



HWA CHONG INSTITUTION
JC2 Preliminary Examinations
Higher 2

CANDIDATE
NAME

CT GROUP

10S

CENTRE
NUMBER

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INDEX
NUMBER

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CHEMISTRY

9647/01

Paper 1 Multiple Choice

23 September 2011

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Complete the information on the optical mark sheet (OMS) as shown below.

1. Enter your NAME (as in NRIC). _____

Write your **name**

2. Enter the SUBJECT TITLE. _____

3. Enter the PAPER NUMBER. _____

4. Enter your CT GROUP. _____

Write your **CT group**

5. Date. _____

6. Enter your NRIC NUMBER or
FIN NUMBER.

7. Now SHADE the corresponding
lozenge in the grid for
EACH DIGIT or LETTER

NRIC / FIN															
S	0	0	0	0	0	0	0	0	0	A	K	U			
F	1	1	1	1	1	1	1	1	1	B	L	V			
G	2	2	2	2	2	2	2	2	2	C	M	W			
T	3	3	3	3	3	3	3	3	3	D	N	X			
	4	4	4	4	4	4	4	4	4	E	O	Y			
	5	5	5	5	5	5	5	5	5	F	P	Z			
	6	6	6	6	6	6	6	6	6	G	Q				
	7	7	7	7	7	7	7	7	7	H	R				
	8	8	8	8	8	8	8	8	8	I	S				
	9	9	9	9	9	9	9	9	9	J	T				

Write and
shade your
NRIC
or FIN number

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 OMS.

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, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

- 1 Mixtures of argon and another gas are commonly used during welding. One such gaseous mixture has a density of 1.82 g dm^{-3} at s.t.p.

What could be the other gas in this mixture? [Density of argon = 1.78 g dm^{-3} at s.t.p.]

- A Carbon dioxide
- B Oxygen
- C Nitrogen
- D Helium

- 2 **X** is an organic iron compound containing only Fe, C and H. When a 0.944 g sample of **X** was subjected to complete combustion, 2.23 g of CO_2 and 0.457 g of H_2O were formed.

What is the empirical formula of **X**?

- A FeCH
- B FeC_2H
- C $\text{Fe}_2\text{C}_5\text{H}_2$
- D $\text{FeC}_{10}\text{H}_{10}$

- 3 Some isotopes are unstable and undergo nuclear (radioactive) reactions. In one type of reaction, an unstable nucleus assimilates an electron from an inner orbital of its electron cloud. The net effect is the conversion of a proton and an electron into a neutron.

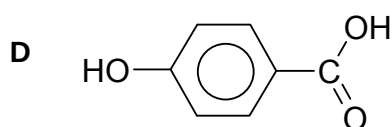
Which of the following describes this type of reaction?

- A $^{11}\text{C} \rightarrow ^{12}\text{C}$
- B $^{111}\text{I} \rightarrow ^{111}\text{Te}$
- C $^{76}\text{Br} \rightarrow ^{75}\text{Br}$
- D $^{76}\text{Kr} \rightarrow ^{75}\text{Br}$

- 4 In which of the following pairs does the first substance have a higher melting point than the second?

