

**CHEMISTRY****9647/01**

Paper 1 Multiple Choice

Wednesday**25th September 2013****1 hour**

Candidates answer on separate paper.

Additional materials: Multiple Choice 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, Civics Group and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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.

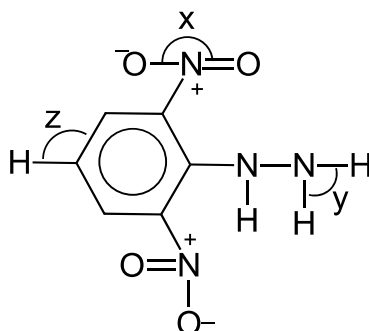
This document consists of **20** printed pages.

Section A

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

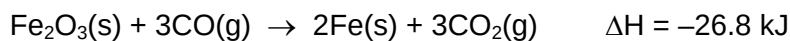
- 1** In which pair do both atoms have the same number of unpaired electron in their ground states?
- A** Ca, Ni **B** Na, Sc **C** N, Fe **D** Fe, Cr
- 2** Silicon, phosphorus and sulfur are in Period 3. Which of the following statements best explains why silicon ($1s^2 2s^2 2p^6 3s^2 3p^2$) has a lower first ionisation energy than phosphorus ($1s^2 2s^2 2p^6 3s^2 3p^3$)?
- A** Silicon has fewer electrons than phosphorus.
B The 3p electrons of phosphorus do not experience inter-electronic repulsion.
C The 3p electrons of phosphorus are further away from the nucleus.
D Phosphorus has more protons than silicon.
- 3** Comproportionation is a chemical reaction where two reactants, each containing the same element but with a different oxidation number, form a product in which the element involved reaches the same oxidation number in the product.
- 1 mol of potassium iodide undergoes comproportionation with compound **X** to form 0.6 mol of iodine. What could be the identity of compound **X**?
- A** KIO_2 **B** IO_2 **C** KIO_3 **D** KIO_4
- 4** A pure hydrocarbon was completely isolated from a fractional distillation column in a refinery. When 10 cm^3 of the hydrocarbon was burned in excess oxygen, the volume of the mixture decreased by 30 cm^3 . On passing the resultant mixture through a solution of sodium hydroxide, the volume further decreased by 30 cm^3 . All volumes were measured at room temperature and pressure.
- What is the formula of the hydrocarbon?
- A** C_2H_6 **B** C_3H_6 **C** C_3H_8 **D** C_4H_{10}

- 5 2,4-dinitrophenylhydrazine (Brady's reagent) is a common reagent used to qualitatively test for carbonyl groups associated with aldehydes and ketones. What would you expect the bond angles, x , y , and z to be, to the nearest 1 degrees, in the molecule of 2,4-dinitrophenylhydrazine?

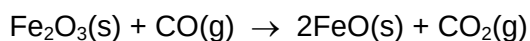


	x	y	z
A	107°	120°	120°
B	107°	107°	109°
C	109°	120°	120°
D	120°	107°	120°

- 6 Given the enthalpy change of the following reactions



Find the enthalpy change for the reaction below



- A** -59.8 kJ **B** -43.3 kJ **C** -10.3 kJ **D** $+6.2 \text{ kJ}$

- 7 For a chemical reaction,

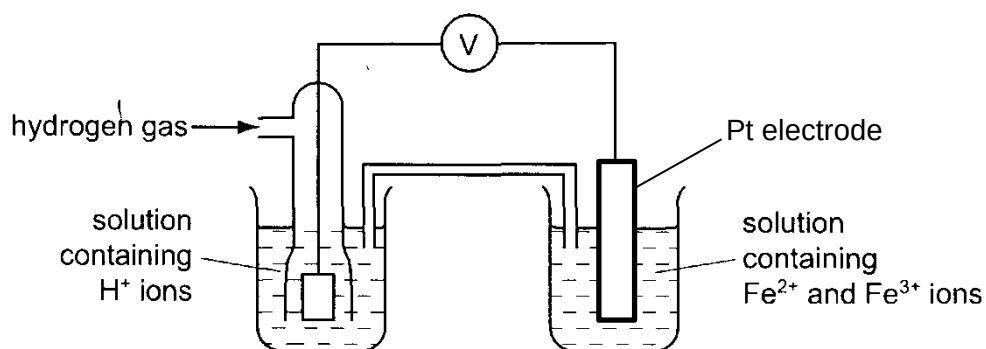


$$\Delta S = -131 \text{ J K}^{-1} \text{ mol}^{-1}$$

Which of the following statement is correct?

