| Name: | Index No.: | CT Group: 11 |
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PIONEER JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION
HIGHER 2

# CHEMISTRY 9647/01

Paper 1 Multiple Choice **20 September 2012**

**1 hour**

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, Centre number 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.

## Section A

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

**1** Acidified, aqueous potassium manganate(VII) oxidises ethanedioate ions, $C_2O_4^{2-}$, to $CO_2$.

$$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + 16H^+(aq) \rightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(l)$$

What is the concentration of potassium manganate(VII), in mol $dm^3$, if 20 $cm^3$ is required to completely oxidise $2.0 \times 10^{-3}$ mol of the salt $KHC_2O_4.H_2C_2O_4$?

**A** $\frac{5}{2} \times \frac{1000}{20} \times 2.0 \times 10^{-3}$

**B** $\frac{5}{2} \times \frac{1000}{20} \times 4.0 \times 10^{-3}$

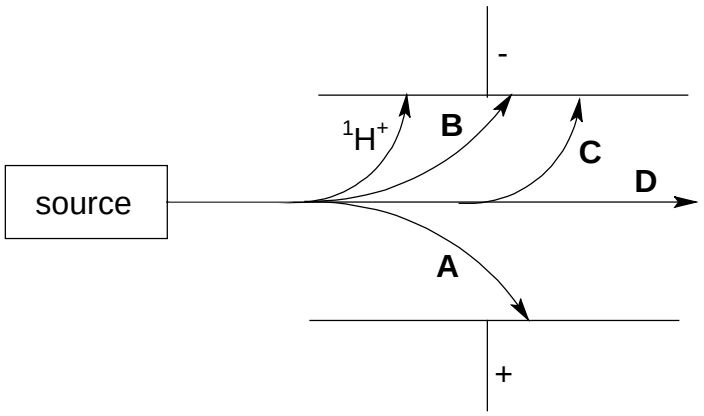
**C** $\frac{2}{5} \times \frac{1000}{20} \times 2.0 \times 10^{-3}$

**D** $\frac{2}{5} \times \frac{1000}{20} \times 4.0 \times 10^{-3}$

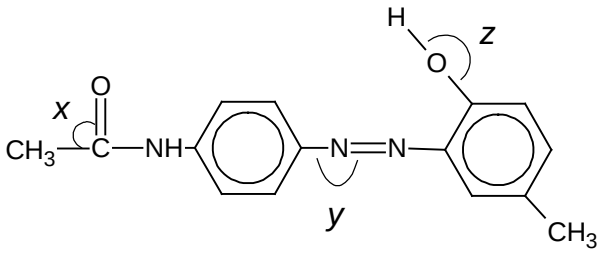
**2** The radioactive decay of polonium, $^{210}_{84}Po$, can be simply represented by the following equation.

$$^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + \alpha + 2e^-$$

What would be the path taken by the alpha particle, **α**, when it is passed through an electric field?



**3** What are the values of angle *x*, *y* and *z* in a molecule of *Disperse Yellow*?




*Disperse Yellow*

| | angle *x* | angle *y* | angle *z* |
|---|---|---|---|
| **A** | 90 | 115 | 105 |
| **B** | 90 | 180 | 180 |
| **C** | 120 | 115 | 105 |
| **D** | 120 | 180 | 115 |

**4** Which of the following pairs of graphs share the same general shape according to ideal gas law for a fixed mass of gas?

| | | | |
|---|---|---|---|
| **A** | p against V (at constant T) | and | V/T against T (at constant p) |
| **B** | pV against V (at constant T) | and | V/T against T (at constant p) |
| **C** | p against T (at constant V) | and | pV against p (at constant T) |
| **D** | V against T (at constant p) | and | pV against p (at constant T) |

**5** Travellers to countries with cold climate may sometimes use heat packs to keep warm. One example is the sodium ethanoate heat pack. This consists of a supersaturated solution of sodium ethanoate and a small metal disc containing very small crystals of sodium ethanoate.

When the disc is broken, the small crystals of sodium ethanoate are released into the solution and act as nucleation sites to catalyse the crystallisation reaction of sodium ethanoate.

Which line gives the signs of $\Delta H$, $\Delta S$ and $\Delta G$ for the overall process?

| | $\Delta H$ | $\Delta S$ | $\Delta G$ |
|---|---|---|---|
| **A** | - | - | - |
| **B** | - | - | + |
| **C** | + | + | - |
| **D** | + | + | + |

**6** Barium reacts with water to form barium hydroxide and hydrogen.

$$Ba(s) + 2H_2O(l) \rightarrow Ba(OH)_2(aq) + H_2(g)$$

The standard enthalpy change for this reaction can be measured in the laboratory.

