

Section A

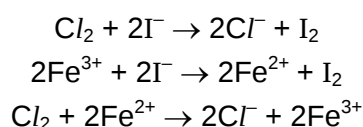
For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1** 25.0 cm³ of a solution of hydrogen peroxide, H₂O₂, was oxidised by excess potassium manganate(VII) solution under acidic condition. The volume of oxygen gas produced at room temperature and pressure was 26 cm³.

What is the concentration of hydrogen peroxide in the solution?

- A** 2.89 × 10⁻² mol dm⁻³ **C** 8.66 × 10⁻² mol dm⁻³
B 4.33 × 10⁻² mol dm⁻³ **D** 1.30 × 10⁻¹ mol dm⁻³

- 2** The equations for three reactions are given below.



What is the correct order of strength of Cl⁻, Fe²⁺ and I⁻ as reducing agents?

	<i>weakest</i>	—————→	<i>strongest</i>
A	Cl ⁻	I ⁻	Fe ²⁺
B	Cl ⁻	Fe ²⁺	I ⁻
C	Fe ²⁺	I ⁻	Cl ⁻
D	I ⁻	Cl ⁻	Fe ²⁺

- 3** In which one of the following pairs does the first species have a higher first ionisation energy than the second one?

- A** Sb, Te **B** Kr, Ar **C** Mg⁺, Al⁺ **D** Se, Se⁺

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

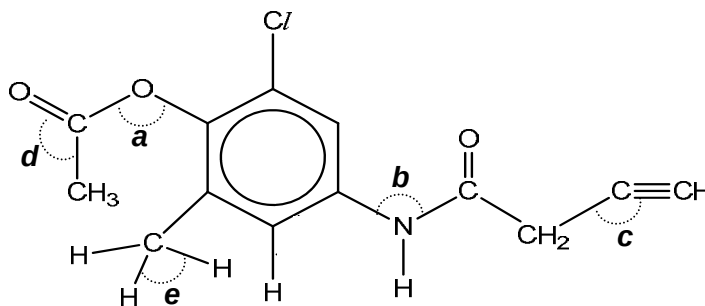
Consider the following chlorine-containing species:



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

- A** Not all atoms achieve stable octet configuration.
B ICl₂⁻ is linear, ClF₃ is T-shaped while ClO₃⁻ is trigonal pyramidal.
C The bond angles increase in the order of ClF₃, ClO₃⁻, ICl₂⁻.
D The oxidising power decreases in the order of O₂, F₂, Cl₂, I₂.

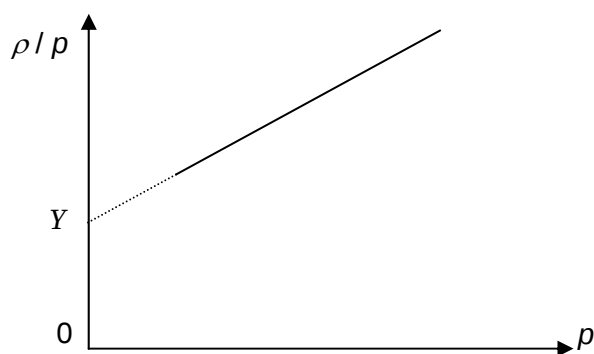
- 5 Refer to the molecule below:



Which one of the following shows the correct information with regard to the various labeled bond angles?

	smallest bond angle	→	largest bond angle
A	c	d	e
B	d	a	c
C	e	b	a
D	b	e	d

- 6 A graph of ρ/p versus p is obtained for a real gas **Z** at 273 K.
[ρ = density of gas in g dm^{-3} , p = pressure of gas in Pa]



What is the relative molecular mass of **Z** at 273 K?

- A $273RY$ B $\frac{273Y}{R}$ C $\frac{273}{RY}$ D $\frac{273R}{Y}$

- 7 Which one of the following equations represents a reaction that is feasible at all temperatures?

- A $\text{W(s)} \rightarrow \text{X(s)} + \text{Y(g)}$ $\Delta H > 0$
 B $2\text{T(g)} + 3\text{U(g)} \rightarrow 4\text{V(g)}$ $\Delta H < 0$
 C $\text{R(g)} \rightarrow 2\text{Q(g)}$ $\Delta H < 0$
 D $\text{K(g)} + \text{L(g)} \rightarrow \text{M(g)}$ $\Delta H > 0$

- 8 The rate of the reaction $3\text{D(g)} + \text{E(g)} \rightarrow \text{G(g)}$ is given by the rate equation, $\text{rate} = k [\text{D}]^2[\text{E}]$.

