RIVER VALLEY HIGH SCHOOL
YEAR 6 PRELIMINARY EXAMINATION (II)

CANDIDATE NAME									
CLASS	6								
CENTRE NUMBER	S					INDEX NUMBER				

H2 CHEMISTRY 9647/01

Paper 1 Multiple Choice

26 September 2014

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class, centre number and index number on the Answer Sheet in the spaces provided.

There are **forty** 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.

This document consists of **19** printed pages and **1** blank page.

Section A

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

1 Wines often contain a small amount of sulfur dioxide that is added as a preservative. The sulfur dioxide content of a wine is found by the following method:

A 50 cm^3 sample of white wine is reacted with 40.0 cm^3 of 0.01 mol dm^{-3} of excess aqueous iodine. The sulfur dioxide in the wine is oxidised to sulfate, SO_4^{2-}, in the process. The unreacted iodine requires exactly 23.60 cm^3 of 0.02 mol dm^{-3} sodium thiosulfate, $Na_2S_2O_3$, for complete reaction.

Determine the concentration of sulfur dioxide, in mol dm^{-3}, in the wine.

A 1.64×10^{-4}

B 3.28×10^{-3}

C 4.72×10^{-3}

D 9.44×10^{-3}

2 An ion $\mathbf{X}^{2+}$ contains 24 protons.

What is the electronic configuration of $\mathbf{X}^{3+}$?

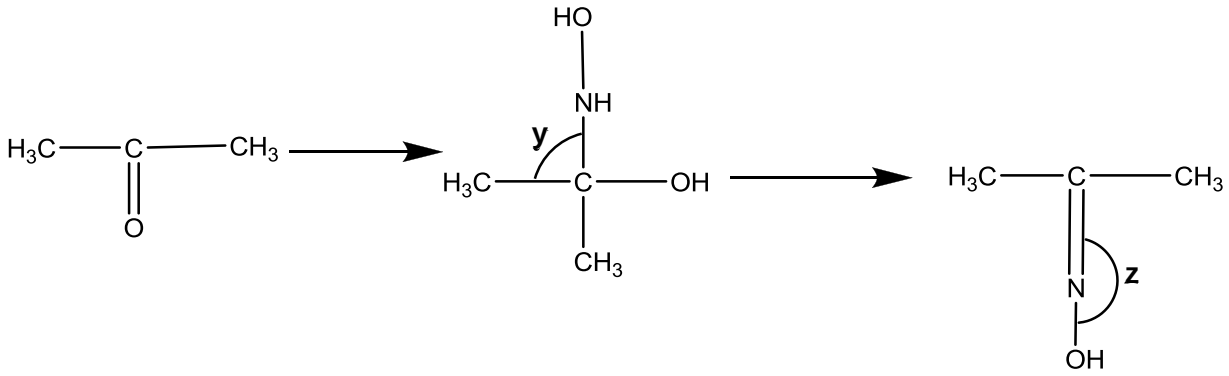
A $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

B $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$

C $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

D $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

3 Hydroxylamine (NH_2OH) can react with propanone via a nucleophilic addition in the following manner:

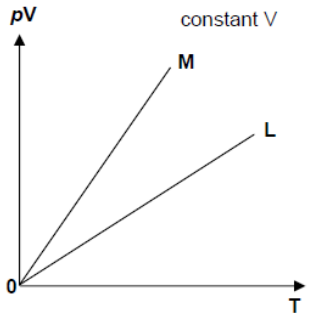


What are the values of the bond angles **y** and **z**?

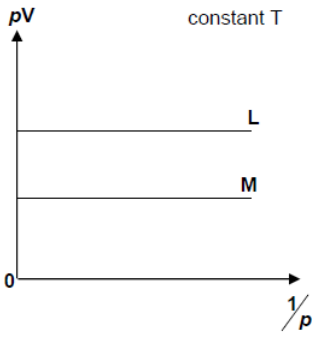
	y	**z**
A	109.5	118
B	90	118
C	109.5	180
D	90	180

4 Which graph correctly describes the behaviour of fixed masses of the ideal gases **L** and **M** where the number of moles of **L** is greater than number of moles of **M**?