- A** The reaction will be spontaneous when temperature is less than -511 K .
B The reaction will be spontaneous when temperature is greater than -511 K .
C The reaction will be spontaneous at any temperature.
D The reaction will not be spontaneous at any temperature.

- 8 Use of the Data Booklet is relevant to this question.



The following values for the cell potential were determined as a change was continuously made.

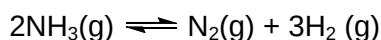
reading number	cell potential / V
1	0.770
2	0.980
3	1.064
4	1.093
...	...
20	1.330

What continuous change in the $\text{Fe}^{3+}/\text{Fe}^{2+}$ half-cell could produce these results?

- A** Increasing the concentration of Fe^{2+} (aq) in the $\text{Fe}^{3+}/\text{Fe}^{2+}$ half-cell.
- B** Replacing the Pt electrode with a Fe electrode.
- C** Adding acidified potassium dichromate(VI) into the $\text{Fe}^{3+}/\text{Fe}^{2+}$ half-cell.
- D** Increasing the concentration of H^+ (aq) in the H^+/H_2 half-cell.
- 9 Molten solutions of AgNO_3 , $\text{Cu(NO}_3)_2$ and $\text{Cr(NO}_3)_3$ are arranged in series and is subjected to a current of 2.0 A for 20 minutes. What is the relative amount of each metal formed?
- A** $\text{Ag} > \text{Cu} > \text{Cr}$
- B** $\text{Ag} = \text{Cu} = \text{Cr}$
- C** $\text{Ag} < \text{Cu} < \text{Cr}$
- D** $\text{Cu} > \text{Ag} > \text{Cr}$

- 10** Chromium plating is applied by electrolysis to objects suspended in an acidified dichromate (VI) solution. How long (in minutes) would it take to apply a chromium plating 0.2 mm thick to a car bumper with a surface area of 0.30 cm^2 in an electrolytic cell carrying a current of 10.0 A? (The density of chromium is 7.19 g/cm^3)
- A 0.800 minutes
 B 2.70 minutes
 C 8.10 minutes
 D 48.0 minutes

- 11** Ammonia decomposes into hydrogen and nitrogen gas at high temperatures.



Ammonia at pressure P was placed in an evacuated reactor which was maintained at constant temperature. At equilibrium, the ratio of nitrogen to ammonia was found to be 1:3.

What is the equilibrium constant, K_p , for the reaction?

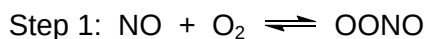
- A $3P^2$ B $75P^2$ C $\frac{P^2}{3}$ D $\frac{3P^2}{25}$
- 12** 0.1 mol of benzoic acid was dissolved in 500 cm^3 of water. The pH of the solution was found to be 2.6. Which of the following should be added to the solution to form a buffer of maximum buffering capacity?
- ($\text{p}K_a$ of benzoic acid is 4.2)
- A 0.1 mol of NaOH
 B 0.05 mol of NaOH
 C 0.1 mol of HCl
 D 0.05 mol of HCl

- 13** An excess of silver sulfate was shaken in a solution of sodium sulfate of concentration $X \text{ mol dm}^{-3}$ and allowed to reach equilibrium. The undissolved silver sulfate was filtered off and the concentration of silver in the solution was found to be $Y \text{ mol dm}^{-3}$.

