Calculator Model / No.

Class	Reg Number

Candidate Name _____

MERIDIAN JUNIOR COLLEGE
JC 2 Preliminary Examination
Higher 2

CHEMISTRY 9647/01

Paper 1 Multiple-Choice Questions **23 September 2011**

1 hour

Additional Materials: Data Booklet and OMR answer sheet

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.

There are **forty** questions in this section. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the OMR answer sheet.

Read very carefully the instructions on the OMR answer sheet.

You are advised to fill in the OMR Answer Sheet as you go along; no additional time will be given for the transfer of answers once the examination has ended.

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1 When an excess of KI solution was added to 10.0 cm^3 of a 0.200 $moldm^{-3}$ solution of JO_4^{3-}, the iodine liberated was titrated against a standard solution of 0.100 $moldm^{-3}$ of sodium thiosulfate, $Na_2S_2O_3$, using starch as the indicator.

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

If the volume of sodium thiosulfate required to discharge the blue-black colouration is 40.00 cm^3, what is the final oxidation state of **J**?

A -3 **B** +1 **C** +2 **D** +3

2 The temperature of a 2.0 dm^3 sample of a gas was changed from 27ºC to ***k***ºC, with its pressure changed from 1 atm to 2 atm. Its final volume remained at 2.0 dm^3.

What is the value of ***k***?

A 13.5
B 54
C 327
D 600

3 Which of the following ions would undergo the greatest deflection in an electric field?

A $^{16}O_2^+$ **B** $^{16}O^{18}O^+$ **C** $^{16}O^{18}O^{2+}$ **D** $^{18}O^{2+}$

4

Compound	formula	b.p. / °C
Water	H_2O	100
Hydroxylamine	NH_2OH	58
Ammonia	NH_3	–33

Which of the following statements is **not** able to explain the above observations?

A Hydroxylamine has a higher boiling point than ammonia as the hydroxylamine can form more hydrogen bonds per molecule than ammonia

B Hydroxylamine has a lower boiling point than water as the N-O bond in hydroxylamine results in weaker hydrogen bonding.

C Water has a higher boiling point than ammonia as the O-H bond in water results in stronger hydrogen bonding.

D Water has a higher boiling point than hydroxylamine as water can form more hydrogen bonds per molecule than hydroxylamine.

5 Which of the following pairs of substances have different types of bonding and structure?

A AlF_3 $AlCl_3$
B BaF_2 BaI_2
C HCl HBr
D Si SiO_2

6 Bromine is formed by the reaction between bromate(V) ions and bromide ions and acid:

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$$

The results of some experiments on the reaction at a given temperature **T** are shown below.

Experiment	Concentration / moldm^{-3}			Initial rate / moldm^{-3}s^{-1}
	BrO_3^-	Br^-	H^+	
1	0.10	0.10	0.10	1.2×10^{-3}
2	0.10	0.30	0.10	3.6×10^{-3}
3	0.20	0.10	0.10	2.4×10^{-3}
4	0.20	0.10	0.20	9.6×10^{-3}

Which of the following statements is ***correct*** based on the above data?

A The overall order of reaction is three.

B The rate of reaction is independent of $[BrO_3^-]$.

C The rate constant of this reaction at temperature **T** is 12 mol^{-3} dm^9 s^{-1}.

D The time taken for the concentration of Br^- to decrease to half its initial value is the same for Experiment 1 to 4.

7 The value of the equilibrium constant for the reaction below is 0.25 at 440ºC.

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

What is the value of the equilibrium constant for the following reaction at 440ºC?

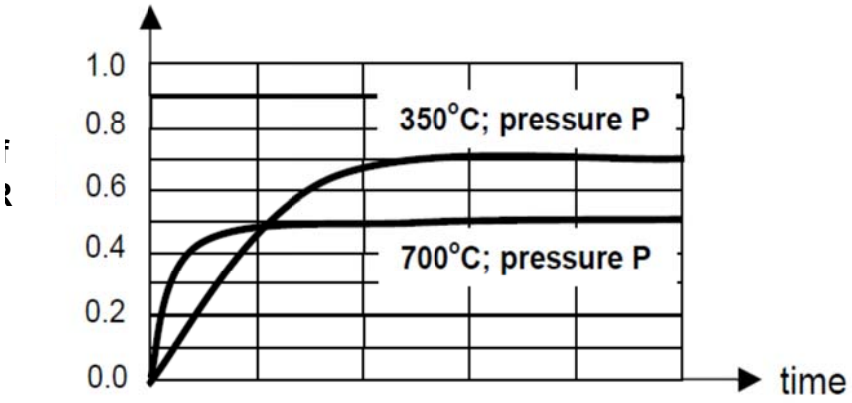
$$HI(g) \rightleftharpoons \tfrac{1}{2} H_2(g) + \tfrac{1}{2} I_2(g)$$

A 0.125
B 0.5
C 2
D 4

8 **L** and **M** can react together to reach equilibrium in the reaction below.

$$\mathbf{L(g) + M(g) \rightleftharpoons Q(g) + R(g)}$$

In an experiment, 1.0 mole each of **L** and **M** were reacted at constant pressure **P** and temperature 350ºC. The amount of **R** present in the mixture at intervals of time was recorded. The experiment was repeated at the same pressure **P**, but at a temperature of 700ºC. The results for both experiments are shown below.