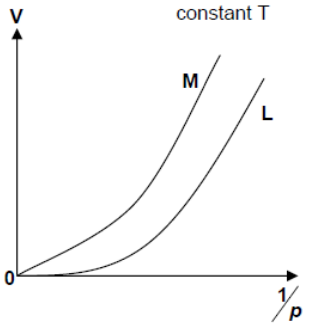
A



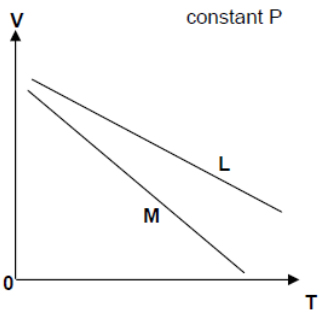
B



C



D



5 Tetrachloroethene is commonly used as degreasing solvent. The enthalpy change for the following reaction is –878.5 kJ mol^{-1}.

$$C_2H_4(g) + 4HCl(g) + 2O_2(g) \rightarrow C_2Cl_4(l) + 4H_2O(l)$$

$$\Delta H_f (C_2H_4(g)) = +52.3 \text{ kJ mol}^{-1}$$
$$\Delta H_f (HCl(g)) = -92.3 \text{ kJ mol}^{-1}$$
$$\Delta H_f (H_2O(l)) = -285.8 \text{ kJ mol}^{-1}$$

Which of the following is the enthalpy change of formation of tetrachloroethene given the information above?

A –52.2 kJ mol^{-1}

B –582 kJ mol^{-1}

C –608 kJ mol^{-1}

D –633 kJ mol^{-1}

6 A typical protein forms hundreds of hydrogen bonds and thousands of van der Waals' forces in folding from primary to tertiary structures.

Which of the following thermodynamic state functions of the protein best represents the folding process?

	ΔG / kJ mol^{-1}	ΔH / kJ mol^{-1}	ΔS / J K^{-1} mol^{-1}
A	–	–	–
B	+	–	+
C	–	+	–
D	+	+	–

7 When 0.20 mol of hydrogen gas and 0.15 mol of iodine gas are heated at 723 K until equilibrium is established, the equilibrium mixture is found to contain 0.26 mol of hydrogen iodide. The equation for the reaction is as follows:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

What is the correct numerical value for the equilibrium constant, K_c?

A 2.25 **B** 48.3 **C** 51.8 **D** 185.7

8 A system at equilibrium is subjected to the following changes separately:

(i) The pressure is reduced at constant temperature

(ii) The temperature is increased at constant pressure

For which equilibrium will both of these changes result in an increase in the proportion of products?

A $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ $\Delta H = +53$ kJ mol^{-1}

B $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$ $\Delta H = -950$ kJ mol^{-1}

C $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92$ kJ mol^{-1}

D $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ $\Delta H = +57$ kJ mol^{-1}

9 Solutions **P**, **R** and **S** contain a strong acid, a weak acid and a strong base, but not necessarily in the same order. The concentration and pH of each solution are shown below.

Solution	Concentration / mol dm^{-3}	pH
P	1.00	2.4
R	0.01	12
S	0.001	3

Which one of the following statements is correct?

A **P** contains a strong acid while **S** is contains a weak acid.

B The pH at equivalence point when **R** is titrated against **S** is less than 7.

C Mixing 500 cm^3 of **P** and 500 cm^3 of **R** produces a buffer solution.

D Mixing 100 cm^3 of **R** and 100 cm^3 of **S** produces a buffer solution.