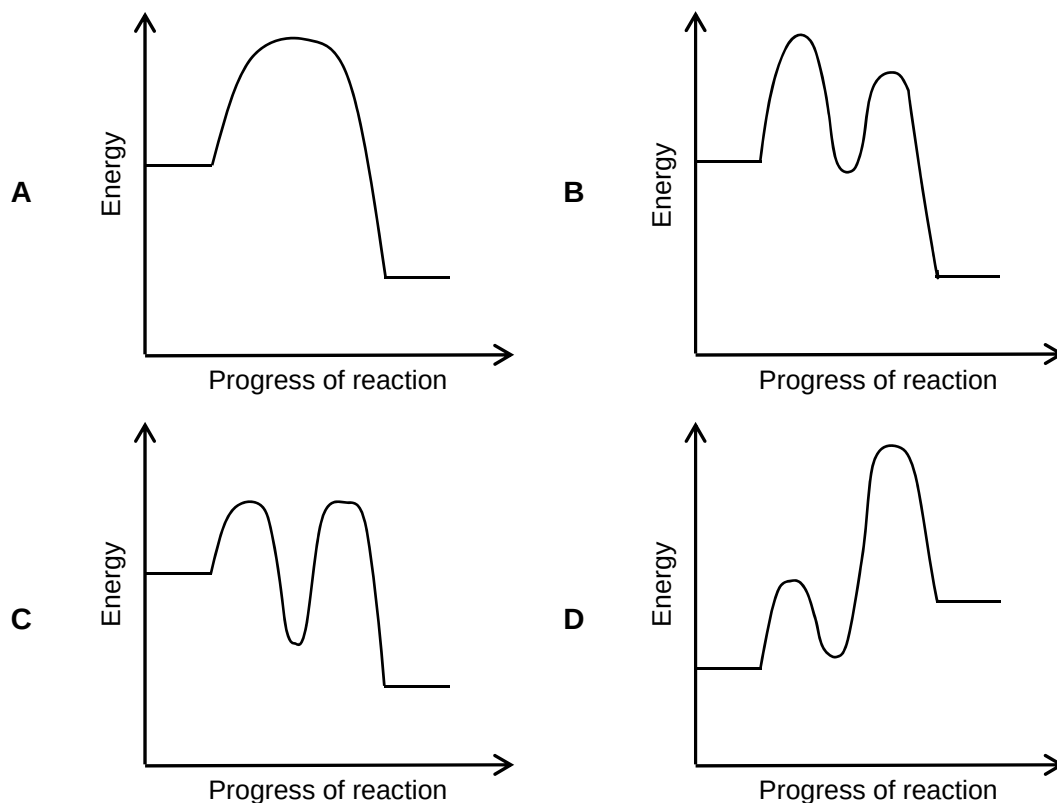
What is the K_{sp} of silver sulfate?

- A $(X + \frac{Y}{2})(Y)^2$ B $(\frac{Y}{2})(Y)^2$ C $(X + Y)(2Y)^2$ D $(X)(Y)^2$

- 14 The reaction between NO and O₂ to give NO₂ is exothermic and proceeds by the following two steps.



It was found that Step 1 is the slow step. Which diagram could represent the reaction pathway diagram for the reaction?



- 15 The reaction between substances **A** and **B** is found to follow the rate equation.

$$\text{Rate} = k[\text{A}]^m[\text{B}]$$

Where k is the rate constant and has units of $\text{mol}^{-2}\text{dm}^6\text{s}^{-1}$.

Two experiments to study the kinetics of this reaction were carried out and the data obtained are tabulated below:

Experiment	Initial [A] / mol dm^{-3}	Initial [B] / mol dm^{-3}	Initial rate / $\text{mol dm}^{-3} \text{s}^{-1}$
1	0.040	0.080	S
2	0.020	y	$\frac{1}{2} \text{S}$

What is the value of y in experiment 2?

- A** 0.020 **B** 0.040 **C** 0.160 **D** 0.320

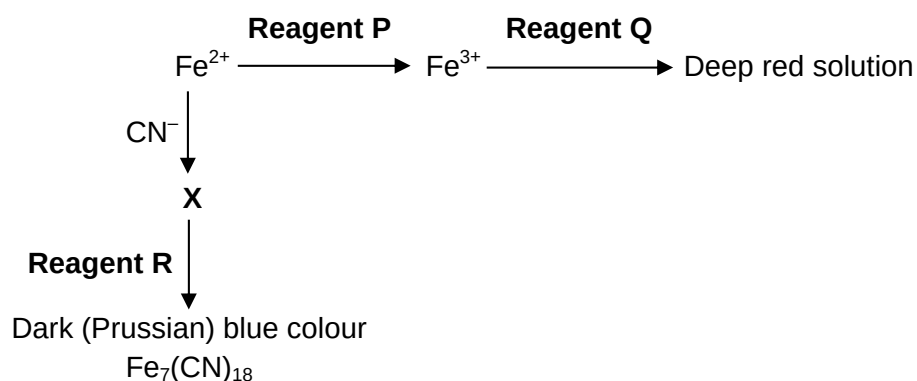
- 16 Three elements, **J**, **K**, **L** have physical properties as shown.