Which one of the following information **cannot** be deduced from the graph?

A The value of K_c decreases with an increase in temperature.

B The equilibrium is achieved at a faster rate at higher temperatures.

C The enthalpy change for the forward reaction is negative.

D The activation energy of the forward reaction is high.

9 At 298 K, the numerical values for the dissociation constant of the aliphatic carboxylic acids, RCO_2H and $R'CO_2H$ in aqueous solution are 2.1×10^{-8} and 2.2×10^{-4} respectively.

Which of the following can be inferred from the given information?

A The volume of 1.0 $moldm^{-3}$ NaOH used to neutralize RCO_2H completely is lower than that for $R'CO_2H$.

B The volume of 1.0 $moldm^{-3}$ HC*l* used to neutralize $RCO_2^-Na^+$ completely is lower than that for $R'CO_2^-Na^+$.

C RCO_2H is a stronger acid than $R'CO_2H$.

D RCO_2^- is a stronger base than $R'CO_2^-$.

10 20.0 cm^3 of 0.10 $moldm^{-3}$ sulfuric acid was mixed with 22.0 cm^3 of 0.12 $moldm^{-3}$ aqueous ammonia. What is the pH of the resulting solution?

A 1.49 **C** 3.17

B 2.87 **D** 13.08

11 The value of the ionic product of water, K_w varies with temperature.

Temperature / °C	**K_w / $mol^2\ dm^{-6}$**
25	1.0×10^{-14}
62	1.0×10^{-13}

What can be deduced from this information?

A Water is acidic at 62°C.

B The pH of water increases as temperature increases.

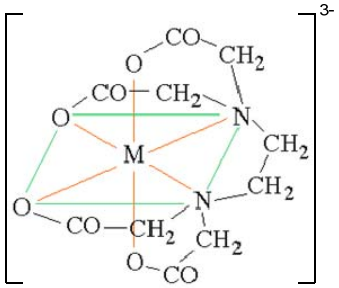
C The ionic dissociation of water is an exothermic process.

D $[OH^-]$ ions in water increases as temperature increases.

12 Consider the following reaction where $edta^{4-}$ forms a complex with a transition metal ion M^{+}:

$$[M(NH_3)_6]^{+} + edta^{4-} \rightarrow [M(edta)]^{3-} + 6NH_3$$

The complex $[M(edta)]^{3-}$ formed has the structure:



Which of the following statements about the spontaneity of the reaction is true?

A The reaction is non-spontaneous at all temperatures.

B The reaction is only spontaneous at low temperatures.

C The reaction is only spontaneous at high temperatures.

D The reaction is spontaneous at all temperatures.

13 Which of these pairs of substances, when mixed, would lead to the highest increase in temperature of the resulting solution?

A 50 cm^3 of 1 $moldm^{-3}$ HC*l* and 50 cm^3 of 1 $moldm^{-3}$ KOH

B 50 cm^3 of 1 $moldm^{-3}$ HC*l* and 50 cm^3 of 1 $moldm^{-3}$ NH_3

C 50 cm^3 of 0.5 $moldm^{-3}$ H_2SO_4 and 100 cm^3 of 1 $moldm^{-3}$ KOH

D 100 cm^3 of 0.5 $moldm^{-3}$ HC*l* and 100 cm^3 of 0.5 $moldm^{-3}$ KOH

14 A student set up 4 standard half-cells each containing one of the metals, **S**, **T**, **V** and **W** immersed in a solution of its metallic salts. These were then used to make different electrochemical cells. The table below shows the standard electrode cell potential, $E^{\ominus}_{cell}$ and the negative terminal of each electrochemical cell.

Cell	Metals used	$E^{\ominus}_{cell}$ / V	Negative terminal
1	**S** and **T**	+1.10	**T**
2	**T** and **V**	+0.46	**V**
3	**T** and **W**	+0.47	**T**

Which one of the following statement is correct?

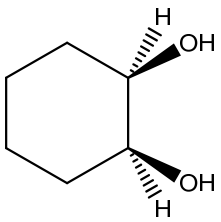
A **V** is produced in Cell 2.
B **S** has a stronger reducing power than **W**.
C **V** can reduce all the cations of **S**, **T** and **W**.
D $E^{\ominus}_{cell}$ for metals **S** and **W** is less than +0.47V.