10 The mechanism involved in the formation of XY_2 is shown below:

Step I : **X** + **Y** $\rightarrow$ **XY** (fast)

Step II : **XY** + **Y** $\rightarrow$ **XY**$_2$ (slow)

What is the rate equation for this reaction?

A Rate = k[**XY**][**Y**]

B Rate = k[**X**][**Y**]

C Rate = k[**X**][**Y**]^2

D Rate = k[**XY**][**Y**]^2

11 When a dilute sulfate solution of a metal **J** is electrolysed, the metal **J** and a diatomic gas **K** are produced at the cathode and the anode respectively in the molar ratio 2 : 1. In another experiment, the same quantity of electricity is used to electrolyse a saturated sodium chloride solution and a gas **L** is evolved at the anode.

What is the molar ratio of **J** : **K** : **L**?

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

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

Iodine clock reaction can be used to study how the concentration of iodide ions affect the rate of oxidation of iodide ions with peroxodisulfate ions.

Peroxodisulfate ions convert iodide ions into iodine slowly.

$S_2O_8^{2-}(aq) + 2I^-(aq) \rightarrow 2SO_4^{2-}(aq) + I_2(aq)$

The rate of the reaction can be increased by the addition of catalysts such as aqueous iron(III) ions.

A possible catalysed reaction pathway involves the following steps:

Step 1: $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow I_2(aq) + 2Fe^{2+}(aq)$

Step 2: $S_2O_8^{2-}(aq) + 2Fe^{2+}(aq) \rightarrow 2SO_4^{2-}(aq) + 2Fe^{3+}(aq)$

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

A Fe^{2+} is a stronger reducing agent than I^-.

B $S_2O_8^{2-}$ is a stronger oxidising agent than Fe^{3+}.

C The $E_{cell}^{\ominus}$ for step 2 is more positive than step 1.

D Aqueous cobalt(II) ions can be used as a catalyst in this reaction.

13 Which of the following oxides is **unlikely** to dissolve in concentrated sodium hydroxide?

A Al_2O_3 **B** MgO **C** P_4O_{10} **D** SiO_2

14 The ionic radii of P^{3-}, S^{2-} and Cl^- are 0.212 nm, 0.184 nm and 0.181 nm respectively.

Which of the following statements correctly explains the decrease in radius from P^{3-} to Cl^-?

A an increase in the nuclear charge and a constant total number of electrons

B an increase in the nuclear charge and total number of electrons

C an increase in total number of electrons while nuclear charge remains constant

D a decrease in nuclear charge while total number of electrons remains constant

15 Which one of the following statements about Group II elements is correct?

A The reactivity with cold water decreases down the group.

B The charge density of the cations increases down the group.

C The magnitude of the lattice energy of their oxides increases down the group.

D The thermal stability of their carbonates increases down the group.

16 Which one of the following statements is most likely to be true for astatine, the element below iodine in Group VII of the periodic table?

A Silver astatide and dilute aqueous ammonia will react to form a soluble complex.

B Sodium astatide react with hot concentrated sulfuric acid to form hydrogen astatide.

C When sparked, hydrogen reacts explosively and completely with astatine.

D Aqueous potassium astatide and chlorine will produce black solids of astatine.

17 Which of the following statements concerning transition metals is correct?

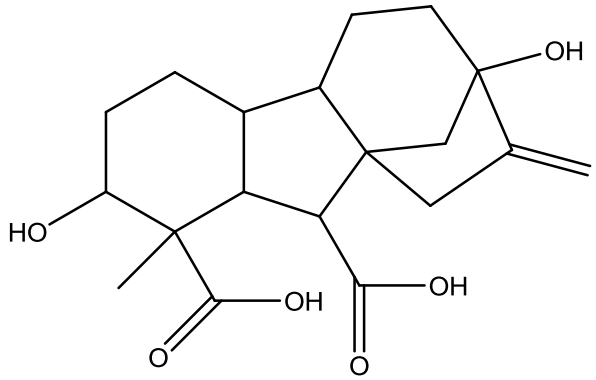
A They are the only metals which have more than one oxidation state.