What further information is needed to calculate the standard enthalpy change of formation of solid barium hydroxide?

I Standard enthalpy change of formation of water
II Standard enthalpy change of solution of barium hydroxide
III Standard enthalpy change of hydration of barium ion
IV Standard enthalpy change of hydration of hydroxide ion

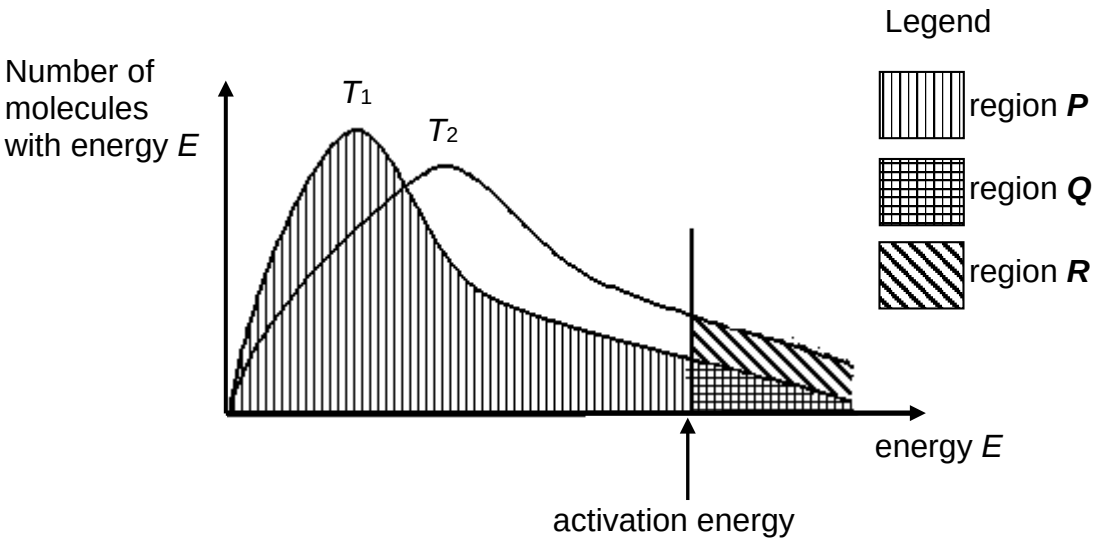
**A** I only

**B** I and II

**C** III and IV

**D** I, II, III and IV

**7** The distribution of the number of molecules with energy $E$ is given in the sketch for two temperatures, $T_1$ and a higher temperature $T_2$. The letters ***P***, ***Q***, ***R*** refer to the separate and differently shaded areas. The activation energy is marked on the energy axis.

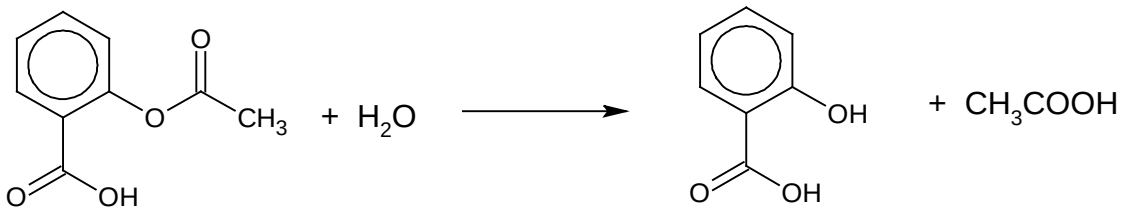



Which expression gives the fraction of the molecules present which have at least the activation energy at the higher temperature $T_2$?

**A** $\frac{Q}{P}$ **B** $\frac{Q+R}{P}$ **C** $\frac{Q+R}{P+Q}$ **D** $\frac{Q+R}{P+Q+R}$

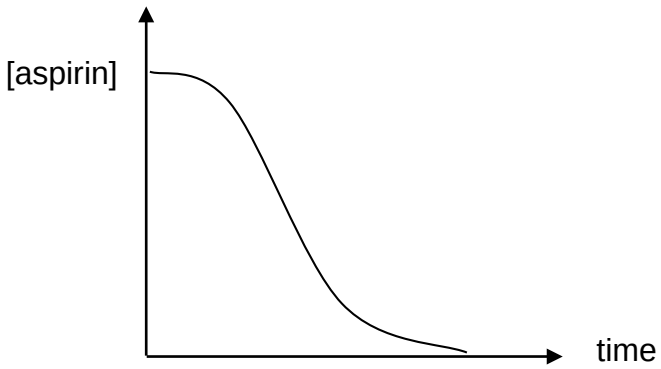
**8** Aspirin is an analgesic often used to relieve minor aches and pains. The chemical stability of aspirin is of great importance since it becomes less effective when exposed to high temperature and moisture.