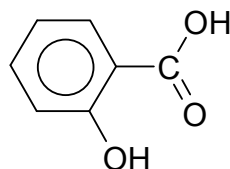
First substance

- A $\text{CH}_3\text{CH}_2\text{OCH}_3$
- B $(\text{CH}_3)_3\text{CH}$
- C RbCl



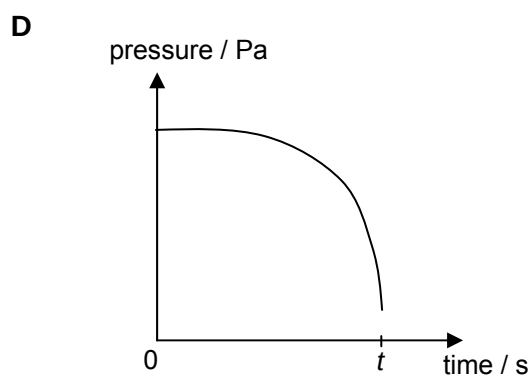
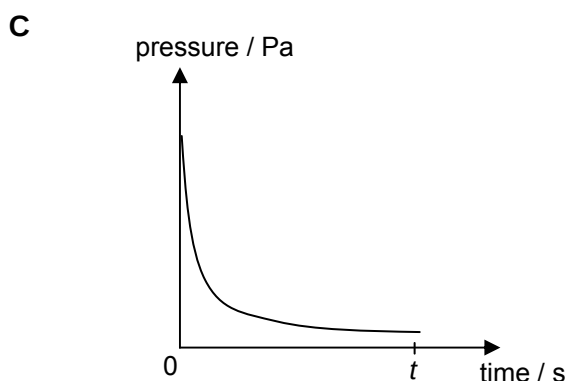
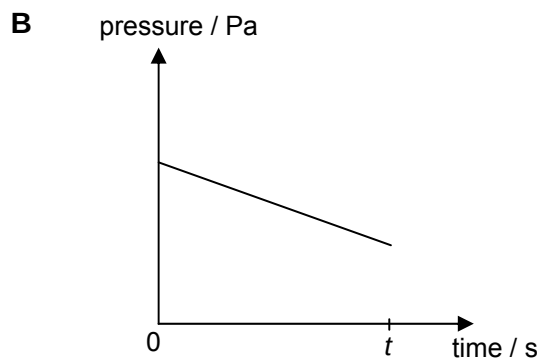
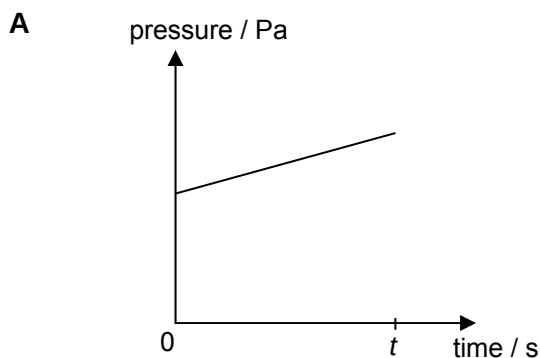
Second substance

- $\text{CH}_3\text{CH}_2\text{NHCH}_3$
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- KCl



- 5 A fixed amount of an ideal gas is contained in a frictionless gas syringe. For a period of t seconds, the volume of the syringe is increased at a constant rate. The temperature within the syringe is constant throughout.

Which of the following graphs correctly shows how the pressure in the syringe changes within the t seconds?



- 6 When water vaporizes, 40.7 kJ mol^{-1} of heat enthalpy is required.

What is the entropy change when 72 g of water boils at 100°C ?

- A** -436 J K^{-1}
B -109 J K^{-1}
C $+109 \text{ J K}^{-1}$
D $+436 \text{ J K}^{-1}$

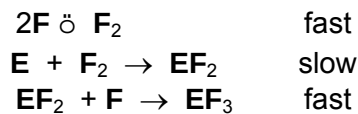
- 7 Trace levels of radioactive isotope caesium-134 is believed to have travelled by air to China from the quake-damaged Fukushima Daiichi Nuclear Power Plant in Japan.

Given that the radioactive decay of caesium-134 is a first-order reaction with the rate constant $k = 0.347 \text{ year}^{-1}$, what is the time taken for caesium-134 to reach one-eighth of its initial concentration?

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

- 8 Consider the following reaction: $\text{E} + 3\text{F} \rightarrow \text{EF}_3$

The mechanism involves the following steps:

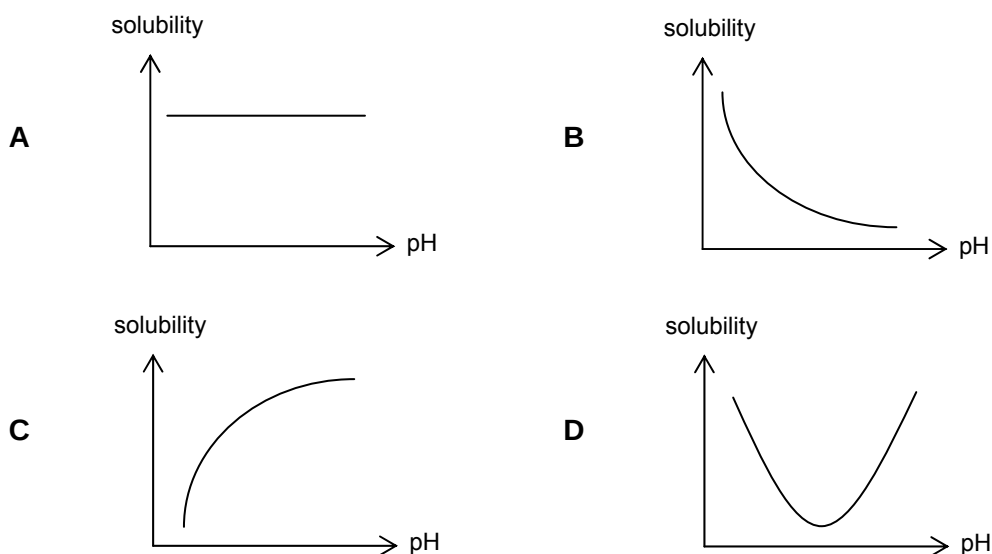


Based on the information, what is the rate equation for this reaction?

- A Rate = $k[\text{F}]^2$
 B Rate = $k[\text{E}][\text{F}]^2$
 C Rate = $k[\text{E}][\text{F}]^3$
 D Rate = $k[\text{E}][\text{F}_2]$
- 9 Consider the equilibrium $3\text{J}_2(\text{g}) + 2\text{KJ}(\text{g}) \rightleftharpoons 2\text{KJ}_4(\text{g})$.
- When 4 mol of KJ_4 was put into a 2 dm^3 container and heated, the equilibrium mixture contained 0.8 mol of KJ .
- What is the numerical value of the equilibrium constant, K_c ?
- A 74.1
 B 9.23
 C 1.16
 D 0.108
- 10 Phenolphthalein ($\text{C}_{20}\text{H}_{14}\text{O}_4$) is an organic compound used as an acid-base indicator. Why does phenolphthalein, which is colourless in acidic solutions, turn pink in alkaline solutions?
- A It is oxidised to a pink compound by hydroxide ions.
 B It is reduced to a pink compound by hydroxide ions.
 C It forms a pink anion by loss of H^+ ions.
 D It forms a pink cation by gain of H^+ ions.

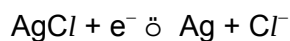
- 11 The numerical value of the solubility product of calcium fluoride is 3.9×10^{-11} .

Given that HF is a weak acid, which diagram shows how the solubility of CaF_2 will vary with pH at constant temperature?



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

The AgCl / Ag reference electrode is based on the following reaction:

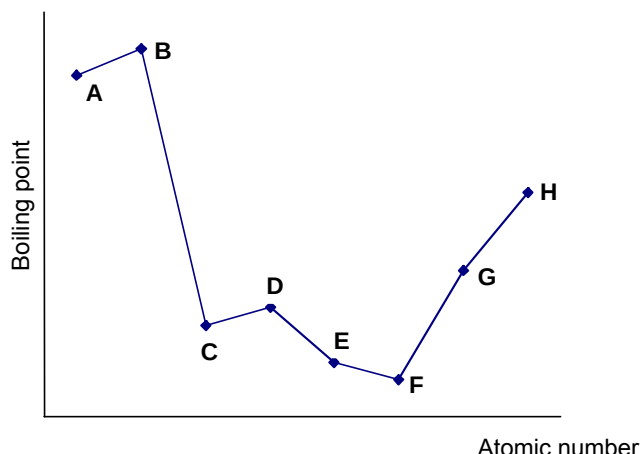


The reduction potential of the $\text{Fe}^{2+} / \text{Fe}$ couple was found to be -0.64 V when measured using the AgCl / Ag reference electrode.

What is the reduction potential of the AgCl / Ag electrode with respect to the standard hydrogen electrode?

- A -0.20 V B $+0.20 \text{ V}$ C -1.10 V D $+1.10 \text{ V}$

- 13 The graph below shows the variation in the boiling points for eight consecutive elements in the Periodic Table, all with atomic number between 10 and 20.



Which of the following statements is true?

- A** Element **D** forms an acidic oxide.
- B** Element **G** does not conduct electricity.
- C** Element **A** and beryllium are in the same group.
- D** The element immediately preceding **A** has a smaller atomic radius than **A**.
- 14 Which of the following statements is true about magnesium and barium and their compounds?
- A** Magnesium carbonate is more stable to heat compared to barium carbonate.
- B** Magnesium has a lower tendency to form complex ions compared to barium.
- C** The lattice energy of magnesium oxide is more negative than the lattice energy of barium oxide.
- D** The pH of a saturated solution of magnesium hydroxide is higher than the pH of a saturated solution of barium hydroxide.
- 15 A mixture of iodine and chlorine was reacted with excess sodium thiosulfate solution.
- The resulting mixture was treated with excess aqueous barium nitrate. Precipitate **W** formed was filtered off and washed with distilled water.
 - The filtrate was treated with excess silver nitrate. The precipitate formed was filtered off and washed with excess aqueous ammonia.
 - The mixture was again filtered, leaving behind precipitate **X**.