B They are the only metals which form complex ions.

C They are the only metals with high melting points.

D They are the only metals which give coloured ions in an aqueous solution.

18 Gibberelic acid is a plant hormone that controls various aspects of plant growth.

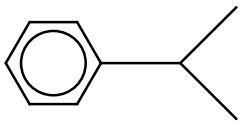


gibberelic acid

What is the number of chiral centres in the product after gibberelic acid reacts with HC*l*?

A 7 **B** 8 **C** 9 **D** 11

19 The organic molecule cumene is derived from cumin, a spice well-known for its distinctive flavour and aroma and an essential flavouring in South Asian dishes.



Cumene

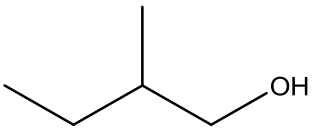
When cumene undergoes free radical reaction with bromine, x mol of a non-chiral monosubstituted product is obtained.

What is the amount of chiral monosubstituted product formed?

A $\frac{x}{6}$ **B** x **C** 3x **D** 6x

20 Which of the following isomers of $C_5H_{11}OH$ gives, on dehydration, the greatest number of different alkenes (including stereoisomers)?

A



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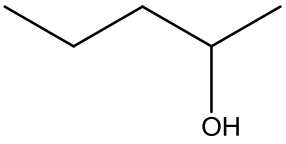
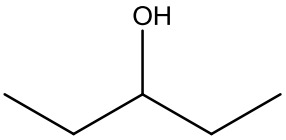
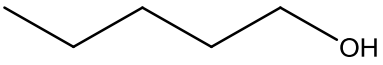


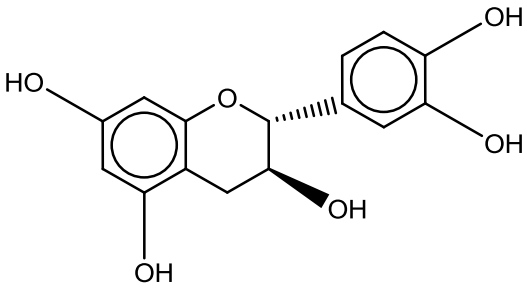
C



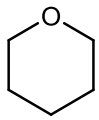
D



21 Catechin is a type of natural phenol and antioxidant found in green tea, chocolate and peaches.



Catechin

The 

functional group is inert.

Which statement about catechin is correct?

A 1 mol of catechin reacts with 5 mol of NaOH.

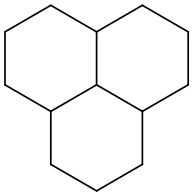
B 1 mol of catechin reacts with Na to form 5 mol of H_2.

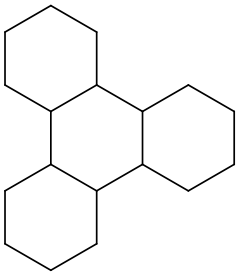
C It can undergo electrophilic substitution with FeCl_3(aq).

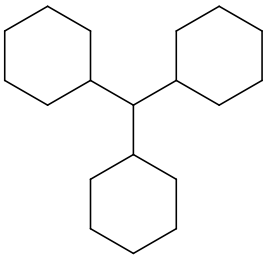
D It has 2 chiral centres.

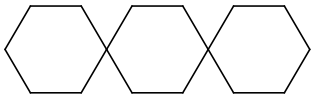
22 Cyclohexane undergoes substitution with chlorine gas.

Which of the following is a possible by-product during the termination stage?

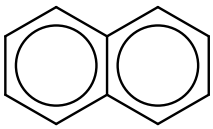
A 

B 

C 

D 

23 Naphthalene is an organic aromatic compound with the formula $C_{10}H_8$. It undergoes similar reactions as benzene and is best known as the main ingredient in traditional mothballs.