A kinetic study on the reaction of aspirin and water was conducted.




aspirin

The graph below shows the concentration of aspirin against time for this reaction.




What does the shape of the graph suggest about this reaction?

**A** It is exothermic.

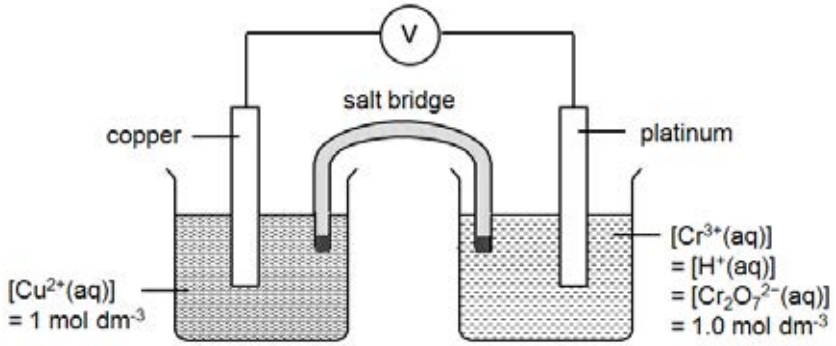
**B** It is endothermic.

**C** It shows first order kinetics.

**D** It produces its own catalyst.

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

A cell is set up by connecting a $Cu^{2+}/Cu$ half-cell and an acidified $Cr_2O_7^{2-}/Cr^{3+}$ half-cell under standard conditions.




Which of the following correctly describes the effect on the e.m.f of the cell when the corresponding change is made?

| | Change | Effect on e.m.f of cell |
|---|---|---|
| **A** | replace copper with an alloy of copper and silver | increases |
| **B** | addition of concentrated $H_2SO_4$ into reduction half-cell | decreases |
| **C** | addition of dilute NaOH into oxidation half-cell | decreases |
| **D** | addition of water into oxidation half-cell | increases |

**10** 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**?

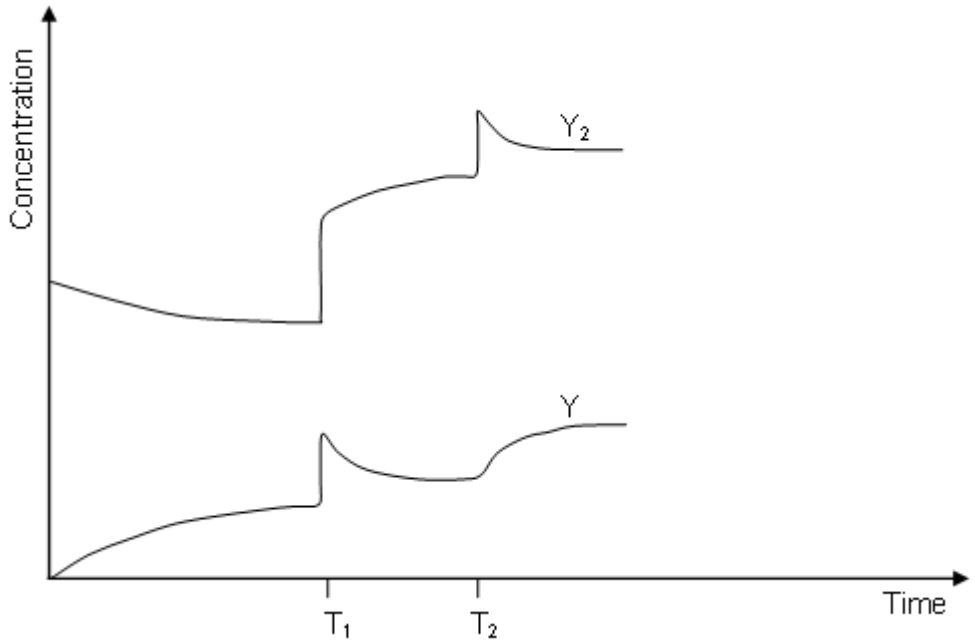
**A** 2:1:1 **B** 2:1:2

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

**11** The following equation represents the conversion of $Y_2$ to Y.

$$Y_2(g) \rightleftharpoons 2Y(g)$$

The conversion was studied using a fixed amount of $Y_2$ in a reaction vessel. At different times during the experiment, changes were made to the conditions in the reaction vessel. The change in the concentrations in the equilibrium mixture with time is given by the graph below:




Which one of the following statements is correct?