Which anion was present in each of the precipitates respectively?

	Precipitate W	Precipitate X
A	SO_4^{2-}	Cl^-
B	SO_4^{2-}	I^-
C	Cl^-	I^-
D	I^-	SO_4^{2-}

16 Which of the following particles, on losing an electron, contains five unpaired d-electrons?

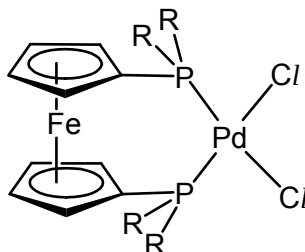
A Fe^{2+}

B Cr^+

C Mn^{2+}

D Ni^+

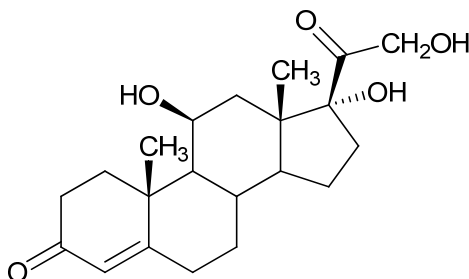
17 Palladium compounds are widely used as catalyst in coupling reactions. One such compound is $(\text{dppf})\text{PdCl}_2$ with its structure shown below.



What does the structure of $(\text{dppf})\text{PdCl}_2$ suggest about the nature of the bonding between Pd and the phosphorus atoms, and the oxidation state of Pd?

	nature of bonding	oxidation state
A	covalent	0
B	ionic	0
C	covalent	+2
D	ionic	+2

18 Cortisol is the major hormone synthesized by the human adrenal cortex.



Cortisol

How many chiral centres are there in the compound formed by reacting cortisol with excess LiAlH_4 ?

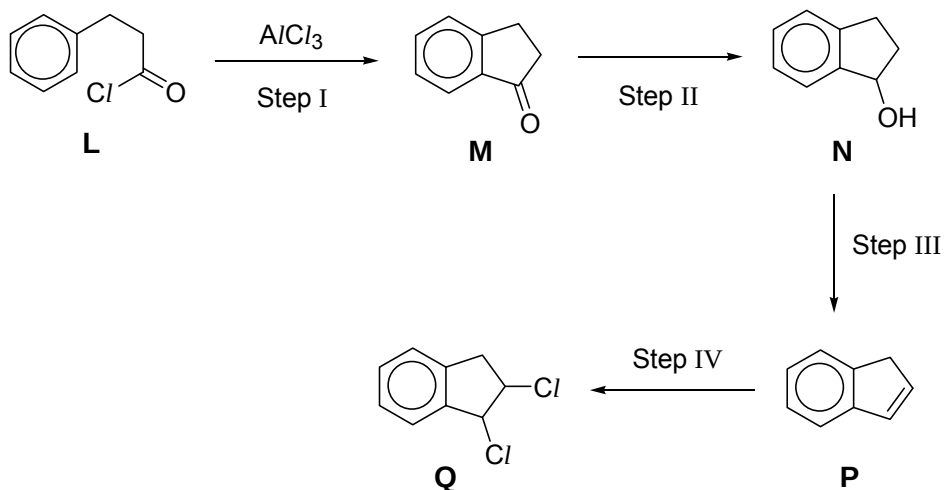
A 7

B 8

C 9

D 10

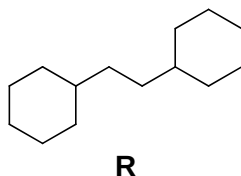
19 Consider the following reaction scheme.



Which of the following statements about the above reaction scheme is **incorrect**?

- A** Compound **P** is a planar molecule.
- B** Step I is an electrophilic substitution.
- C** Compound **Q** can exhibit *cis-trans* isomerism.
- D** Step III can be carried out by heating compound **N** over Al_2O_3 .