Naphthalene

Which of the following statements about naphthalene is correct?

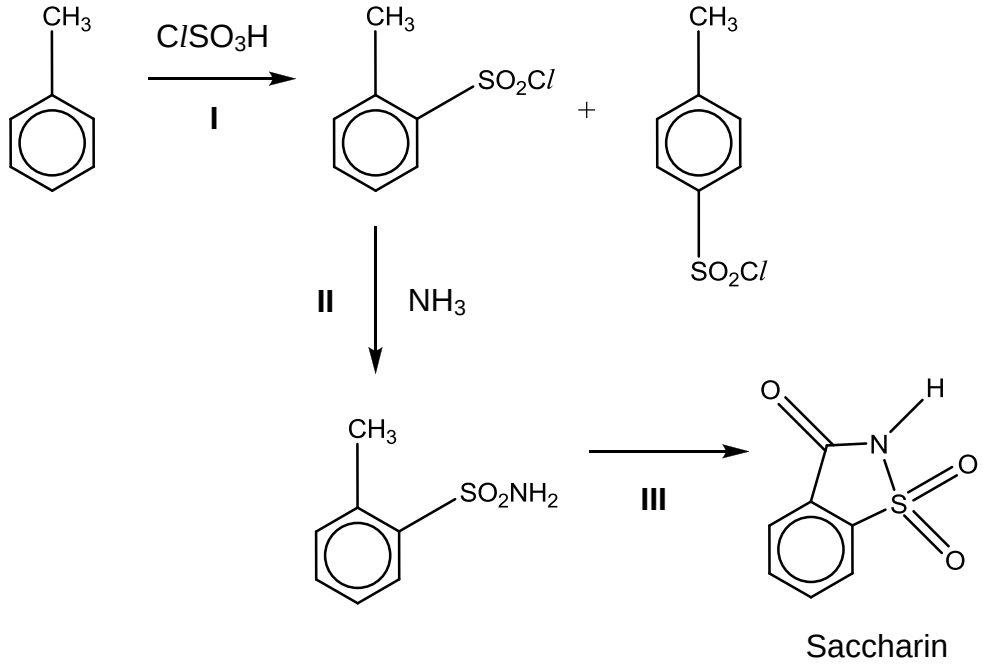
A Naphthalene is a planar molecule.

B Naphthalene has 12 π electrons.

C Naphthalene undergoes electrophilic substitution with aqueous bromine.

D Naphthalene undergoes free radical substitution to form two isomeric monobromo products.

24 Saccharin is a commonly used artificial sweetener. The original synthetic route proposed by Remsen and Fahlberg started with methylbenzene.



Saccharin

Which of the following best describes reactions **I**, **II** and **III**?

	Reaction I	Reaction II	Reaction III
A	Electrophilic Substitution	Condensation	Oxidation
B	Electrophilic Substitution	Elimination	Condensation
C	Electrophilic Addition	Condensation	Condensation
D	Electrophilic Addition	Elimination	Oxidation

25 In which of the following reactions is the inorganic reagent acting as a nucleophile?

A $C_6H_6 + H_2SO_4 \rightarrow C_6H_5SO_3H + H_2O$

B $CH_3CH{=}CH_2 + HBr \rightarrow CH_3CHBrCH_3$

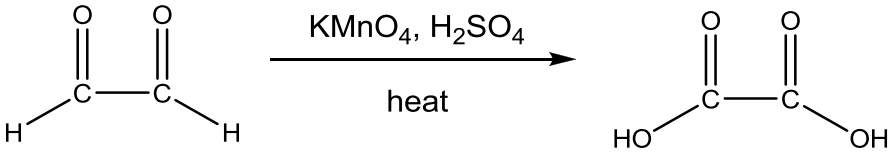
C $CH_3CH_2NH_2 + HCl \rightarrow CH_3CH_2NH_3Cl$