**A** A catalyst was added at $T_1$.

**B** There was a decrease in volume of the reaction vessel at $T_2$.

**C** There was an increase in temperature at $T_2$.

**D** More $Y_2$ was introduced at $T_2$.

**12** A pure sample of dinitrogen tetraoxide at an initial pressure of 1 atm is allowed to reach equilibrium in a vessel of constant volume and constant temperature.

$$N_2O_4 \rightleftharpoons 2NO_2$$

What is the equilibrium constant, $K_p$, for this reaction, given that the equilibrium pressure is 1.5 times greater than the initial pressure?

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

**13** The table below shows the values of the ionic product of water, $K_w$, at two different temperatures.

| Temperature / $^oC$ | $K_w$ / $mol^2\ dm^{-6}$ |
|---|---|
| 25 | $1.00 \times 10^{-14}$ |
| 62 | $1.00 \times 10^{-13}$ |

Which of the following statements is correct for pure water?

**A** The ionic dissociation of water is an exothermic process.

**B** At 62 $^oC$, pH = 14 − pOH.

**C** At 62 $^oC$, pH < pOH.

**D** At 62 $^oC$, it is neutral and pH < 7.

**14** A sample of waste solution at pH 1 is found to contain 0.100 mol $dm^{-3}$ zinc sulfate and 0.100 mol $dm^{-3}$ lead(II) sulfate. Solid sodium hydroxide is slowly added until the pH is 5.

The solubility product of zinc hydroxide is $3.00 \times 10^{-17}$ $mol^3\ dm^{-9}$ and that of lead(II) hydroxide is $1.42 \times 10^{-20}$ $mol^3\ dm^{-9}$.

Which statement describes what happens in the solution?

**A** No precipitate is formed.

**B** Only lead(II) hydroxide is precipitated.

**C** Only zinc hydroxide is precipitated.

**D** Both zinc hydroxide and lead(II) hydroxide are precipitated.

**15** *P*, *Q* and *R* are elements of the third period of the Periodic Table. The oxide of *P* is amphoteric, the oxide of *Q* is basic and oxide of *R* is acidic.

What is the order of decreasing ionic radius?

**A** *RQP*

**B** *RPQ*

**C** *QPR*

**D** *PQR*

**16** Which property of the Group II elements (magnesium to barium) and their compounds increases with increasing proton number?

**A** The ease of thermal decomposition of the carbonate

**B** The pH of the aqueous chloride

**C** The solubility of hydroxide in water

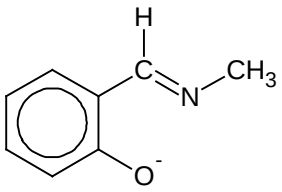
**D** The magnitude of the enthalpy change of hydration of the metal ion

**17** The ash from burnt seaweed contains chlorides and iodides of some Group I and Group II elements. Some seaweed ash was treated with concentrated sulfuric acid and the resulting fumes passed first through a cold tube and then bubbled through aqueous silver nitrate.

What would be observed during the experiment?