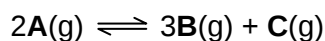
Two experiments using the same initial amounts of **D** and **E** were carried out at temperature, T . The data is shown below.

experiment	volume of reaction vessel	initial rate of reaction
1	V	R_1
2	$2V$	R_2

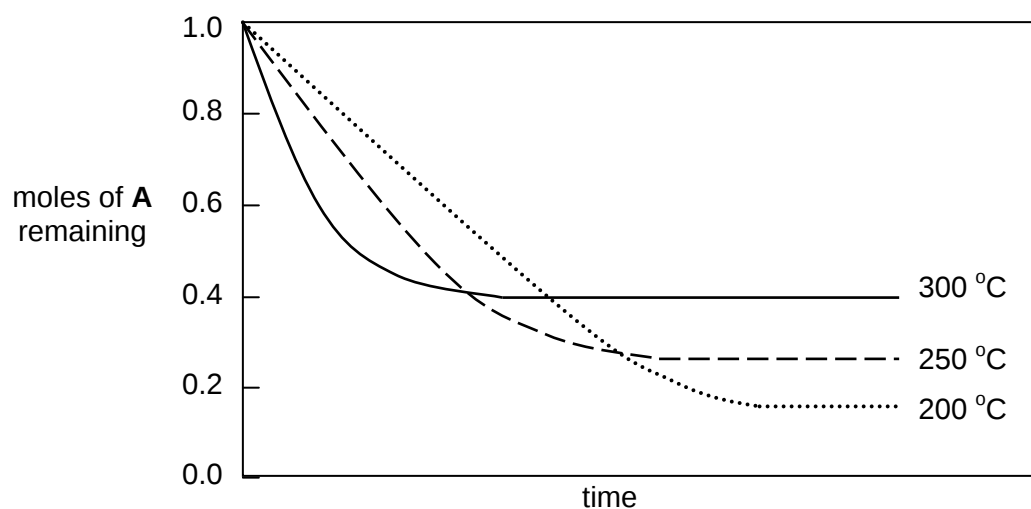
Which one of the following shows the correct relationship between R_1 and R_2 ?

- A** $R_2 = \frac{1}{8} R_1$
 B $R_2 = \frac{1}{4} R_1$
 C $R_2 = R_1$
 D $R_2 = 8R_1$

- 9 Gas **A** decomposes to two other gases, **B** and **C**, according to the following equation:



The graph below shows the decomposition of 1.0 mol of pure gas **A** in the presence of a catalyst at various temperatures.



Which one of the following statements about the above system is **incorrect**?

- A** The decomposition of **A** is endothermic.
B The K_p of the system decreases with increasing temperature.
C The percentage decomposition of **A** is 60 % at 300 °C.
D The system becomes more disordered when it reaches equilibrium state.

- $$\text{HPO}_4^{2-}(\text{aq}) + \text{H}_2\text{BO}_3^-(\text{aq}) \rightleftharpoons \text{H}_2\text{PO}_4^-(\text{aq}) + \text{HBO}_3^{2-}(\text{aq})$$

	acids				bases		
A	H_2PO_4^-	>	H_2BO_3^-	and	HBO_3^{2-}	>	HPO_4^{2-}
B	H_2BO_3^-	>	H_2PO_4^-	and	HBO_3^{2-}	>	HPO_4^{2-}
C	H_2PO_4^-	>	H_2BO_3^-	and	HPO_4^{2-}	>	HBO_3^{2-}
D	H_2BO_3^-	>	H_2PO_4^-	and	HPO_4^{2-}	>	HBO_3^{2-}

- | | | | |
|--------------|----------------------|-----------------------|------------------------------|
| calcium salt | CaCO_3 | CaF_2 | $\text{Ca}_3(\text{PO}_4)_2$ |
| K_{sp} | 8.7×10^{-9} | 4.0×10^{-11} | 1.2×10^{-26} |

A $\text{Ca}_3(\text{PO}_4)_2$, CaF_2 , CaCO_3
B $\text{Ca}_3(\text{PO}_4)_2$, CaCO_3 , CaF_2
C CaCO_3 , CaF_2 , $\text{Ca}_3(\text{PO}_4)_2$
D CaF_2 , CaCO_3 , $\text{Ca}_3(\text{PO}_4)_2$

- A** -0.48 V **C** $+0.10\text{ V}$
B -0.10 V **D** $+0.48\text{ V}$

- 13** X, Y and Z are elements in the same period of the Periodic Table.

Given the following information:

- The hydroxide of X gives an aqueous solution with pH less than 7.
- The hydroxide of Y reacts with both strong acids and alkalis.
- The hydroxide of Z gives an aqueous solution which is strongly alkaline.

Which one of the following statements is correct?

- A The atomic radius decreases from X to Y to Z.
- B The electrical conductivity decreases from X to Y to Z.
- C The electronegativity decreases from X to Y to Z.
- D The first ionisation energy increases from X to Y to Z.

- 14** CaCO_3 decomposes at $900\text{ }^\circ\text{C}$ to produce CO_2 and the metal oxide.

CaSO_4 decomposes at $1100\text{ }^\circ\text{C}$ to produce SO_3 and the metal oxide.

Which one of the following statements explains the greater thermal stability of CaSO_4 ?

- A The CO_2 molecule is smaller than SO_3 .
- B The CO_3^{2-} ions are more easily polarized than SO_4^{2-} .
- C The charge density of CO_3^{2-} is greater than that of SO_4^{2-} .
- D The lattice energy of CaCO_3 is more exothermic than CaSO_4 .

- 15** Astatine, At is below iodine in Group VII of the Periodic Table.

Which one of the following statements is most likely to be true for astatine?