D $CH_3CH_2Br + H_2O \rightarrow CH_3CH_2OH + HBr$

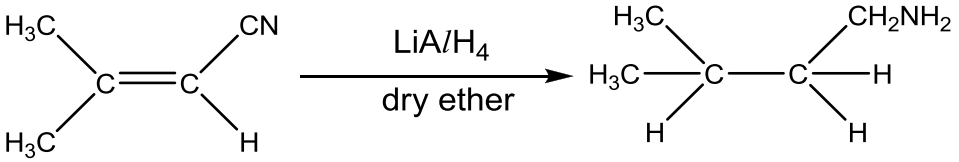
26 The reaction conditions of four different transformations are given below.

Which transformation has a set of conditions that is correct?

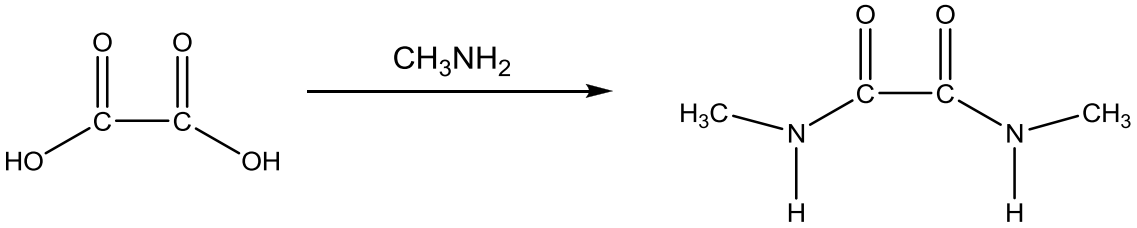
A



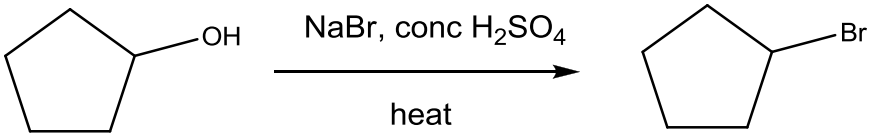
B



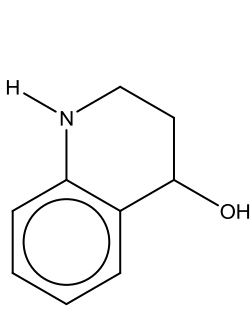
C



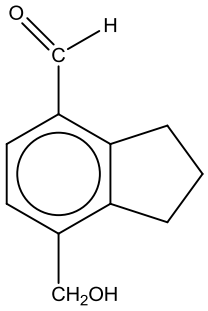
D



27 Which of the following reagents and conditions can be used to distinguish between the two compounds **X** and **Y** below?



X



Y

A Fehling's reagent, warm

B Aqueous bromine, r.t.p.

C P_4 and CI_2, heat

D Acidified $K_2Cr_2O_7$, heat

28 After the reduction of nitrobenzene to phenylamine, using tin and concentrated hydrochloric acid, an excess of sodium hydroxide is added.

What is the purpose of the sodium hydroxide?

A To lower the boiling point for subsequent distillation.

B To remove water and dry the product as it is hygroscopic.

C To liberate phenylamine.

D To precipitate tin(II) hydroxide.

29 The planet Jupiter is known to have a reducing atmosphere consisting mainly of methane and ammonia, with some ethene and water in the form of ice crystals. Astronomers used the impact of fragments of Comet Shoemaker-Levy-9 with Jupiter to identify more complex molecules present in the planet's atmosphere.

Which molecule is **unlikely** to have been observed?

A $CH_3CH_2NH_2$

B CH_3CH_2OH

C $CH_3CH_2CH_2CH_3$

D CH_3CO_2H

30 GABA is a neuro-transmitter released by red algae which will encourage shellfish larvae to settle on the ocean bed.

$$H_2NCH_2CH_2CH_2CO_2H$$

GABA

In what way does GABA differ from amino acids derived from the hydrolysis of proteins?