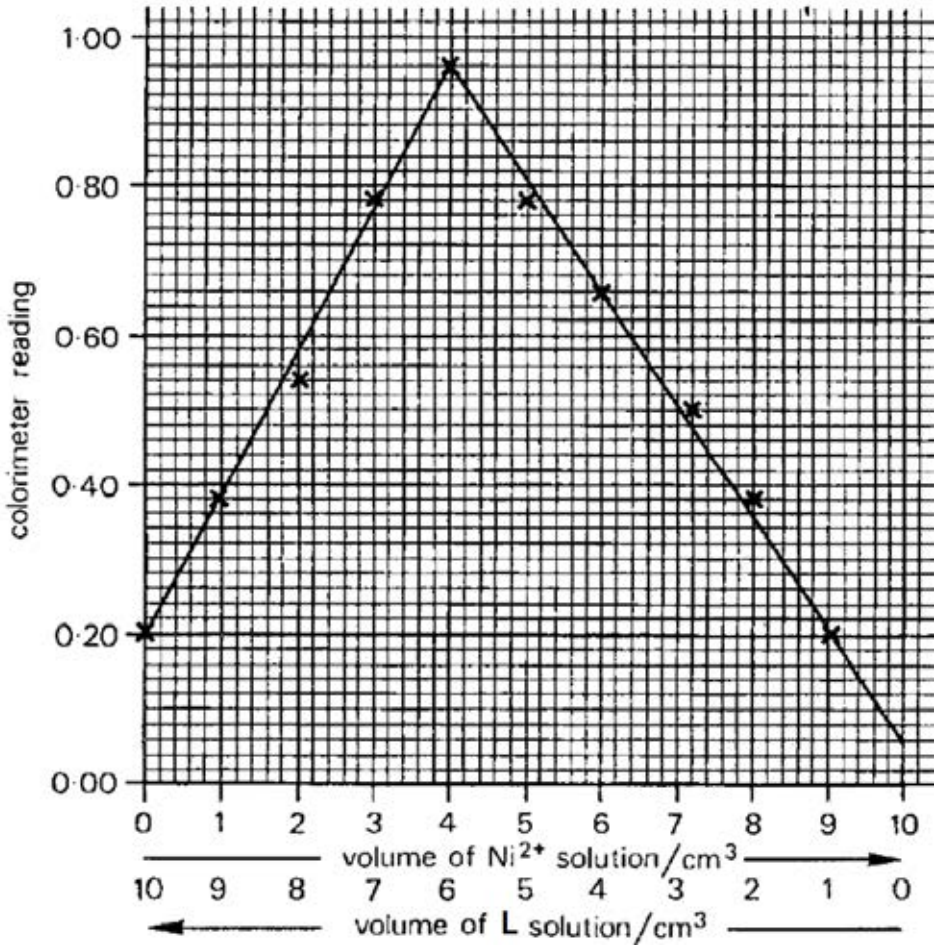
| | inside the cold tube | with aqueous silver nitrate |
|---|---|---|
| **A** | no deposit | white precipitate |
| **B** | no deposit | yellow precipitate |
| **C** | black deposit | white precipitate |
| **D** | black deposit | yellow precipitate |

**18** Nickel(II) ion forms a red complex with ligand **L** (shown below) at room temperature.




**L**

The graph below was obtained when the colour intensities of mixtures of a 4 x $10^{-3}$ mol $dm^{-3}$ solution of **L** and a 3 x $10^{-3}$ mol $dm^{-3}$ solution of nickel(II) chloride were measured using a colorimeter at room temperature




Which one of the following statements regarding the ligand **L** or the nickel(II) complex is correct?

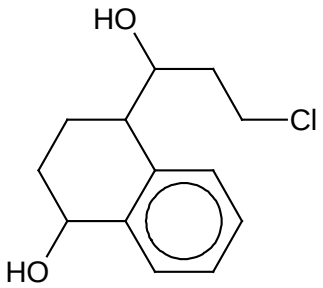
**A** **L** is a monodentate ligand.

**B** The nickel(II) complex is negatively charged.

**C** The nickel(II) complex absorbs red light strongly.

**D** The co-ordination number of nickel in the complex is 4.

**19** What is the total number of possible isomers that can be formed when the following compound reacts with hot excess concentrated $H_2SO_4$?

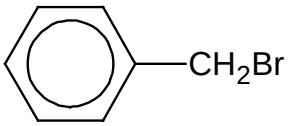


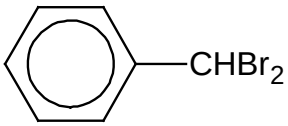

**A** 2 **B** 4 **C** 6 **D** 8

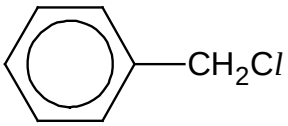
**20** How many esters with molecular formula $C_4H_8O_2$ react with hot, acidified potassium manganate(VII) to give carbon dioxide?

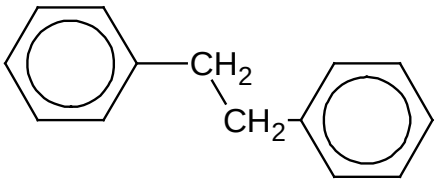
**A** 2 **B** 3 **C** 4 **D** 5

**21** When excess Br*Cl* is added to the methylbenzene in the presence of *uv* light, which organic compound will be produced in the smallest proportion?