- A At_2 is soluble in water.
- B AgAt is insoluble in dilute NH_3 but dissolves in concentrated NH_3 .
- C HAt decomposes readily on heating to give hydrogen and astatine.
- D At_2 reacts with aqueous NaCl to give an aqueous solution of NaAt and Cl_2 .

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

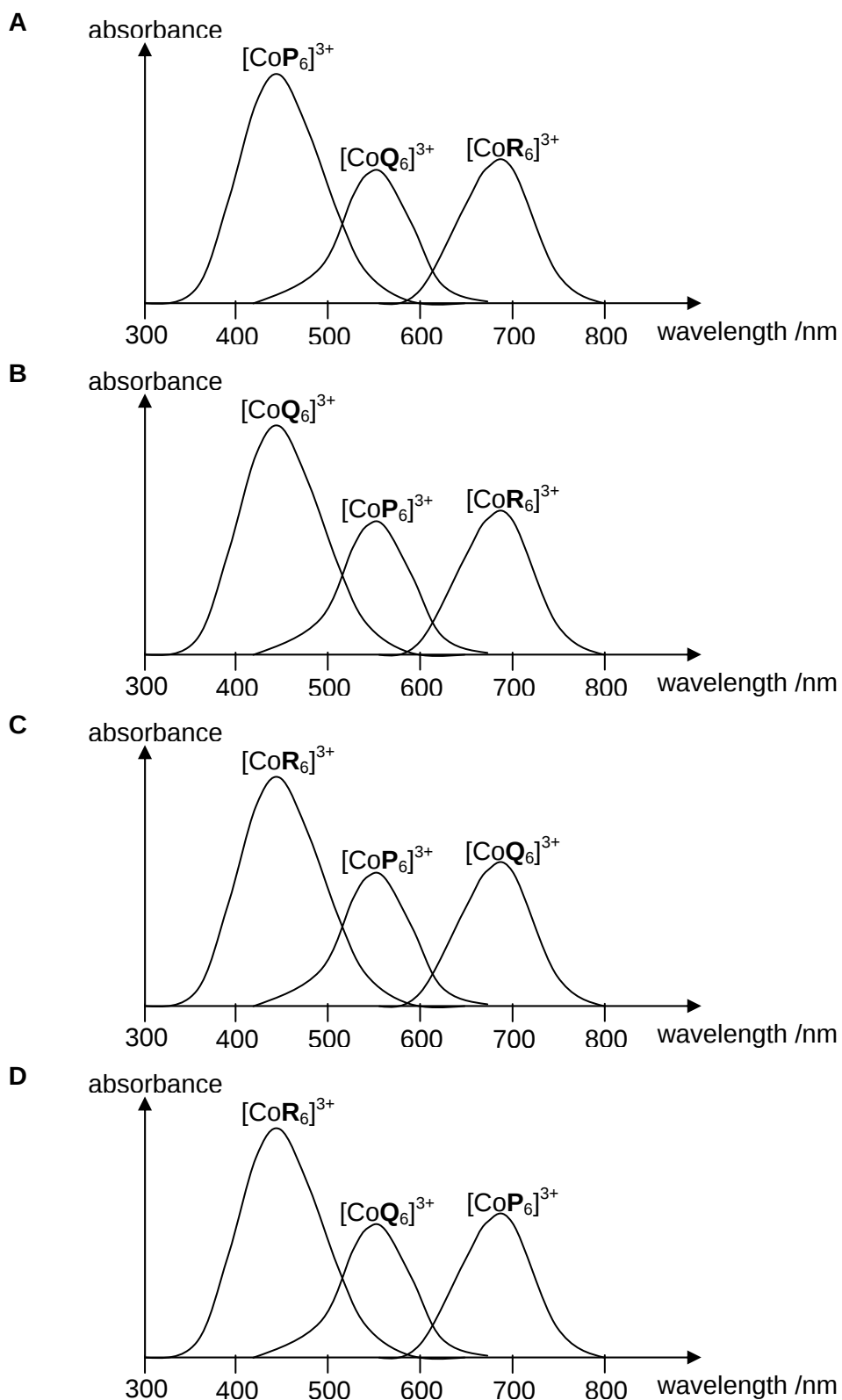
x mol of bromine gas is reacted completely with excess aqueous sodium hydroxide at $70\text{ }^\circ\text{C}$. The resulting solution is acidified and aqueous silver nitrate added.

What is the mass (in g) of silver bromide formed?

- | | | | |
|---|--------|---|--------|
| A | $113x$ | C | $313x$ |
| B | $188x$ | D | $376x$ |

- 17 $[\text{CoP}_6]^{3+}$, $[\text{CoQ}_6]^{3+}$ and $[\text{CoR}_6]^{3+}$ are three complexes of cobalt(III). Ligand **P** results in a smaller d–d splitting compared to ligand **Q** while $[\text{CoR}_6]^{3+}$ is blue in colour.

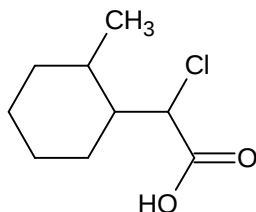
Which one of the following diagrams shows the possible absorption spectra of the three cobalt(III) complexes?