Substance	Melting point of element / °C	Solubility of oxide in water	Electrical conductivity of chloride in liquid state
J	112	Soluble	Nil
K	650	Insoluble	Good
L	98	Soluble	Good

What could be the identities of **J**, **K** and **L**?

	J	K	L
A	P	Na	Al
B	S	Mg	Na
C	Na	Si	Pb
D	Si	P	Mg

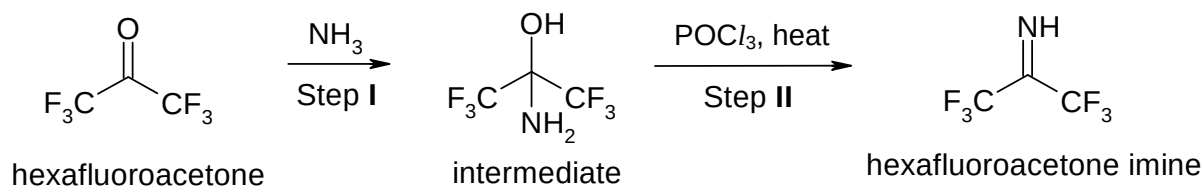
- 17 The following shows the reaction of Fe ions with various reagents.



Suggest the identities for reagents **P**, **Q** and **R**.

	Reagent P	Reagent Q	Reagent R
A	Cl_2	CNS^-	Fe^{3+}
B	Cl_2	NaOH	Fe^{2+}
C	SO_2	NaOH	Fe^{2+}
D	SO_2	CNS^-	Fe^{3+}

21 Consider the following reaction:



Which of the following statement is **not** correct about the reaction?

- A NH_3 acts as a nucleophile in Step I.
- B POCl_3 acts as a dehydrating agent in Step II.
- C The reaction intermediate contains only one sp^3 hybridised carbon atom.
- D The reaction intermediate can be used to synthesise $\text{C}(\text{CF}_3)_2(\text{NH}_2)_2$ in less than 3 steps.
- 22 Phosgene, COCl_2 , is a highly toxic compound that is formed when trichloromethane, CHCl_3 , is left exposed to the atmosphere.

Below is a reaction scheme that involves trichloromethane and phosgene:

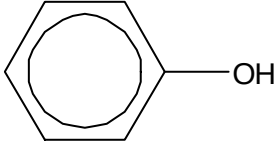


Which of the following type of reaction is **not** being observed in the reaction scheme?

- A Oxidation
- B Elimination
- C Electrophilic addition
- D Nucleophilic substitution
- 23 Which of the following reagents and conditions can be used to distinguish the pair of compounds in each set?

	<u>Compound 1</u>	<u>Compound 2</u>	<u>Reagent and condition</u>
A	$\text{C}_6\text{H}_5\text{OH}$	$\text{C}_6\text{H}_5\text{NH}_2$	$\text{Br}_2(\text{aq})$, room temperature
B	$\text{CH}_3\text{CH}_2\text{COCHI}_2$	$\text{CH}_3\text{CH(OH)CH}_2\text{CH}_3$	$\text{I}_2(\text{aq})$, $\text{NaOH}(\text{aq})$, warm
C	$\text{C}_6\text{H}_5\text{COCI}$	$\text{C}_6\text{H}_5\text{COBr}$	$\text{AgNO}_3(\text{aq})$, room temperature
D	$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3$	$\text{CH}_3\text{CH}=\text{CH}_2$	$\text{KMnO}_4(\text{aq})$, $\text{H}_2\text{SO}_4(\text{aq})$, heat under reflux

- 24 Values of the acid dissociation constants, K_a , for some weak acids are given below:

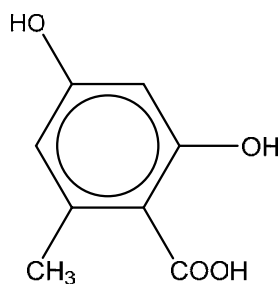
Acid	$K_a / \text{mol dm}^{-3}$
	1.3×10^{-10}
H_2CO_3	4.5×10^{-7}
$\text{CH}_3\text{CO}_2\text{H}$	1.8×10^{-5}

A sample of phenyl ethanoate, $\text{C}_6\text{H}_5\text{OCOCH}_3$, was heated under reflux with an excess of NaOH(aq) .