15 Two electrolytic cells containing $\mathbf{X}_2(SO_4)_{\mathbf{m}}(aq)$ and $\mathbf{Y}_2(SO_4)_{\mathbf{n}}(aq)$ are connected in series, where **X** and **Y** are both metals. The relative atomic masses of **X** to **Y** is 2 : 3. When a current is passed through the set-up, the ratio of the masses of **X** : **Y** liberated is 1 : 2.

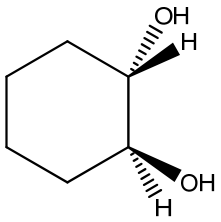
What are the values of **m** and **n**?

	m	**n**
A	1	3
B	2	6
C	3	1
D	4	3

16 The structures below represent cyclohexane-1,2-diol.



cis



trans

Which of the following statements about the two isomers is ***incorrect***?

A Both isomers can form dimers.
B Both isomers can rotate plane-polarised light.
C The *cis* isomer has a lower boiling point than the *trans* isomer.
D The *cis* isomer has a lower solubility in water than the *trans* isomer.

17 Which of the following alcohols yield only a single product upon heating with concentrated H_2SO_4?

A $CH_3CH(CH_3)CH_2OH$

B $CH_3CH_2CH(OH)CH_3$

C $CH_3CH_2CH_2CH(OH)CH_3$

D $CH_3CH_2CH(OH)CH_2CH_3$

18 Which property of benzene results from the stability associated with the ring of delocalised π electron cloud?

A It does not conduct electricity.

B It is susceptible to attack by electrophiles.

C It undergoes electrophilic substitution instead of electrophilic addition.

D All the carbon-carbon bonds have exactly the same bond length.

19 An organic compound undergoes the following reactions:

(i) It decolourises a solution of bromine in tetrachloromethane.
(ii) It reacts with phosphorus pentachloride giving copious white fumes of HC*l*.
(iii) One mole of the compound reacts with two moles of hot potassium hydroxide.

The compound is likely to be

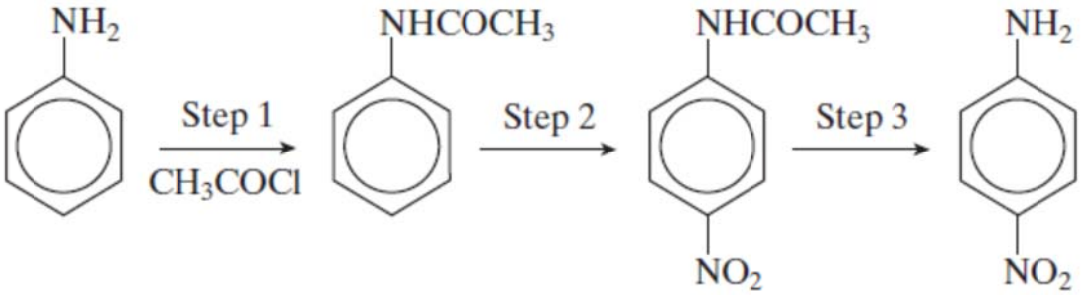
A $ClCH_2CH_2CH{=}CHCH(Cl)CO_2H$
B $ClCH_2CH_2CH{=}CHCO_2H$
C $BrCH_2CH_2CH_2CH_2COCl$
D $HOCH_2CH{=}CHCH{=}CHCH_2Cl$

20 A student carried out an experiment to study the ease of hydrolysis of a series of chlorinated organic compounds, and recorded the observations based on the addition of acidified silver nitrate solution.

Which one of the following gives the expected results?

	Shortest	*Time taken for ppt to appear* →		*Longest*
A	C_6H_5Cl	$C_6H_5CH_2Cl$	$C_6H_5CH(OH)Cl$	C_6H_5COCl
B	C_6H_5Cl	$C_6H_5CH(OH)Cl$	$C_6H_5CH_2Cl$	C_6H_5COCl
C	C_6H_5COCl	$C_6H_5CH_2Cl$	$C_6H_5CH(OH)Cl$	C_6H_5Cl
D	C_6H_5COCl	$C_6H_5CH(OH)Cl$	$C_6H_5CH_2Cl$	C_6H_5Cl

21 A student proposed the following synthetic route to obtain compound **F** from compound **E**.



E **F**

Which of the following statements about the following conversion of **E** to **F** is **correct**?

A Step 1 of the conversion can be achieved using CH_3COOH.

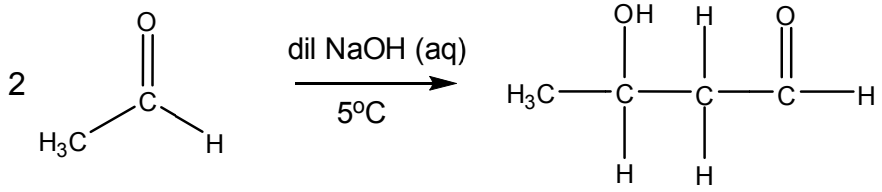
B Step 2 of the conversion does not require the use of a catalyst.

C Step 3 of the conversion requires the use of a reducing agent such as $NaBH_4$.