18 Which one of the following species is unlikely to exist?

- A $[\text{Cu}(\text{S}_2\text{O}_3)]^-$
 B $[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]^-$
 C $[\text{Mn}(\text{CN})_6]^{2+}$
 D $[\text{VO}(\text{H}_2\text{O})_5]^{2+}$

19 Compound **P** is optically active.

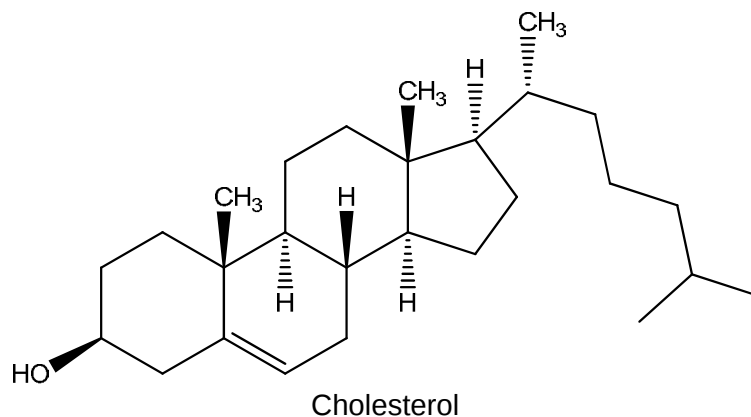


P

How many stereoisomers does compound **P** have?

- A 2
 B 4
 C 8
 D 16

20 Cholesterol is an essential structural component of animal cell membranes that is required to establish proper membrane permeability and fluidity.



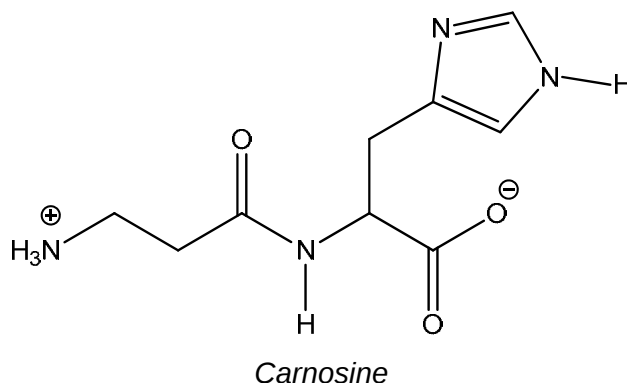
The following are two claims about the structure of cholesterol.

- 1 All the seventeen carbon atoms in the four rings lie in the same plane.
- 2 The molecule can exhibit cis–trans isomerism at the C=C double bond.

Which one of the following claims is correct?

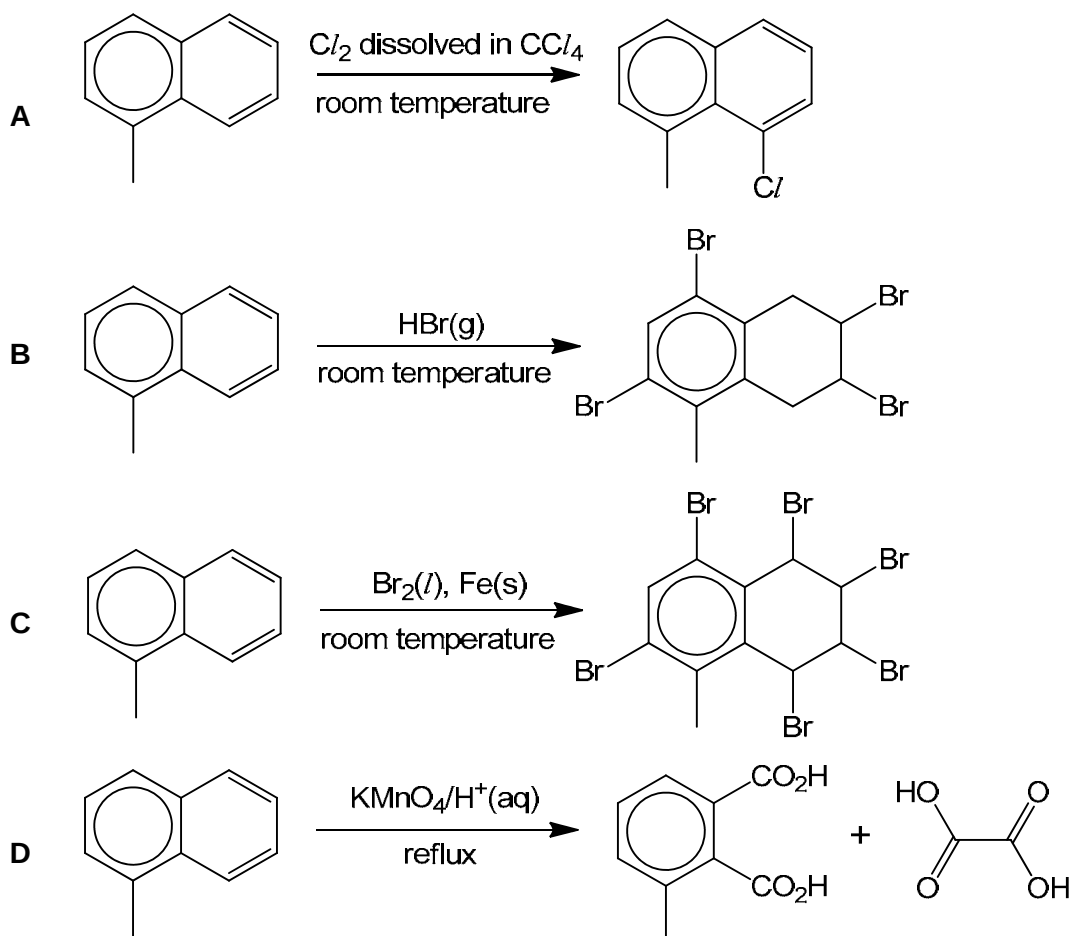
- A Only **1** is correct.
 B Only **2** is correct.
 C Both **1** and **2** are correct.
 D Neither **1** nor **2** is correct.