Excess CO_2 was subsequently bubbled through the mixture.

Which of the following would be found in the resultant mixture?

- A Phenol and ethanoic acid
 - B Sodium phenoxide and sodium ethanoate
 - C Sodium phenoxide and ethanoic acid
 - D Phenol and sodium ethanoate
- 25 Orsellinic acid is found in lichens which are composite organisms consisting of fungus and a photosynthetic partner.



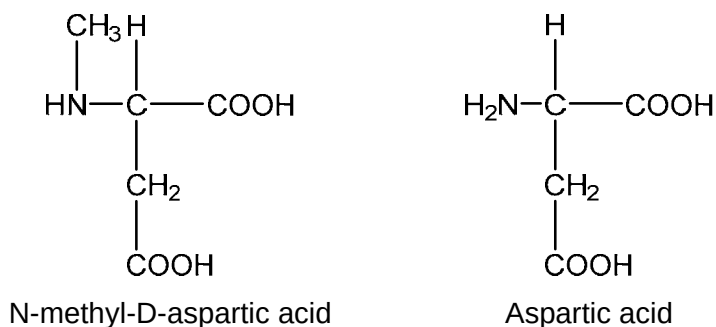
Orsellinic acid

0.1 mol of orsellinic acid was reacted with excess $\text{Na}_2\text{CO}_3(\text{aq})$ and the gaseous product formed was passed through a bottle of excess concentrated NaOH .

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

- A 2.2 g
- B 4.4 g
- C 6.6 g
- D 13.2 g

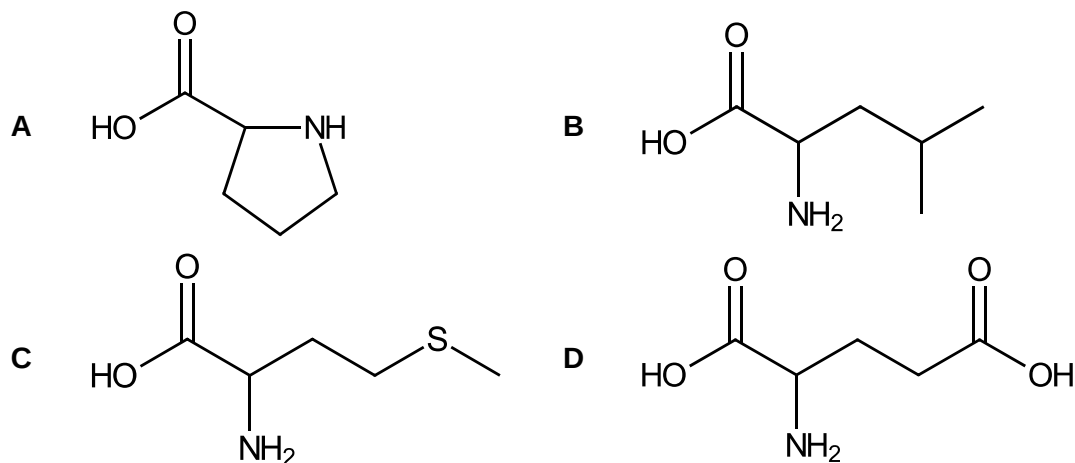
- 26 N-methyl-D-aspartic acid is a neuroprotective agent used in the treatment of strokes and epilepsy while aspartic acid is an essential amino acid found in human.



What is the number of dipeptides that could possibly be formed between N-methyl-D-aspartic acid and aspartic acid?

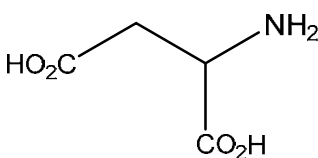
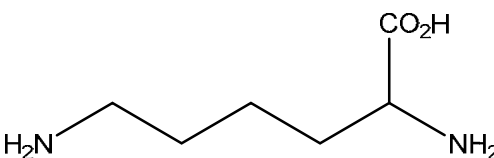
- A 1 B 2 C 3 D 4
- 27 "Helix breakers" are amino acids that disrupt the regularity of the α -helical backbone conformation in a protein. These amino acids often also cause breakages or deformations in β -pleated sheets as well.