D **E** can be directly converted to **F** using the reagents in Step 2**.**

22 An aldol reaction involves reaction of aldehydes and ketones that possess an α hydrogen (i.e hydrogen bonded to carbon adjacent to carbon in C=O group).

For example, two ethanal molecules combine to form 3-hydroxybutanal in dilute NaOH(aq) at or below room temperature.



Which of the following compounds could be possibly obtained from the aldol reaction of butanone?

A $CH_3CH_2C(OH)(CH_3)CH_2COCH_3$
B $CH_3CH_2C(OH)(CH_3)CH_2CH_2COCH_3$
C $CH_3CH_2C(OH)(CH_3)CH_2COCH_2CH_3$
D $CH_3CH_2CH_2CH(OH)CH(CH_2CH_3)CHO$

23 Compounds **G**, **H** and **J** are present in the ratio of 2 : 1 : 1.

G $CH_3CH_2CH_2CH{=}CHCH_2COOH$

H $CH_3CH_2CH_2COCH_2CH_2COOH$

J $CH_3CH_2CH_2CH_2CH_2CH_2CHO$

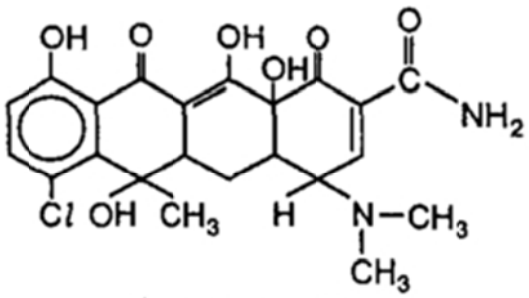
If all are reduced by a solution of an excess of $LiAlH_4$ respectively, how many hydrogen atoms would be incorporated in total?

A 8
B 10
C 12
D 14

24 When dissolved in water, which of the following salts will have the lowest pK_a value?

A $CH_3COO_2^-Na^+$
B K^+Cl^-
C $NH_4^+Cl^-$
D $C_6H_5NH_3^+Cl^-$

25 *Aureomycin* is a powerful antibiotic.



aureomycin

Which of the following statements about this compound is correct?

A *Aureomycin* exists as a total of 128 stereoisomers.

B One mole of *Aureomycin* reacts with 4 moles of ethanoyl chloride.

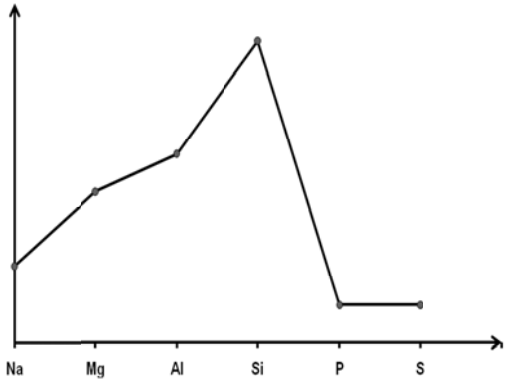
C One mole of *Aureomycin* reacts with 3 moles of chloroethane on heating.

D One mole of *Aureomycin* reacts with 5 moles of hot sodium hydroxide solution.

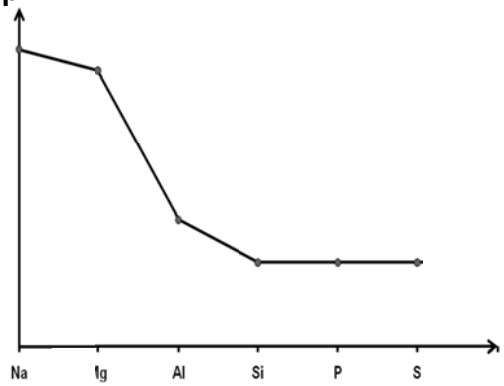
26 In separate experiments, oxides of the Period 3 elements, sodium to sulfur, is each added to water.

Which of the following diagrams best represents how the pH of the solutions varies across the period?

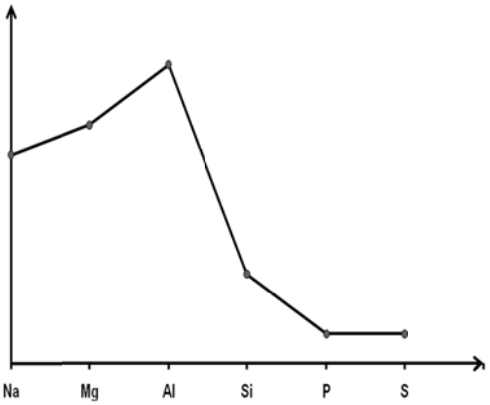
A



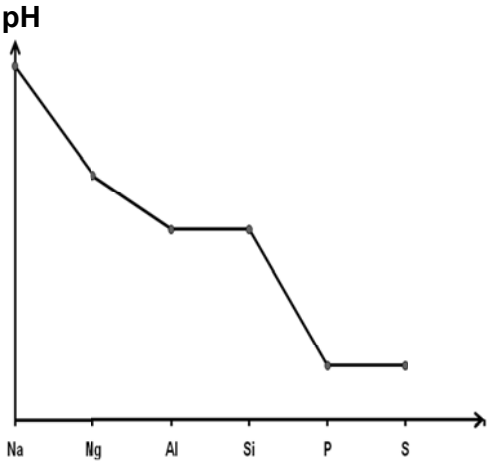
C



B



D



27 Element **K** has very low conductivity at room temperature. It forms only one chloride that hydrolyses in water forming a white solid and an acidic solution.