- 21 *Carnosine* is an antioxidant dipeptide and is found in muscle and brain tissues more than other tissues in the body.



Which one of the following statements best describes *Carnosine*?

- A The most polar bond in *Carnosine* is C=O.
 B *Carnosine* gives positive test with Brady's reagent.
 C There are four sp^3 hybridized atoms in *Carnosine*.
 D 3 lone pairs of electrons in *Carnosine* are delocalised by resonance.
- 22 Which one of the following transformations is correct?

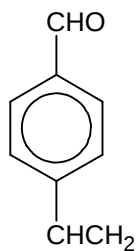


23 Compound **Q** is subjected to the following tests and the results are recorded below.

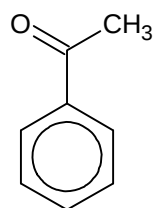
reagents and conditions	Observations
acidified KMnO_4 and reflux	Purple solution turns colourless. Effervescence of colourless gas.
Fehling's reagent and warm	No precipitate is seen.
Tollen's reagent and warm	Silver mirror is formed.

Which one of the following could be compound **Q**?

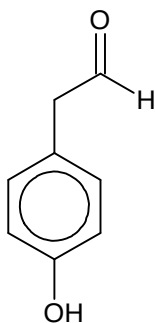
A



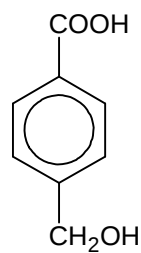
B



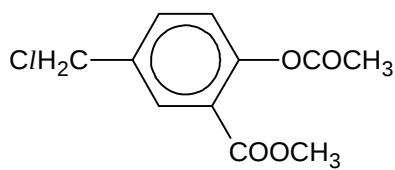
C



D



- 24 Which one of the following represents the organic product when an excess of hot aqueous sodium hydroxide is added to compound **R**?

**R**

- A**
- B**
- C**
- D**

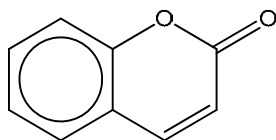
- 25 Compound **L**, $C_6H_{14}O$

- gives effervescence with Na(s);
- reacts with acidified potassium manganate(VII) under reflux to give compound **M**, which forms a yellow precipitate with warm alkaline aqueous iodine;
- dehydrates to give alkene **N**, which oxidatively cleaves to give carbon dioxide and 3-methylbutanoic acid.

What is the structure of compound **L**?