A It does not form zwitterions.

B It is not soluble in water.

C It is not a 2-aminocarboxylic acid.

D It does not form a polyamide linkage.

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31 Which of the following particles have a single unpaired electron?

1 The copper ion in CuI

2 The methyl free radical

3 A molecule of NO

32 After an oil spillage at sea, liquid hydrocarbon layer floats on the surface of the sea water. Which of the following statements help to explain why liquid hydrocarbons both float on, and are less dense than water?

1 Hydrocarbons molecules are not solvated by water.

2 There are only van der Waals' interactions between hydrocarbon molecules.

3 Hydrogen bonds between the molecules in liquid water cause them to pack closer together.

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

An electrochemical cell contains a Mn^{2+}/Mn half−cell and a $\mathbf{Q}^{3+}/\mathbf{Q}$ half−cell. The following reactions take place at the two electrodes.

$$Mn \rightarrow Mn^{2+} + 2e^{-}$$

$$\mathbf{Q}^{3+} + 3e^{-} \rightarrow \mathbf{Q}$$

Which of the following statements are correct?

1 The Mn electrode is the negative electrode.

2 **Q** can be chromium metal.

3 The number of moles of **Q** deposited is 1.5 times the number of moles of Mn^{2+} formed.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

34 The table gives data for the reaction between **X** and **Y** at constant temperature.

X + **Y** → **Z**

Experiment	[X] / mol dm^{-3}	[Y] / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.4	0.1	2.5×10^{-4}
2	0.2	0.2	5.0×10^{-4}
3	0.2	0.4	1.0×10^{-3}

Which statements follow from these results?

1 The half-life of this reaction is 277 s.

2 The mechanism involves more than 1 step.

3 The rate equation can be written as: rate = k[**X**][**Y**].

The responses **A** to **D** should be selected on the basis of

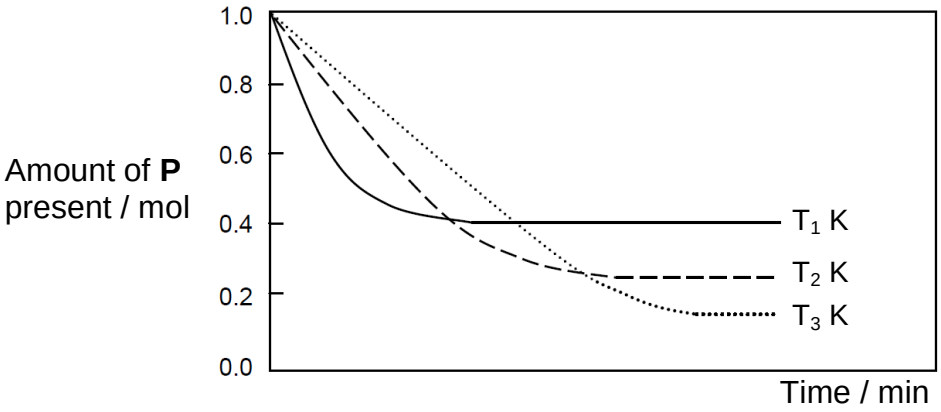
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

35 A gas **P** can react to give another gas **R** according to this equation:

$$2\mathbf{P}(g) \rightleftharpoons \mathbf{R}(g)$$

The graph below represents the decomposition of 1.0 mol of **P** in a container of a fixed volume at various temperatures.



Which of the following statements about the above system are correct?

1 The equilibrium constant, K_p, for the decomposition reaction increases with decreasing temperature.

2 At T_1 K, the mole fraction of **P** is greater than that of **R** at equilibrium.

3 The decomposition is spontaneous at all three temperatures.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

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

Which of the following statements are true about vanadium and its compounds?