20 Compound **R**, $\text{C}_{14}\text{H}_{26}$, reacts with chlorine gas in the presence of sunlight.



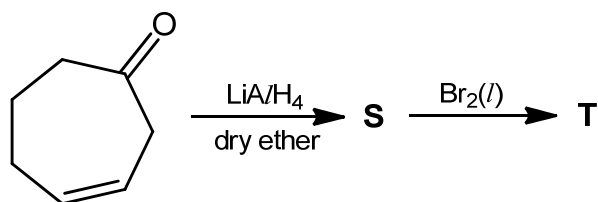
Which of the following statements about this reaction is correct?

- A** The maximum number of mono-chlorinated structural isomers with formula $\text{C}_{14}\text{H}_{25}\text{Cl}$ is 5.
- B** $\text{C}_{28}\text{H}_{52}$ is present in small quantities in the product.
- C** Homolytic fission only occurs in the initiation step.
- D** HCl is formed in the termination step.

21 In which of the following reactions is the inorganic reagent acting as an electrophile?

- A** $\text{C}_6\text{H}_5\text{CH}_3 + \text{Cl}_2 \longrightarrow \text{C}_6\text{H}_5\text{CH}_2\text{Cl} + \text{HCl}$
- B** $\text{C}_6\text{H}_5\text{CH}_2\text{Br} + \text{NaOH} \longrightarrow \text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{NaBr}$
- C** $\text{C}_6\text{H}_5\text{COCH}_3 + \text{HCN} \longrightarrow \text{C}_6\text{H}_5\text{C}(\text{OH})(\text{CN})\text{CH}_3$
- D** $\text{C}_6\text{H}_5\text{CHCH}_2 + \text{HCl} \longrightarrow \text{C}_6\text{H}_5\text{CHClCH}_3$

22 The reaction scheme below gives product T.

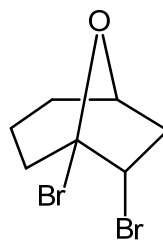


Which of the following is the most likely structure for T?

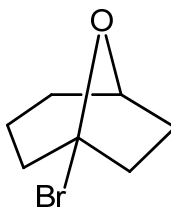
A



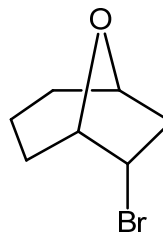
B



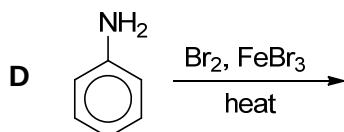
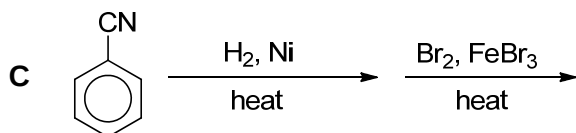
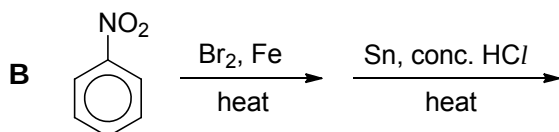
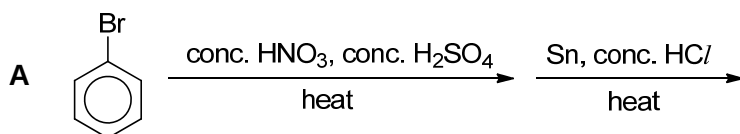
C



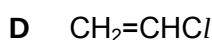
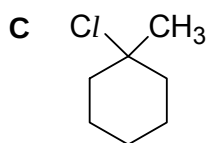
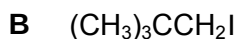
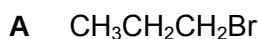
D



23 Which of the following is the best sequence for synthesizing 3-bromophenylamine?



24 Which compound undergoes an S_N1 substitution reaction?



25 An optically pure enantiomer of butan-2-ol was found to rotate plane-polarised light clockwise by 13.5° .

When an optically pure enantiomer of 2-bromobutane was reacted with aqueous sodium hydroxide under heating, the purified product obtained was found to rotate plane-polarised light clockwise by 5.5° .

Which of the following mechanisms could have taken place, assuming complete reaction?