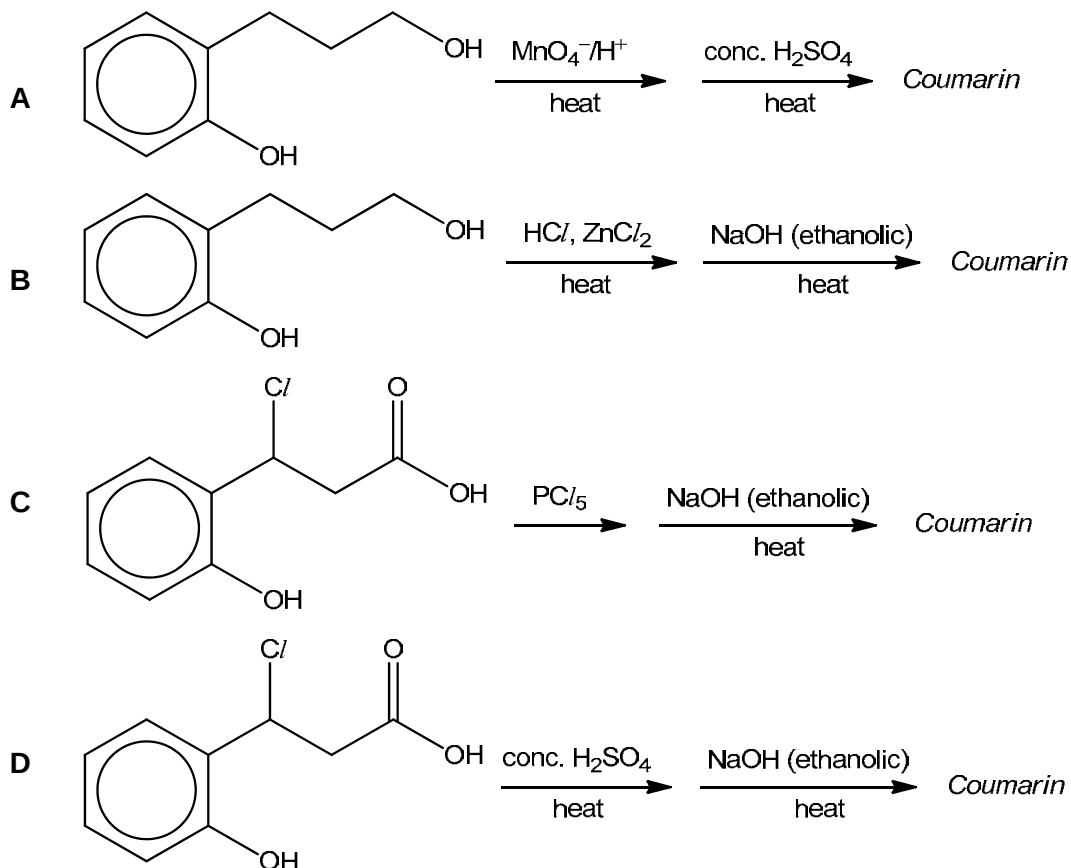
- A**
- B**
- C**
- D**

- 26 *Coumarin* is a fragrant organic chemical compound. It has a sweet odour, readily recognized as the scent of new-mown hay, and has been used in perfumes since 1882.

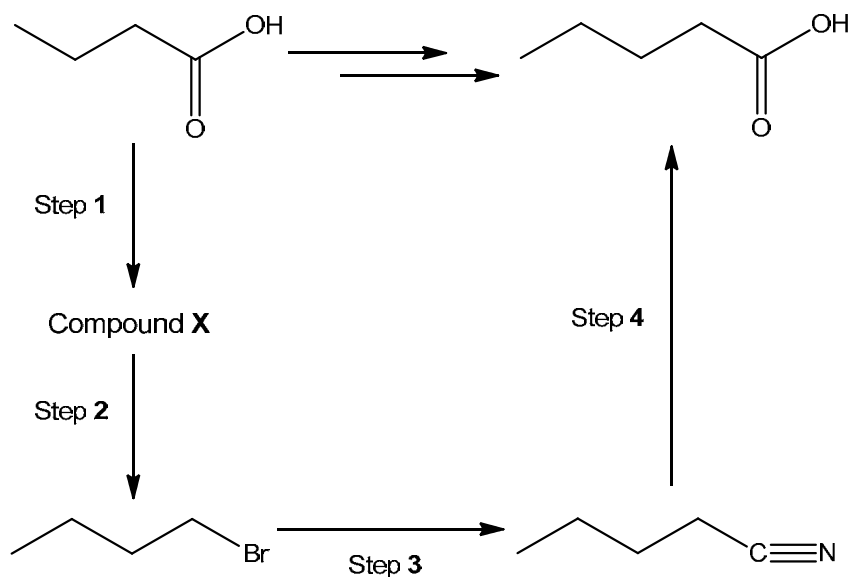


Coumarin

Which one of the following is a possible synthesis route for *Coumarin*?



- 27 The following reaction scheme is from a student's laboratory notebook. The scheme is, however, incomplete.



In an attempt to understand the reaction scheme, the following deductions were made by another student.

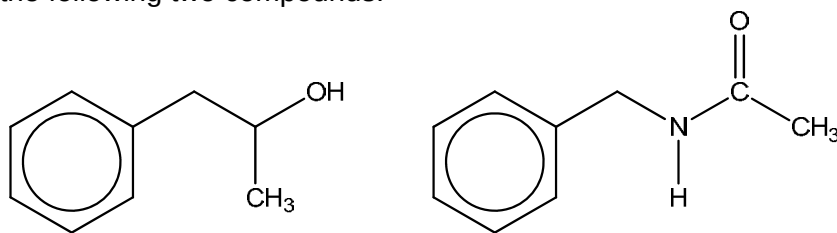
Statement I Step 1 can be achieved using ethanolic NaBH_4 .

Statement II Step 2 is a nucleophilic substitution reaction.

Statement III Step 3 can be achieved by heating with ethanolic KCN .

Which one of the following options is correct?

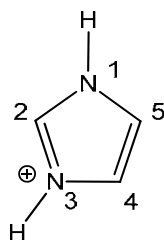
- A I and II only are correct
- B I and III only are correct
- C II and III only are correct
- D I, II and III are correct
- 28 Four students suggested combinations of I_2/OH^- and 2,4-dinitrophenylhydrazine to differentiate the following two compounds.