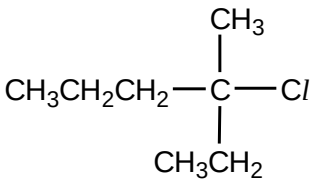
1 Lead is able to reduce vanadium from the +5 to the +3 oxidation state.

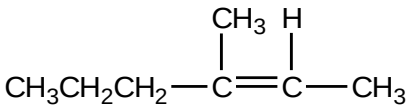
2 The maximum oxidation state of vanadium is found in the oxoanion VO^{2+}.

3 The density of vanadium is smaller than that of calcium.

37 Which of the following reactions will lead to a racemic mixture of products?

1 CH_3CHO with HCN and a small amount of NaOH

2  with aqueous sodium hydroxide, heat under reflux

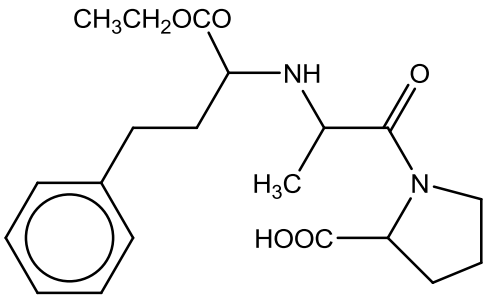
3  with HBr dissolved in CCl_4

The responses **A** to **D** should be selected on the basis of

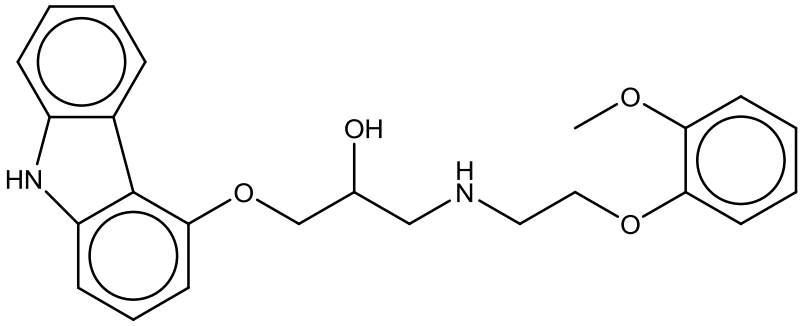
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

38 Enalapril and carvedilol are two drugs that are commonly used in the treatment of heart diseases.



Enalapril



Carvedilol

Which of the following can be used to distinguish between the two compounds?

1 sodium carbonate

2 aqueous chlorine

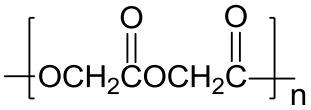
3 hot acidified potassium manganate(VII)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

39 Surgicryl is a synthetic polymer that can be used to stitch wounds together during a surgery. It degrades into smaller molecules over two to three months. Hence, patients do not have to return to the hospital to remove the stitches.



surgicryl

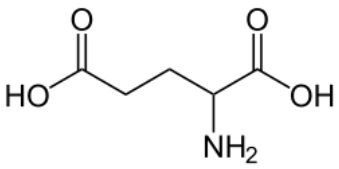
Which of the following statements explain Surgicryl's suitability for this function?

1 Surgicryl can be hydrolysed in the body.

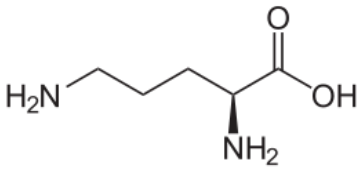
2 The small molecules produced are soluble in water.

3 Surgicryl is degraded slowly due to its large size.

40 Glutamic acid and ornithine are both amino acids that can be found in the human body.



Glutamic acid



Ornithine

Which of the following statements about the two amino acids are correct?

1 Both amino acids are likely to be found on the outer surface of a globular protein.

2 During an electrophoresis, glutamic acid will be nearer to the cathode than ornithine.

3 The isoelectric point of glutamic acid is higher than that of ornithine.

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