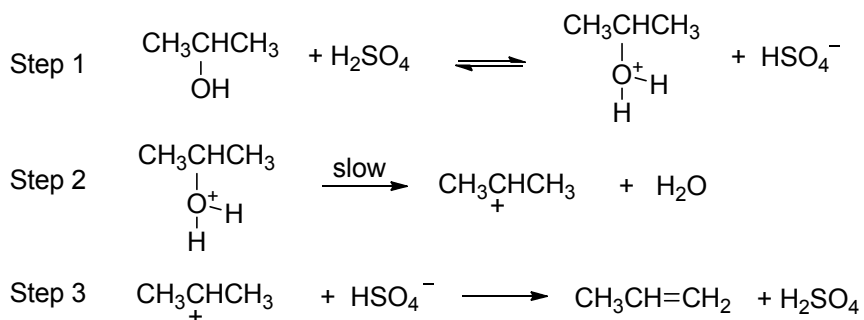
A S_N1 only

B S_N2 only

C Both S_N1 and S_N2

D Elimination only

26 The dehydration of propan-2-ol to form propene is thought to involve the following steps:



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

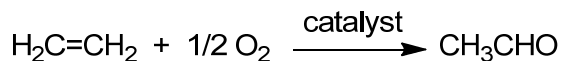
A Propan-2-ol acts as a base in Step 1.

B H_2SO_4 is a catalyst in this reaction.

C A possible side product of the reaction is $\text{CH}_3\text{CH}(\text{OSO}_3\text{H})\text{CH}_3$.

D It is more likely for primary alcohols to proceed via this mechanism than tertiary alcohols.

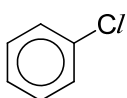
- 27 Aldehydes and ketones are produced industrially by the catalytic oxidation of alkenes. For example, ethanal is manufactured from ethene as shown.



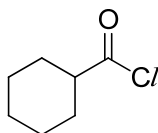
The process is also used industrially with but-2-ene, $\text{CH}_3\text{CH}=\text{CHCH}_3$. Which compound is obtained from but-2-ene?

- A $\text{CH}_3\text{CH}_2\text{CHO}$
- B $\text{CH}_3\text{COCH}_2\text{CH}_3$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- D $(\text{CH}_3)_2\text{CHCHO}$

- 28 Which of the following reagents **cannot** be used to distinguish **U** and **V**?



U



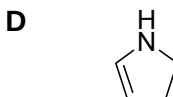
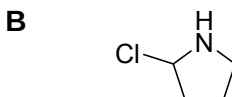
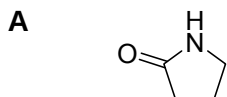
V

- | | | | |
|---|--------|---|----------------------------|
| A | water | B | ethanolic silver nitrate |
| C | phenol | D | 2,4-dinitrophenylhydrazine |

- 29 Which procedure gives the best yield of ethyl ethanoate, $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$, starting from ethanoic acid, $\text{CH}_3\text{CO}_2\text{H}$, and ethanol, $\text{C}_2\text{H}_5\text{OH}$?

- A reacting $\text{CH}_3\text{CO}_2\text{H}$ with SOCl_2 , then adding $\text{C}_2\text{H}_5\text{OH}$
- B reacting $\text{C}_2\text{H}_5\text{OH}$ with SOCl_2 , then adding $\text{CH}_3\text{CO}_2\text{H}$
- C refluxing a mixture of $\text{CH}_3\text{CO}_2\text{H}$ and $\text{C}_2\text{H}_5\text{OH}$ with NaOH(aq)
- D refluxing $\text{C}_2\text{H}_5\text{OH}$ with concentrated H_2SO_4 , then adding $\text{CH}_3\text{CO}_2\text{H}$

- 30 Which of the following compound has the lowest pK_b value?



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 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** AlCl_3 reacts with LiAlH_4 and $(\text{CH}_3)_3\text{N}$ to give $(\text{CH}_3)_3\text{NAlH}_3$.

Which statements about $(\text{CH}_3)_3\text{NAlH}_3$ are correct?

- 1** It contains coordinate (dative) bonding.
- 2** The bonds around all C, N and Al atoms are tetrahedrally arranged.
- 3** The oxidation state of all the hydrogen atoms is +1.

- 32** Which reactions below have an endothermic enthalpy change?

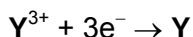
- 1** $\text{Cl}^-(\text{g}) \rightarrow \text{Cl}(\text{g}) + \text{e}^-$
- 2** $\text{NaCl}(\text{s}) \rightarrow \text{Na}^+(\text{g}) + \text{Cl}^-(\text{g})$
- 3** $\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CH}_3\text{Cl}(\text{g}) + \text{HCl}(\text{g})$

- 33** Which of the following observations are true when $0.100 \text{ mol dm}^{-3} \text{ CH}_3\text{NH}_2$ ($\text{p}K_b = 3.38$) is gradually added to 10.0 cm^3 of $0.100 \text{ mol dm}^{-3} \text{ HCl}$?

