C_4H_{10}O$ gives, on complete dehydration, the greatest number of different alkenes?

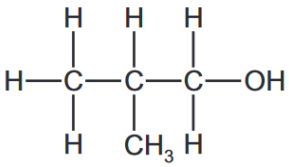
A



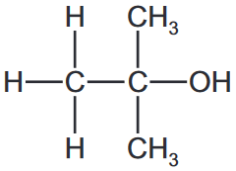
B



C



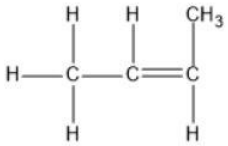
D



26	Answer: B

A ✗ **A will give only one product.**

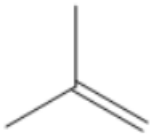
B ✓ **B will give rise to two products that are structural isomers**



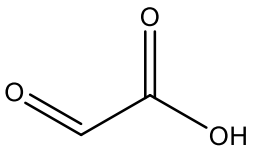
The second product on the right will give rise to a pair of cis-trans isomers.

C ✗ **C and D will both give the only one product after dehydration.**

D ✗



27 Glyoxylic acid is widely used in hair straightening products.



glyoxylic acid

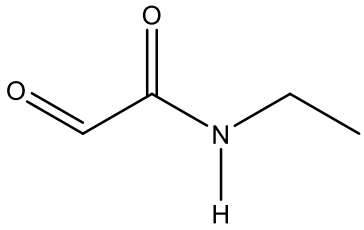
Which statement about this compound is **incorrect**?

A It can turn hot acidified potassium dichromate(VI) from orange to green.

B It can undergo acid base reaction with aqueous sodium hydroxide.

C It can undergo reduction with sodium boron hydride, $NaBH_4$ to form $HOCH_2CH_2OH$.

D It can undergo condensation with ethylamine, in the presence of DCC to form



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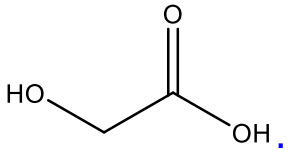
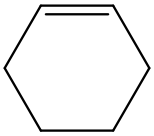
27	Answer: C Glyoxylic acid contains both aldehyde and carboxylic acid functional groups. **A** **The aldehyde will undergo oxidation. Orange dichromate(VI) turns green Cr^{3+}.** × **B** **The carboxylic acid will undergo acid base reaction with aqueous sodium hydroxide giving salt and water.** × **C** **The aldehyde can be reduced by $NaBH_4$ to form primary alcohol. However, the carboxylic acid cannot be reduced by $NaBH_4$. Hence, product formed is** ✓  . **D** **The carboxylic acid will undergo condensation with ethylamine forming amide.** ×

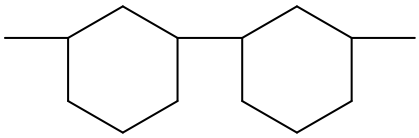
28 Cyclohexene can form an addition polymer.



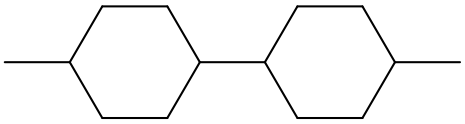
cyclohexene

Which of the following shows a section of the polymer?

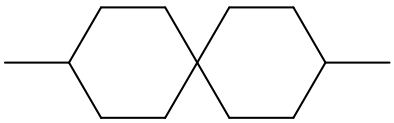
A



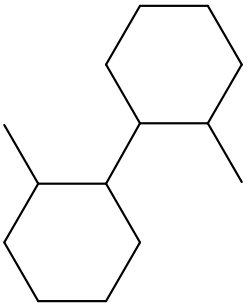
B

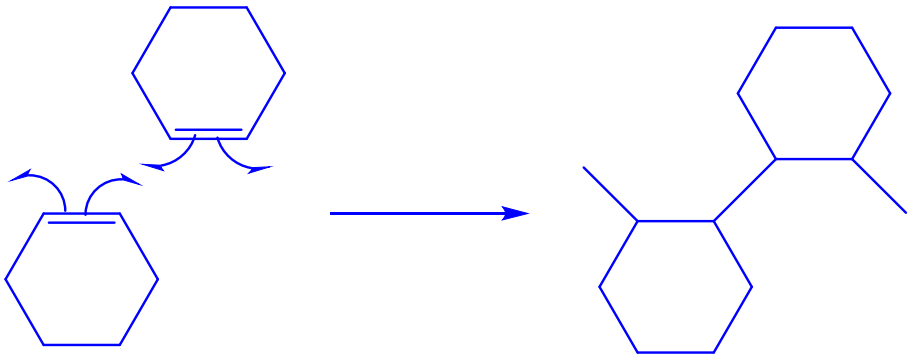


C



D



28	Answer: D 

29 Part of the structure of a polyamide is shown below:

$$–NH–CH(CH_3)–NHCO–CH(CH_3)–CO–$$

Which of the following statements is **not** true?

A It is a thermoplastic.

B The polymer chains are held together by hydrogen bonds.

C The polymer can be used to make containers to contain acids.

D The N–C–O angle in the polymer is 120°.

29	Answer: C
	A ✗ **The polyamide is a linear polymers with no cross linkages so it is classified as a thermoplastic.**
	B ✗ **The amide linkages in the polymer is capable of forming hydrogen bonds with another amide linkages in the polymer.**
	C ✓ **The polymer has amide linkages and hence the containers cannot contain acid as it will hydrolyse the amide bonds.**
	D ✗ **The C has 3 bond pairs and 0 lone pairs around it in N-C-O. Hence, it's a trigonal planar geometry around the C atom so its 120°.**

30 In which contexts is surface area important?

1 high tensile strength of graphene

2 the ability of a gecko to climb a wall

3 prevention of atmospheric pollution using catalytic convertors.

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

30	Answer: D (2 and 3 only)
	✗1 **High tensile strength of graphene is due to network of strong C-C covalent bonds**.
	✓2 **Spatulae are nanostructures which possess high surface to volume ratio and there are billions of spatula per gecko, thus creating a huge collective surface area of contact. The cumulative spatula-wall instantaneous dipole-induced dipole interactions generated is therefore translated into enormous attractive/adhesive forces capable of supporting many times the animal's body weight.**
	✓3 **The larger surface area to volume ratio of platinum nanoparticles offer increased catalytic efficiency in catalytic converters as more platinum atoms are exposed to more reactants.**

Answers

1	B	11	D	21	A
2	B	12	C	22	C
3	B	13	A	23	D
4	A	14	B	24	A
5	B	15	D	25	A
6	C	16	C	26	B
7	C	17	D	27	C
8	A	18	D	28	D
9	D	19	C	29	C
10	B	20	A	30	D