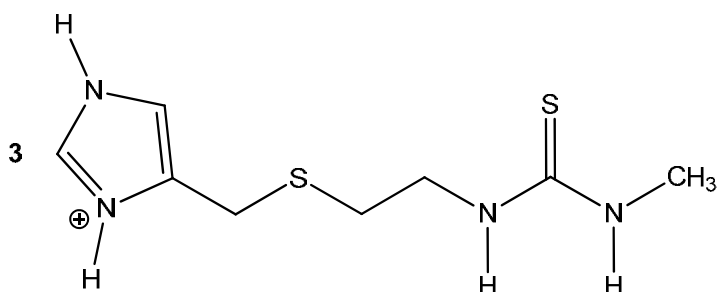
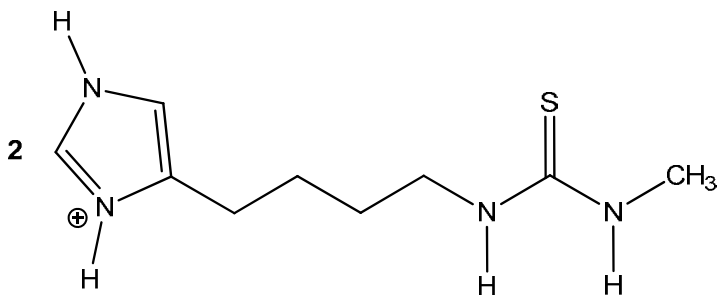
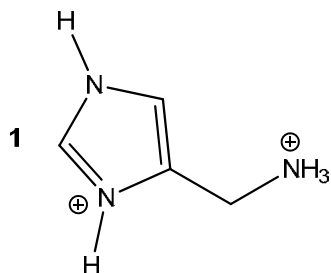
Which one of the following student's suggestions can distinguish the two compounds?

- A Only I_2/OH^- can be used.
- B Only 2,4-dinitrophenylhydrazine can be used.
- C Both I_2/OH^- and 2,4-dinitrophenylhydrazine can be used.
- D Both I_2/OH^- and 2,4-dinitrophenylhydrazine cannot be used.

- 29 The protonated N-3 of an unsubstituted imidazolium ion has a pK_a of 6.8. The following formula shows the structure of an unsubstituted imidazolium ion.



Inserting different substituents on the ring will alter the acidity of imidazolium ion.



What is the correct order of the ions above in decreasing acidity of the protonated nitrogen in the ring?

A 1 > 2 > 3

C 2 > 3 > 1

B 1 > 3 > 2

D 3 > 1 > 2

- 30 Which one of the following proteins will **not** retain its primary structure?

- A Adding a few drops of tetrachloromethane to collagen.
- B Boiling insulin with dilute hydrochloric acid.
- C Beating egg white with a glass rod.
- D Mixing Ca^{2+} ions with casein.

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 (you may find it helpful to put a tick against the statements that you consider to be correct).

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

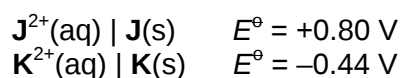
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

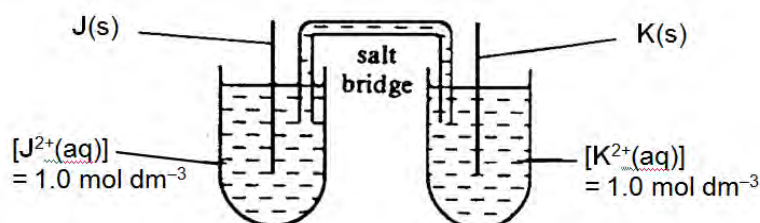
31 Which of the following statements are correct?

- 1** 6.02×10^{23} molecules of nitrogen gas weigh 28.0 g.
- 2** 24.0 dm^3 of ammonia gas at r.t.p. contains 3.0 g of hydrogen.
- 3** 16.0 g of oxygen gas contains 6.02×10^{23} oxygen atoms.

32 The standard electrode potentials for metals **J** and **K** are given below.



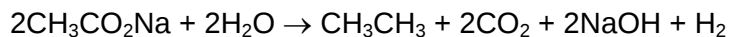
The electrochemical cell shown in the diagram below is set up.



Which of the following statements are correct descriptions of this cell?

- 1** The cations from the salt bridge will enter $\text{K}^{2+}(\text{aq}) \mid \text{K}(\text{s})$ half cell.
- 2** The e.m.f. of the cell is +1.24 V.
- 3** The e.m.f. of the cell will decrease when the concentration of K^{2+} ions increases.

- 33** When a solution of concentrated sodium ethanoate is electrolysed, the equation for the reaction is



Which statements regarding the electrolysis are correct?

- 1** Hydrogen is liberated at the cathode.
 - 2** Carbon dioxide is liberated at the anode.
 - 3** Ethane is liberated at the cathode.
- 34** Benzyl chloride ($\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$) was reacted with aqueous sodium hydrosulfide (NaSH) in the presence of aqueous sodium iodide (NaI). The time taken for the reaction to complete and the initial concentrations are given in the following table:

Experiment	$[\text{C}_6\text{H}_5\text{CH}_2\text{Cl}]$	$[\text{NaSH}]$	$[\text{NaI}]$	t / s
1	0.1	0.05	0.05	120
2	0.2	0.05	0.05	60
3	0.1	0.10	0.05	120
4	0.05	0.10	0.10	240
5	0.4	0.15	0.04	?

Which of the following statements are correct?