Both the chloride and oxide of **L** have high melting points. The oxide reacts readily with water. The chloride dissolves in water to form a neutral solution.

Element **M** has a chloride and an oxide which reacts vigorously with water to form solutions containing strong acids.

If elements **K**, **L** and **M** are in the Period 3, what are their identities?

	K	**L**	**M**
A	S	Na	A*l*
B	S	Mg	A*l*
C	Si	Na	P
D	Si	Mg	P

28 Properties of chlorine, iodine and their compounds are compared.

Which of the following properties would be smaller for chlorine, when compared to iodine?

A oxidizing ability of the element

B solubility of the silver halide

C strength of the van der Waals' forces between particles of the elements

D thermal stability of the hydrogen halide

29 Which of the following statements best explains why $[Fe(H_2O)F_5]^{2-}$ appears colourless?

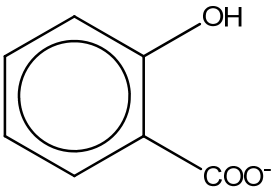
A The complex is octahedral in shape.

B The d orbitals are half-filled.

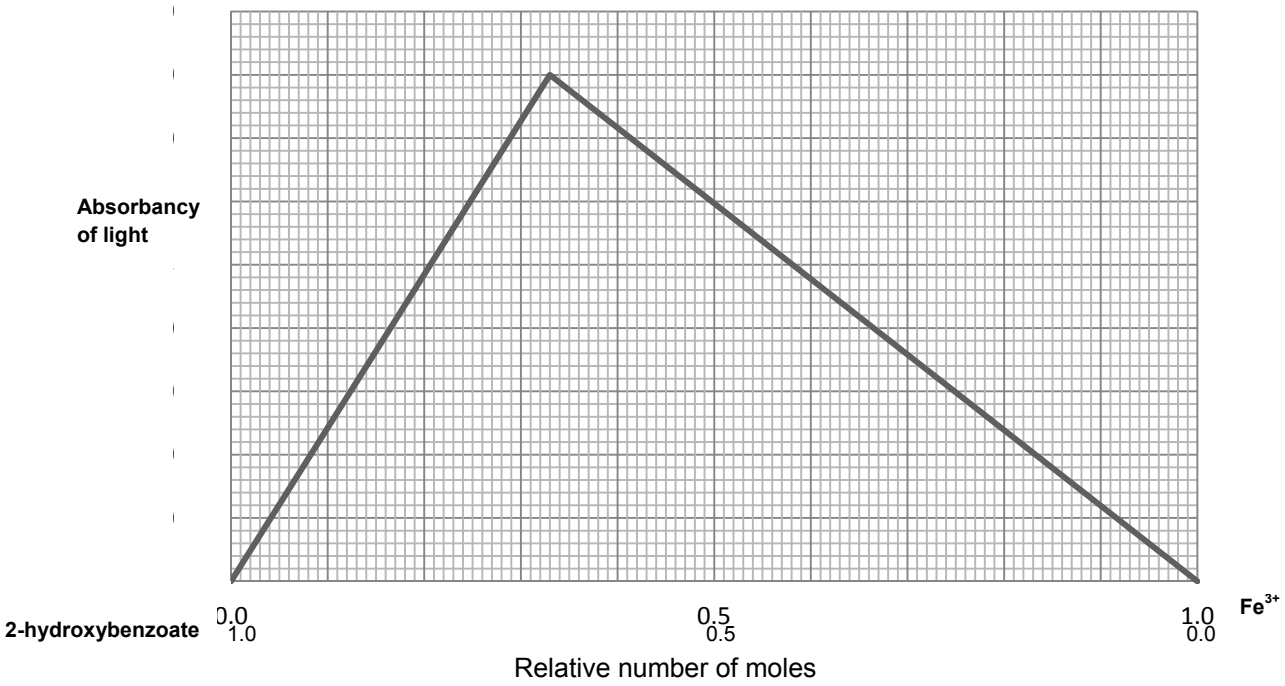
C The electrons do not undergo d-d transition.

D There is a large energy gap between d orbitals due to d-orbital splitting.

30



Mixtures of solutions containing Fe^{3+} (aq) and a bidentate ligand, 2-hydroxybenzoate ions (structure as above) show light absorbancy as shown in the graph below.