Which of the following amino acids is likely to be a "helix breaker"?



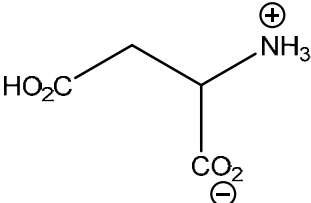
- 28 What are the type of bonds responsible for the formation of β -pleated sheets in a protein?
- A Peptide bonds between the individual amino acid units.
- B Hydrogen bonds between the side chains of a polypeptide chain.
- C Van der Waals forces between the side chains of a polypeptide chain.
- D Hydrogen bonds between the peptide groups of two extended polypeptide chains.

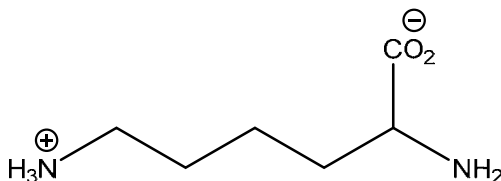
29 Consider the following amino acids found in proteins and their associated pK_a values.

Amino acid	 Aspartic acid	 Lysine
Relative molecular mass	133	146
pK_a values	1.88, 3.65 and 9.60	2.18, 8.95 and 10.53

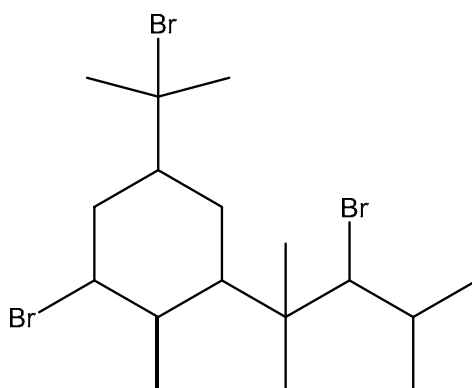
Which of the following statements is correct in a gel electrophoresis separation of the two amino acids?

- A** At pH = 6, aspartic acid would migrate faster towards cathode than lysine would towards anode.
- B** At pH = 6, aspartic acid would migrate slower towards anode than lysine would towards cathode.

- C** At pH = 9, the major form of aspartic acid would be
- 

- D** At pH = 9, the major form of lysine would be
- 

- 30 What is the total number of stereoisomers for the major product when the following compound is heated under reflux with ethanolic sodium hydroxide?



A 0

B 2

C 4

D 8

Section B

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

Decide whether each of the statements is or is not correct. (You may find it helpful to put a tick against the statements which you consider to be correct.)

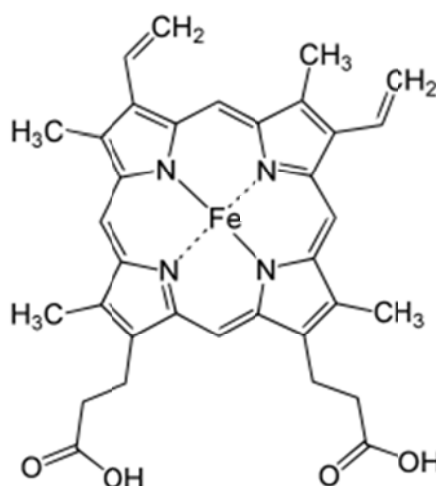
The responses **A** to **D** should be selected on the basis of

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** Haemoglobin has a quaternary structure with four globular protein subunits. Each subunit of haemoglobin has an embedded heme group which contains one iron atom that can bind one oxygen molecule.

The diagram below shows the heme group held in a heterocyclic ring, known as the porphyrin.



Note that the four N atoms and the Fe ion are planar.

Which of the following descriptions of the bonds are present between Fe and the N-atoms in the porphyrin ring?

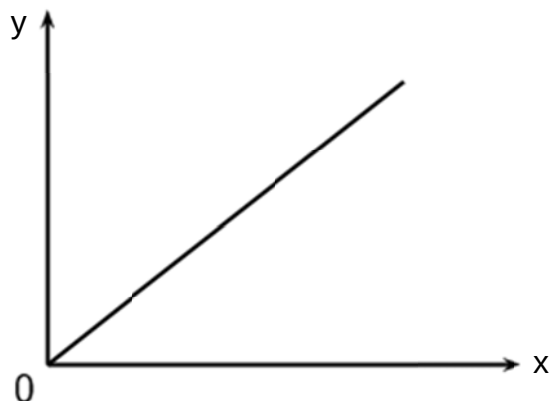
- 1** Ion-dipole interactions
- 2** Ionic bonds
- 3** Co-ordinate bonds

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.