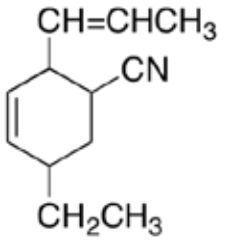
**A** 


**B** 


**C** 


**D** 

**22** Which of the following statements regarding compound **Z** is **incorrect**?




Compound **Z**

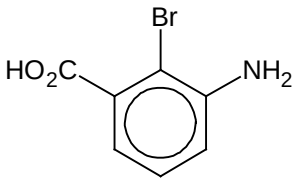
**A** There is only one *sp* hybridised carbon atom in a molecule of **Z**.

**B** A molecule of **Z** contains four p bonds.

**C** After **Z** reacts with LiA*l*H$_4$, all the carbon atoms in the product formed are $sp^3$ hybridised.

**D** After **Z** reacts with HC*l*(g), all but one carbon atom in the product formed are $sp^3$ hybridised.

**23** Compound **V** may be synthesised from benzene.




**V**

Which of the following synthetic routes will yield compound **V**?

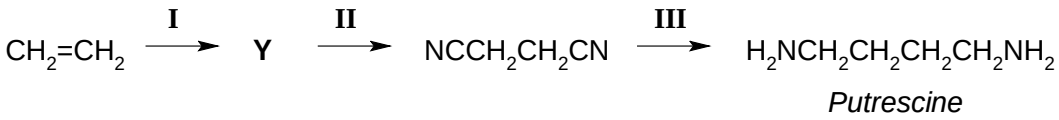
**A** alkylation ® nitration ® oxidation ® bromination ® reduction

**B** bromination ® nitration ® reduction ® alkylation ® oxidation

**C** nitration ® alkylation ® reduction ® bromination ® oxidation

**D** nitration ® reduction ® bromination ® alkylation ® oxidation

**24** *Putrescine* is used in the production of *Nylon-4,6*. It can be synthesised from ethene by the following reactions.




Which of the following gives the correct reagents and conditions for steps **I** to **III**?

| | **I** | **II** | **III** |
|---|---|---|---|
| **A** | $Br_2$ | KCN in ethanol, heat | $H_2$, Ni, 200 °C |
| **B** | $Br_2$ | HCN, trace NaCN, 15 °C | $LiAlH_4$, dry ether |
| **C** | cold, alkaline $KMnO_4$ | KCN in ethanol, heat | $LiAlH_4$, dry ether |
| **D** | cold, alkaline $KMnO_4$ | HCN, trace NaCN, 15 °C | $H_2$, Ni, 200 °C |

**25** Which of the following compounds would **not** give sodium ethanoate when treated with hot, aqueous sodium hydroxide?

**A** $CH_3CONHCH_3$

**B** $C_6H_5OCOCH_3$

**C** $CH_3CH_2CN$

**D** $CH_3COCl$

**26** When treated with concentrated potassium hydroxide, benzaldehyde undergoes disproportionation.

What compounds are produced in this reaction?

**A** $C_6H_5O^-K^+$ and $C_6H_5CO_2^-K^+$

**B** $C_6H_5O^-K^+$ and $C_6H_5CH_2OH$

**C** $C_6H_5CH_2O^-K^+$ and $C_6H_5CO_2^-K^+$

**D** $C_6H_5CH_2OH$ and $C_6H_5CO_2^-K^+$

**27** Which of the following compounds

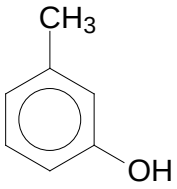
(i) does **not** decolourise hot, acidified $KMnO_4$(aq) and
(ii) gives a salt when reacted with NaOH(aq)?