What is the likely co-ordination number of iron in this complex ion?

A 2

B 4

C 6

D 8

For questions 31 to 40, one or more of the three numbered statements 1 to 3 may be correct.

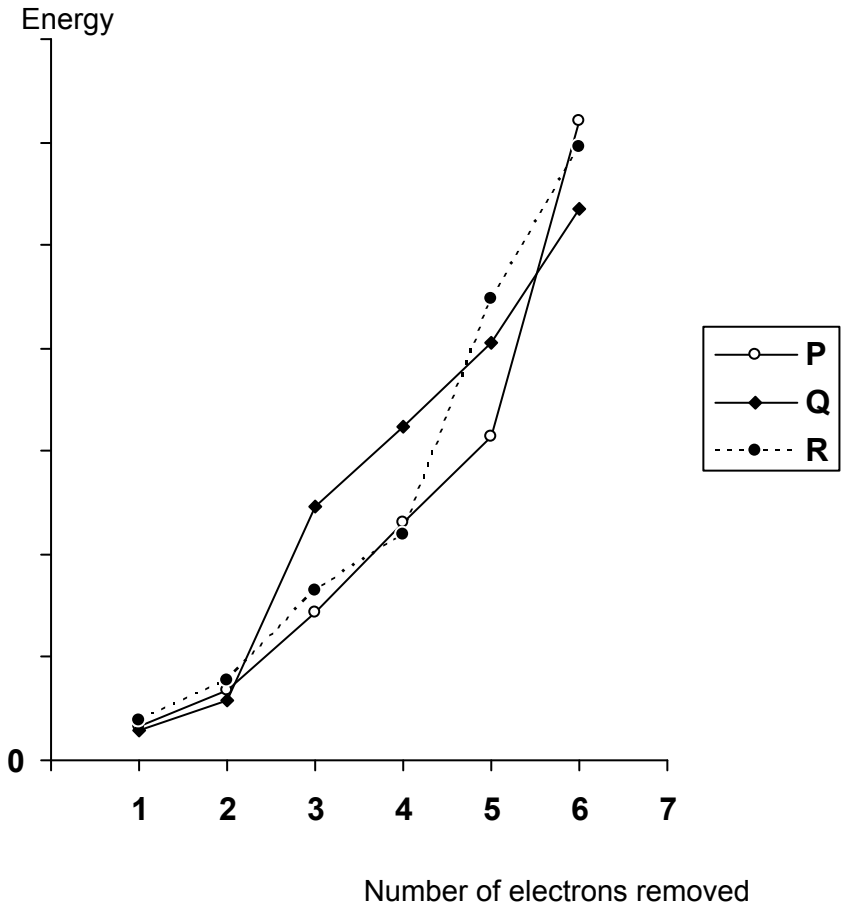
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements which you consider to be correct).

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 Successive ionisation energies of three elements from a particular period in the Periodic Table are plotted below.



Which of the following statements is/are true about elements **P, Q** and **R?**

1 Element **P** is from Group V of the Periodic Table.

2 Element **R** is from Group IV of the Periodic Table.

3 Elements **P**, **Q** and **R** are from Period 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.

32 **S** and **T** react in an equilibrium reaction given below:

$$\mathbf{S}(g) + \mathbf{T}(g) \rightleftharpoons \mathbf{U}(g) + \mathbf{V}(g) \qquad \Delta H > 0$$

The rate constant of such a reaction is usually

1 different for the forward and backward reactions.

2 increased in the presence of a catalyst.

3 lowered when temperature decreases.

33 The conversion of graphite to diamond is an endothermic process.

Which of the following statements is/are correct?

1 The energy content of diamond is higher than that of graphite.

2 The bond energy of the C–C bonds in diamond is greater than that in graphite.

3 The activation energy to convert graphite to diamond is lower than the activation energy for the reverse reaction.

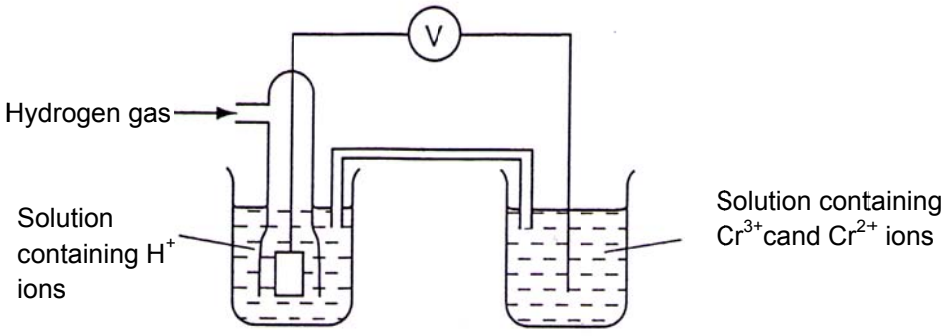
The responses A to D should be selected on the basis of

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

The diagram represents an experiment to confirm the value of $E^{\ominus}$ (Cr^{3+} / Cr^{2+}).