- 1** The pH at equivalence point is in the acidic region.
- 2** When 15.0 cm^3 of CH_3NH_2 has been added, the solution is able to buffer a larger amount of alkali than acid.
- 3** When 20.0 cm^3 of CH_3NH_2 has been added, the pH of the solution would be 10.6.

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

An electrolytic cell containing Mn^{2+} and another metal ion, Y^{3+} , is connected to Mn and Pt electrodes. The reactions that took place are



Which of the following statements are correct?

- 1 The Mn electrode is the anode.
- 2 A possible identity of Y is aluminium.
- 3 The number of moles of Y deposited is 1.5 times the number of moles of Mn^{2+} formed.

- 35 Astatine is a radioactive element below iodine in the Periodic Table.

Which statements concerning astatine will be true?

- 1 It exists as a solid at standard state.
- 2 It forms diatomic molecules which dissociate more readily than iodine molecules.
- 3 It forms a precipitate with aqueous silver nitrate which dissolves in concentrated ammonia.

- 36 Zirconium has an atomic number of 40.

Which zirconium compounds are likely to exist?

- 1 Zr_2O_7
- 2 ZrOF_2
- 3 $[\text{Zr}(\text{NH}_3)_6]\text{Cl}_3$

- 37 Hydroxyapatite, a basic calcium phosphate, $\text{Ca}(\text{OH})_2 \cdot 3\text{Ca}_3(\text{PO}_4)_2$, is the mineral found in bone. In older people, calcium ions can be lost from the hydroxyapatite, weakening the bone structure. In such cases, strontium salts are administered to strengthen the bone. The strontium ions replace the lost calcium ions in the hydroxyapatite.

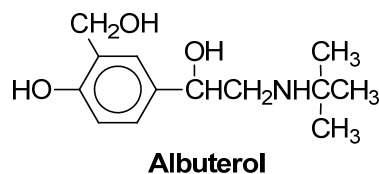
[Numerical value of K_{sp} : $\text{Ca}(\text{OH})_2$, 5.02×10^{-6} ; $\text{Sr}(\text{OH})_2$, 1.46×10^{-1}]

Which statements are correct?

- 1 Strontium ions are nearly the same size as calcium ions and so may easily replace them in the hydroxyapatite.
- 2 Strontium hydroxide is less soluble than calcium hydroxide and so will precipitate better in the bone structure.
- 3 There is ionic, covalent and metallic bonding in hydroxyapatite which gives it strength.

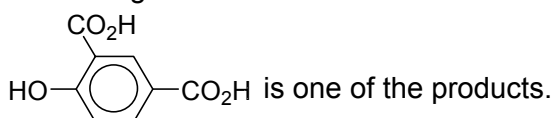
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 38 Albuterol dilates the airways of the lung and is used for treating asthma and other conditions of the lung.

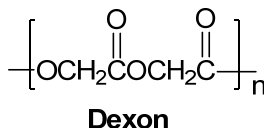


Which of the following statements are true about albuterol?

- 1 On addition of aqueous sodium carbonate, effervescence of CO_2 is produced.
- 2 On heating with NaOH(aq) , one mole of NaOH is used up per mole of albuterol.
- 3 On heating under reflux with acidified concentrated KMnO_4 ,



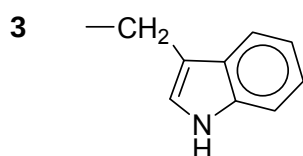
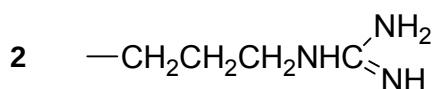
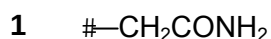
- 39 Dexon is a synthetic polymer that is routinely used to stitch wounds together during surgery. It is broken down into smaller molecules over three to six months. Patients, therefore, do not have to undergo a second surgery to remove the stitches.



Which correct statements explain Dexon's suitability for this function?

- 1 Dexon can be hydrolysed in the body.
- 2 Dexon is broken down slowly due to its large size.
- 3 The small molecules produced are water soluble.

- 40 Which groups within an amino acid are able to form a cross-chain link to stabilize the tertiary structure of a protein?



Answers

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