**A** $CH_3CO_2CH_2CO_2H$

**B** $CH_2(OH)COCH_2CO_2H$

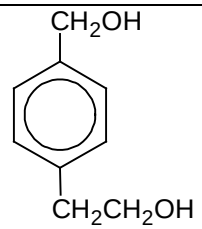
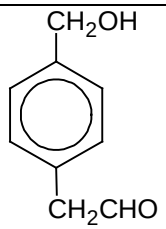
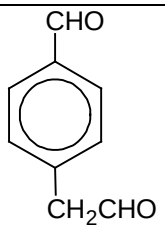
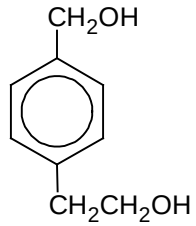
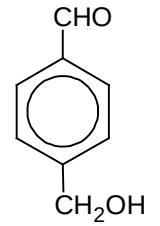
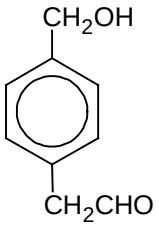
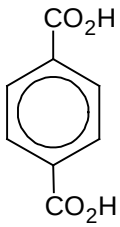
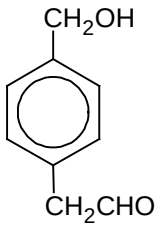
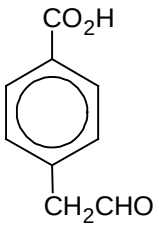
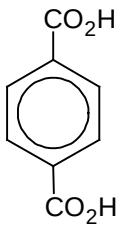
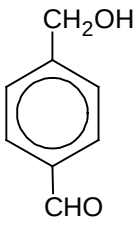
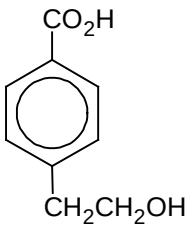
**C** $(CH_3)_2C(OH)CH_2COOH$

**D**

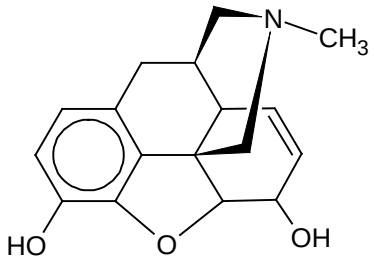



**28** Compounds **X**, **Y** and **Z** all react with $PCl_5$ to release hydrogen chloride, but only one reacts with Fehling's solution.

Which one of the following combinations could be **X**, **Y** and **Z**?

| | **X** | **Y** | **Z** |
|---|---|---|---|
| **A** |   |   |   |
| **B** |   |   |   |
| **C** |   |   |   |
| **D** |   |   |   |

**29** Morphine is an effective pain killer.




morphine

Which of the following statements about morphine is correct?

**A** It contains 4 chiral centres.

**B** It reacts with $Br_2$(aq) to incorporates up to 3 atoms of bromine atoms in each molecule.

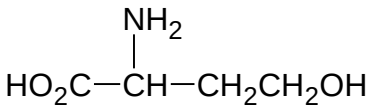
**C** It decolourises Baeyer's reagent (alkaline $KMnO_4$) at room temperature.

**D** With excess $PCl_5$, 1 mole of morphine reacts with excess $PCl_5$ to give 2 moles of $HCl$.

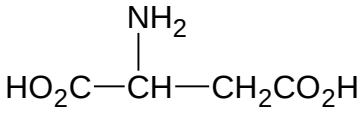
**30** A mixture of amino acids can be separated using electrophoresis. The solution of amino acids is buffered at a specific pH and placed in a well in a gel conducting current between two electrodes.

At a buffer pH of 8, which of the following amino acids will appear closest to the anode at the end of electrophoresis?

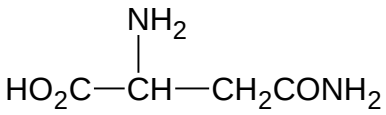
**A**



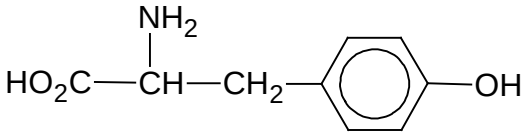

**B**




**C**




**D**



## 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** Gases **A** and **B** are both gaseous hydrocarbons. When a 30 $cm^3$ mixture of **A** and **B** in the ratio of 1:2 is sparked continuously with excess oxygen gas, 70 $cm^3$ of the residual gas is absorbed by aqueous sodium hydroxide.

Which of the following pairs of hydrocarbons could be **A** and **B**?

| | **A** | **B** |
|---|---|---|
| **1** | methane | propane |
| **2** | propane | ethane |
| **3** | pentane | methane |

**32** Which of the following pairs of elements have the same number of unpaired electrons in their ground state?

**1** carbon and titanium

**2** nitrogen and cobalt

**3** fluorine and copper

**33** Which of the following could act as acidic buffers?

**1** A 1:2 mixture of NaOH and $C_6H_5COOH$

**2** A 1:2 mixture of HC*l* and $NaHCO_3$

**3** A 1:2 mixture of HC*l* and $CH_3CO_2Na$

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** A chloride and an oxide of two elements were dissolved in water.

Only one of the solutions can dissolve $Al_2O_3$ but both solutions cannot dissolve $SiO_2$.

Which of the following could be the chloride and the oxide?