- 1** The value of t for experiment 5 is 30 s.
 - 2** For experiment 1, iodomethylbenzene ($\text{C}_6\text{H}_5\text{CH}_2\text{I}$) is formed in greater amount than phenylmethanethiol ($\text{C}_6\text{H}_5\text{CH}_2\text{SH}$).
 - 3** The reaction proceeds via $\text{S}_{\text{N}}1$ mechanism as the positive charge generated on carbocation is stabilized by resonance.
- 35** When aqueous ammonia is added drop-wise to a mixture of $\text{Cu}(\text{NO}_3)_2$ and $\text{Mg}(\text{NO}_3)_2$, precipitation occurs. Aqueous ammonia is then added in excess and filtration is carried out.

Which of the following statements are correct?

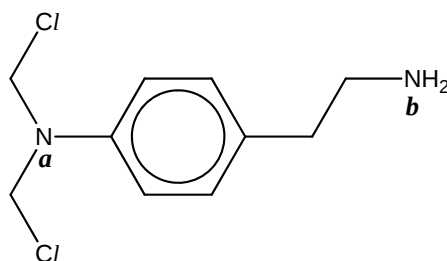
- 1** A dark blue filtrate is obtained.
- 2** No residue will be obtained from the filtration.
- 3** There is no change in observation when $\text{Mg}(\text{NO}_3)_2$ is replaced with $\text{Zn}(\text{NO}_3)_2$.

- 36** Indium is in the same group as aluminium in the Periodic Table.

When aqueous sodium carbonate is added separately to aqueous indium(III) chloride and aqueous aluminium chloride, effervescence is only observed with aluminium chloride.

Which of the following statements help to explain the difference in behaviour?

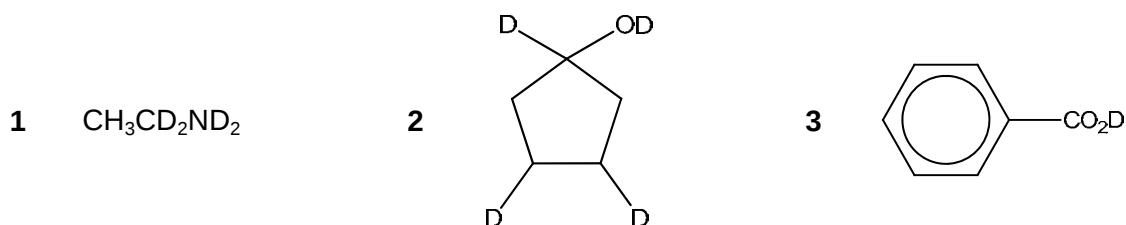
- 1 The standard enthalpy change of hydration of indium(III) chloride is more exothermic than that of aluminium chloride.
 - 2 In^{3+} has a much bigger ionic radius than Al^{3+} .
 - 3 Water ligands in $\text{Al}^{3+}(\text{aq})$ are polarised to a greater extent than those in $\text{In}^{3+}(\text{aq})$.
- 37** The Syrian government is recently being accused by the international community for using nerve agents against the rebels. One nerve agent used by the Nazi army during World War II is shown below. The compound contains 2 nitrogen atoms labelled N_a and N_b .



Which of the following statements are true about the compound?

- 1 $\text{N}_a\text{--C}$ bond where C is from benzene ring is shorter than $\text{N}_b\text{--C}$ bond.
 - 2 The pH of a solution of the compound will decrease when aqueous bromine is added.
 - 3 The lone pair of electrons on N_b is more available for donation than the lone pair of electrons on N_a .
- 38** Deuterium, D, is an isotope of hydrogen.

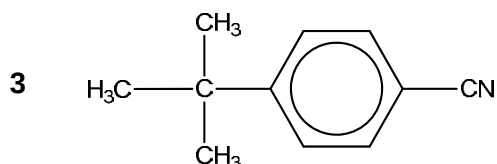
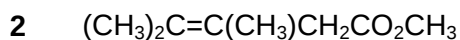
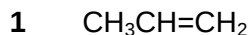
Which compounds can be formed by reacting D_2 with another molecule in the presence of platinum catalyst?



- 39** Use of the table of 'Characteristic values for infra-red absorption' in the Data Booklet is needed to answer this question.

Compound **A** is obtained by reacting compound **B** with excess hot acidified KMnO_4 . The infra-red spectrum of compound **A** shows a strong absorption at wavenumber 2700 cm^{-1} .

Which of the following compounds could be compound **B**?



- 40** Which of the following statements about the α -helix structure are correct?

- 1** It has low solubility in water or polar solvents.
- 2** The polypeptide chains are held in place by intra-chain hydrogen bonds.
- 3** The polypeptide chains are arranged in a parallel fashion running in same or opposite directions to each other.

Victoria Junior College
2013 H2 Chemistry Prelim Exam 9647/1
Suggested Answers

1	B	6	A	11	B	16	C	21	D	26	C	31	A	36	C
2	B	7	C	12	C	17	B	22	C	27	C	32	C	37	A
3	A	8	A	13	C	18	C	23	A	28	A	33	B	38	B
4	D	9	A	14	B	19	C	24	C	29	B	34	A	39	A
5	D	10	A	15	C	20	D	25	D	30	B	35	D	40	B