The emf of the cell was found to be 0.45 V rather than the expected 0.41 V.

Which statement(s) is / are correct to explain the above observation?

1 $[H^+(aq)]$ is greater than 1.00 $moldm^{-3}$.

2 $[Cr^{3+}(aq)]$ is smaller than 1.00 $moldm^{-3}$.

3 The electrode on the left in the set-up is a positive electrode.

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

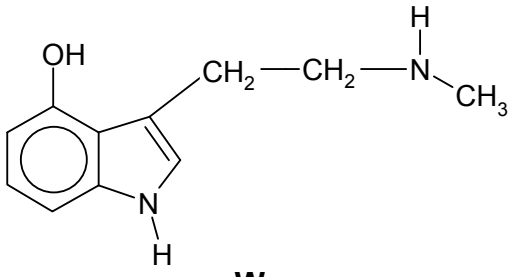
Which properties would be expected from radium, $_{88}$Ra, or its compounds?

1 Radium carbonate only gives off CO_2 at a very high temperature.

2 Radium hydroxide is insoluble in water.

3 Radium is inert towards cold water.

36 *Psilocin* is a psychedelic mushroom alkaloid. It is the active compound that produces hallucinations from ingesting "magic mushrooms" and amplifies sensory experience. Compound **W** is a derivative of *Psilocin*.



W

Which of the following is/are correct statements for compound **W**?

1 Its acidic group has a lower pK_a than that of ethanol.

2 It acts as a weaker nucleophile than ethanol when it forms an ester with an acyl chloride.

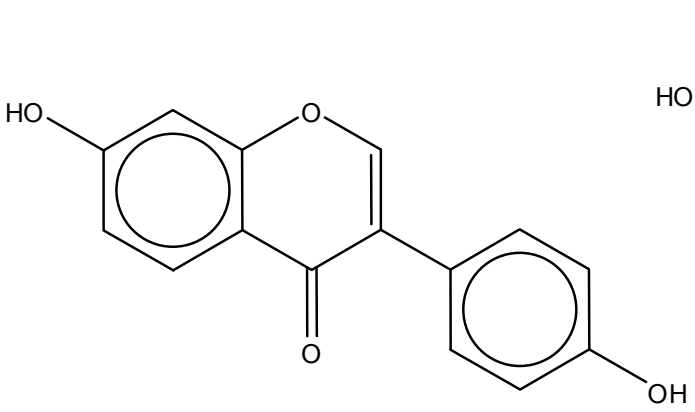
3 It dissolves in both aqueous acids and alkalis.

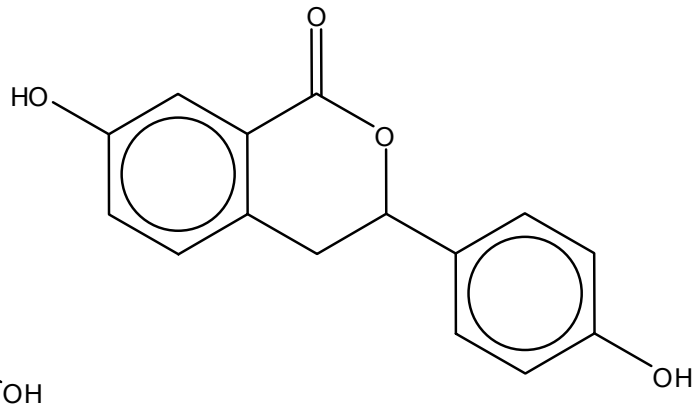
The responses A to D should be selected on the basis of

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.