- 32** Which one of the following graphs share the same general shape as seen in the graph below, according to ideal gas law for a fixed mass of gas at temperature T in Kelvins?



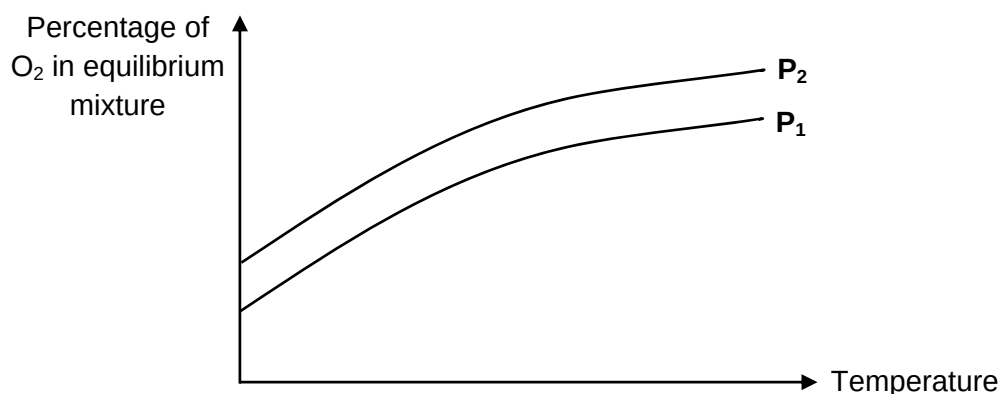
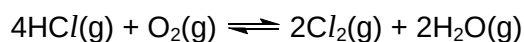
- 1** VT against T^2 (at constant P)
- 2** P against T/V (at constant V)
- 3** PV against T

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.

- 33** The graph below shows how the percentage of oxygen gas in the equilibrium mixture shown below varies with temperature at pressures P_1 and P_2 .



Which of the following statements about the reaction are correct?

- 1 The pressure P_1 is larger than P_2 .
- 2 The forward reaction is exothermic.
- 3 Addition of an inert gas into the system will not cause the graph to shift.

- 34** *Use of the Data Booklet is relevant in this question.*

Cracking is the process whereby complex organic molecules are broken down into simpler molecules such as light hydrocarbons. Gasoline, used as a fuel in automobiles, is often vapour cracked to produce more valuable products such as butane in the petrol-chemical industry.



Which statements about the above reaction are true?

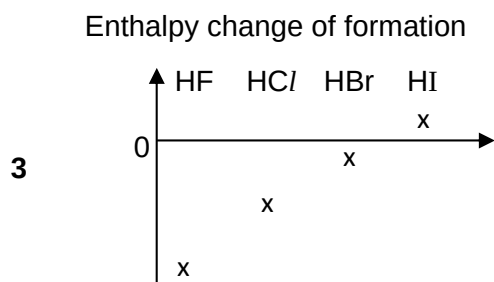
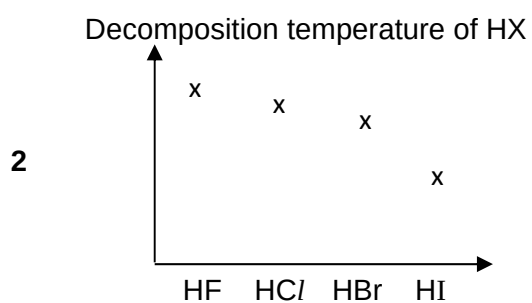
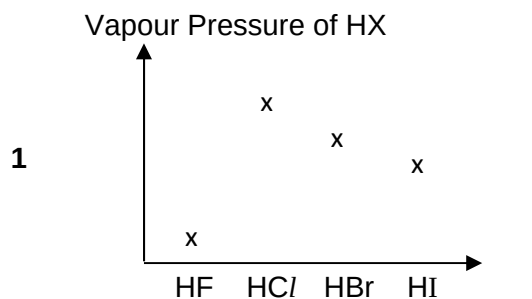
- 1 The reaction is an endothermic reaction.
- 2 The reaction becomes spontaneous at higher temperatures.
- 3 The enthalpy change of the reaction can be determined from only the standard enthalpy change of combustions of C_8H_{18} , C_4H_8 and C_4H_{10} .