**1** $NaCl$ and $SO_3$

**2** $SiCl_4$ and $P_4O_{10}$

**3** $PCl_5$ and $Na_2O$

**35** The hexa-aquairon(III) ion hydrolyses as shown.

$$[Fe(H_2O)_6]^{3+}(aq) + H_2O(l) \rightleftharpoons [Fe(H_2O)_5OH]^{2+}(aq) + H_3O^+(aq)$$

Which of the following statements are correct?

**1** The corresponding iron(II) ion $[Fe(H_2O)_6]^{2+}$ is less likely to undergo hydrolysis.

**2** The iron undergoes a change in oxidation state.

**3** This hydrolysis is favoured by low pH values.

**36** Which of the following statements about the chemical reactions of cyclohexane, cyclohexene and methylbenzene are correct?

**1** Upon reduction under suitable conditions, one mole each of cyclohexene and methylbenzene will react with one mole and three moles of hydrogen gas respectively.

**2** All the three compounds decolourise bromine under *uv* light.

**3** Only cyclohexene and methylbenzene will react with hot, acidified potassium dichromate(VI).

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** For the reaction,

$(CH_3)_3CX + CH_3CH_2O^- \rightarrow (CH_3)_3COCH_2CH_3 + X^-$ (where X = C*l*, Br or I)

which of the following statements are likely to be correct?

**1** The reaction involves a nucleophilic attack by $CH_3CH_2O^-$.

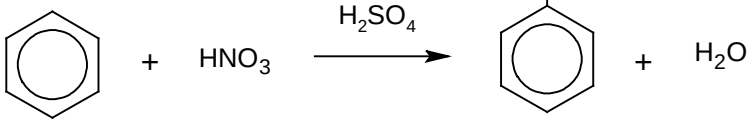
**2** The rate determining step involves the formation of a carbocation.

**3** The reaction will take place more rapidly when X is I than when X is C*l*.

**38** In some organic reactions, the reactive carbon atom is not tetrahedral in the reactant molecule but becomes tetrahedral in the organic intermediate.

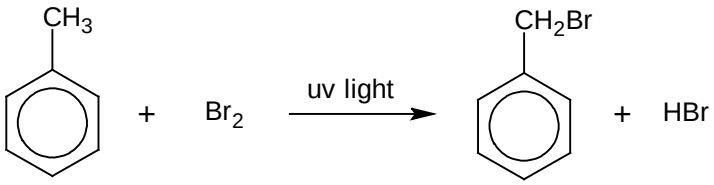
To which of the following reactions does this statement apply?

**1**




**2** $CH_3CHO + HCN \xrightarrow{NaCN} CH_3CH(OH)CN$

**3**

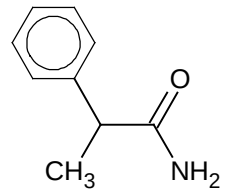
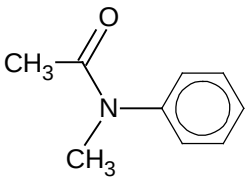


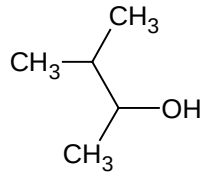
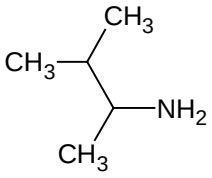
The responses **A** to **D** should be selected on the basis of

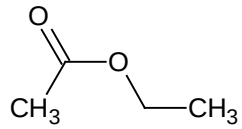
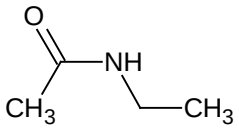
| A | B | C | D |
|---|---|---|---|
| **1**, **2** and **3** are correct | **1** and **2** only are correct | **2** and **3** only are correct | **1** only is correct |

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

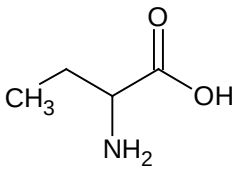
**39** Which of the following pairs of compounds can be distinguished using the stated reagents and conditions?

**1**  and  NaOH(aq) and heat

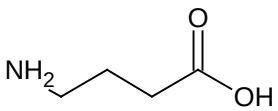
**2**  and  HC*l*(aq)

**3**  and  NaOH(aq), $I_2$(aq), warm

**40** a-aminobutyric acid and g-aminobutyric acid are isomers.



a-aminobutyric acid



g-aminobutyric acid

Which of the following statements are correct?

**1** Both are soluble in water.

**2** Both can form zwitterions.

**3** Both can be obtained from the hydrolysis of protein.

**END OF PAPER**