37 What of the following reagents can be used to distinguish between the following compounds under suitable conditions?





1 2,4-dinitrophenylhydrazine

2 Acidified potassium dichromate

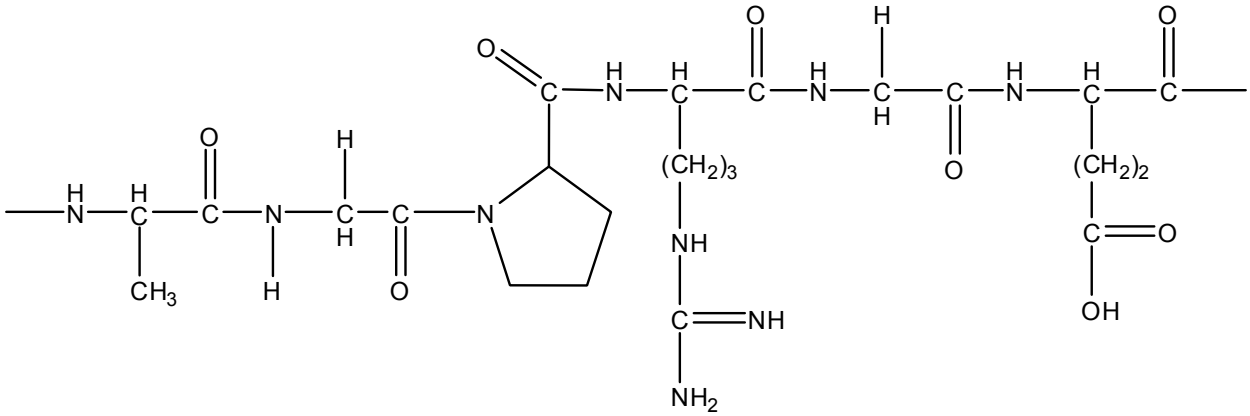
3 Aqueous bromine

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

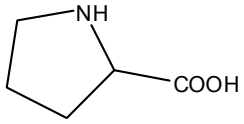
No other combination of statements is used as a correct response.

38 Part of the chain of the gelatin molecule is shown below.

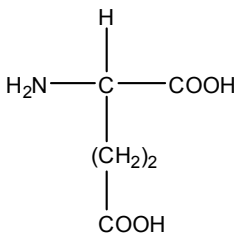


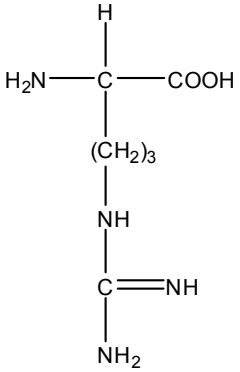
Based on the above structure, which of the following statement(s) is/are correct?

1 When gelatin is heated in 6 moldm^{-3} HC*l* for a prolonged period, $NH_2CH(CH_3)(COOH)$ is one of the products obtained.

2 The amino acid  is rarely found in the α-helix regions of proteins due to its rigid structure and restricted geometry of the bulky five-membered ring.

3 The following amino acids are likely to be the amino acids on the outside of the gelatin molecule:



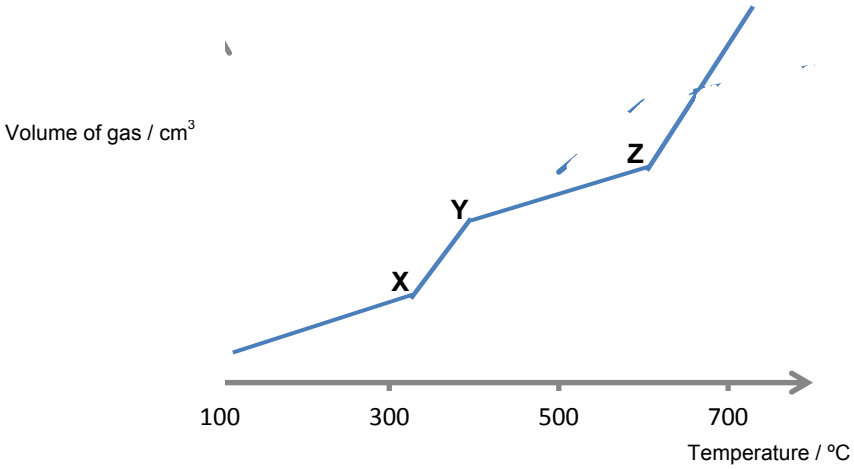


The responses A to D should be selected on the basis of

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 In an experiment, a mixture containing magnesium nitrate and barium nitrate was heated in a boiling tube and any gas evolved collected in a gas syringe.



Which of the following statements is/are correct?

1 The volume increase from **X** to **Y** was due to the decomposition of magnesium nitrate.

2 The volume increase from **Y** to **Z** was due to the decomposition of barium nitrate.

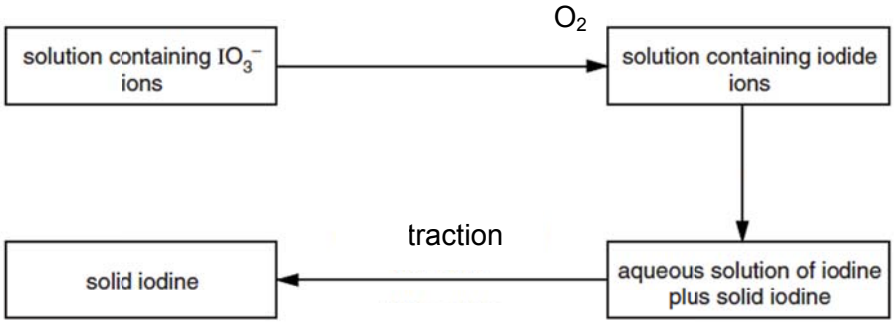
3 Anhydrous nitrate salts were used in the experiment.

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 Iodine is extracted from the ores containing IO_3^- by the following process.



ı IO_3^-

1 SO_2 acts as a reducing agent in Step 1.

2 Step 2 is a disproportionation reaction.

3 Sulfur is a by-product in Step 1.

END OF PAPER