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 Which of the following graphs about hydrogen halides are correct?

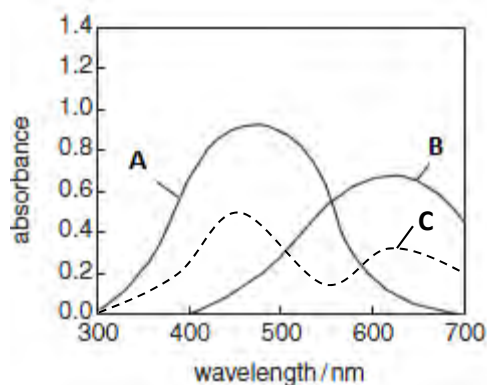


The responses **A** to **D** should be selected on the basis of

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.

- 36** Transition metal, **M** forms complexes with two different ligands **J** and **L**. The visible spectra of solutions of transition metal complex, **A**, $[\text{MJ}_6]^{3+}$, and **B**, $[\text{ML}_6]^{3+}$, are shown in the diagram below.

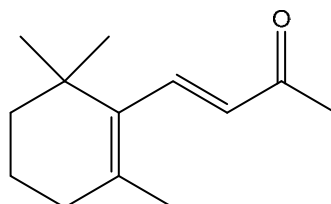


Colours and energies of light at various wavelengths

Wavelength / nm	Colour
400	Violet
450	Blue
500	Green
600	Yellow
650	Red

Which of the following statements are correct about complexes **A** and **B**?

- Complex **A** is red while complex **B** is blue.
 - A** has larger energy gap between the d-orbitals.
 - L** forms a stronger bond with metal **M** compared to **J**.
- 37** Ionone is a sweet-smelling compound found in violets.



Which of the following statements are true about the product formed from reacting ionone with excess lithium aluminium hydride?

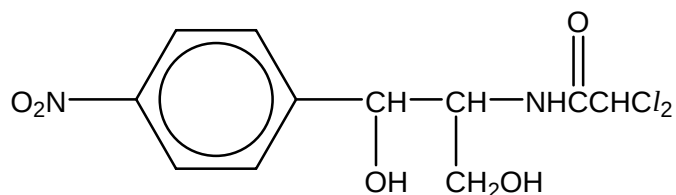
- It contains 1 chiral carbon atom.
- It can turn an acidified solution of potassium dichromate(VI) green.
- It has 4 stereoisomers.

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.

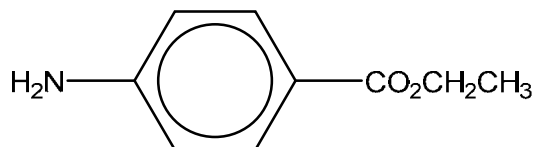
- 38** Chloramphenicol is an antibiotic secreted by bacteria.



What deductions can be made about the reactions of chloramphenicol?

- 1** 1 mol of chloramphenicol reacts with Na metal to form 2 g of gas.
- 2** It can react with 2,4-dinitrophenylhydrazine.
- 3** Effervescence is observed when $\text{Na}_2\text{CO}_3(\text{aq})$ is added to it.

- 39** Benzocaine is often used as a local anaesthetic to relieve pain caused by sunburn.



Which of the following steps may be involved in the synthesis of benzocaine starting from benzene?

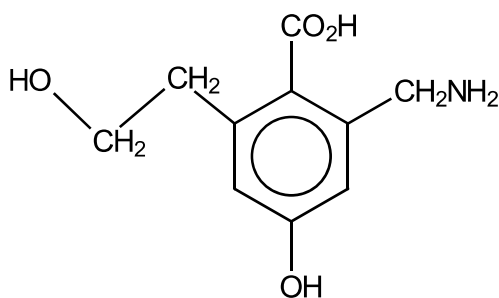
- 1** Electrophilic substitution with chloromethane.
- 2** Reduction using tin and concentrated hydrochloric acid.
- 3** Condensation using methanol.

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.

- 40** Which of the following products would be formed when compound **P** below reacts with PCl_5 at room temperature?



Compound **P**

