TEMASEK JUNIOR COLLEGE

CHEMISTRY 9746/01

Paper 1 Multiple Choice

Friday **19th SEPTEMBER 2008** **1 hour**

Additional materials: Data Booklet
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, index number and CG on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. 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 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.
You may use a calculator.

Section A

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

1 Ethanonitrile, CH_3CN was boiled with NaOH and the NH_3 gas evolved was passed into 50 cm^3 of 1.00 mol dm^{-3} of HC*l*. The excess acid required 26.00 cm^3 of 1.00 mol dm^{-3} NaOH solution for neutralization. What was the mass of ethanonitrile used? (M_r of CH_3CN = 41)

A 0.492 g

B 0.984 g

C 1.07 g

D 1.97 g

2 In which of the following pairs does the first species have a larger bond angle than the second?

A ClO_3^-, BrO_3^-

B SO_3^{2-}, SO_4^{2-}

C PCl_3, $AlCl_3$

D H_2O, H_3O^+

3 Antimony, Sb, is in Group V of the Periodic Table. It forms salts which contain the SbF_5^{n-} anion, the shape of which is square pyramidal. What is the value of n?

A 2

B 3

C 4

D 5

4 Which of the following compounds is the least volatile?

A $CH_3CH_2CH_2CH_2OH$

B $(CH_3)_3COH$

C $CH_3CH_2CH_2CH_2NH_2$

D $(CH_3)_3CNH_2$

5 Each of the following equilibria is subjected to two changes carried out separately:

(i) the volume of vessel is increased at constant temperature;

(ii) the temperature is increased at constant pressure.

For which equilibrium will both of these changes result in an increase in the proportion of products?

A $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ $\Delta H = +53$ kJ mol^{-1}

B $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$ $\Delta H = -950$ kJ mol^{-1}

C $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ $\Delta H = +57$ kJ mol^{-1}

D $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92$ kJ mol^{-1}

6 What is the pH value of 0.05 mol dm^{-3} of ammonium chloride solution, given the K_b of NH_3 is 1.8×10^{-5} mol dm^{-3}?

A 3.02

B 5.28

C 8.72

D 10.98

7 Which set of solutions below will **not** give a buffer solution when they are mixed?

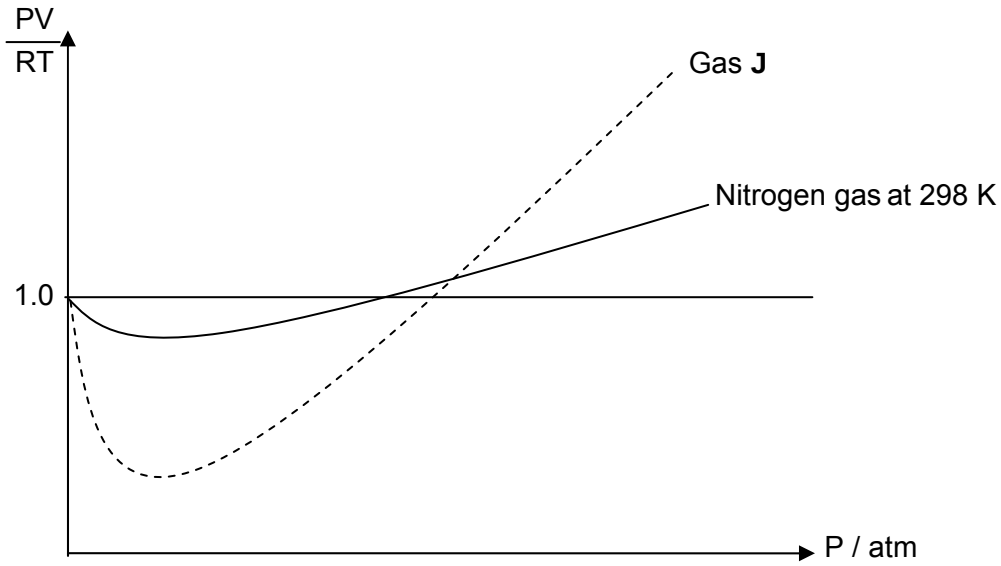
A 50 cm^3 of 0.10 mol dm^{-3} CH_3CO_2H and 50 cm^3 of 0.10 mol dm^{-3} CH_3CO_2Na

B 100 cm^3 of 0.10 mol dm^{-3} CH_3CO_2H and 50 cm^3 of 0.10 mol dm^{-3} NaOH

C 50 cm^3 of 0.10 mol dm^{-3} CH_3CO_2Na and 100 cm^3 of 0.10 mol dm^{-3} HC*l*

D 100 cm^3 of 0.10 mol dm^{-3} CH_3CO_2Na and 50 cm^3 of 0.10 mol dm^{-3} HC*l*

8



Which of the following is true of the identity of Gas **J**?

A Nitrogen gas at a higher temperature

B Neon gas at 298 K

C Hydrogen gas at 298 K

D Carbon dioxide at 298 K

9 Nitrosyl fluoride, NOF can be produced from nitrogen monoxide and fluorine.

$$2NO(g) + F_2(g) \rightarrow 2NOF(g)$$

The rate equation for this reaction is rate = $k[NO][F_2]$.

What can be deduced from the information given?

A The reaction involves a three step mechanism.

B Position of equilibrium will shift to the right on increasing pressure.

C Half-life with respect to fluorine gas is equal to $\frac{\ln 2}{k}$.

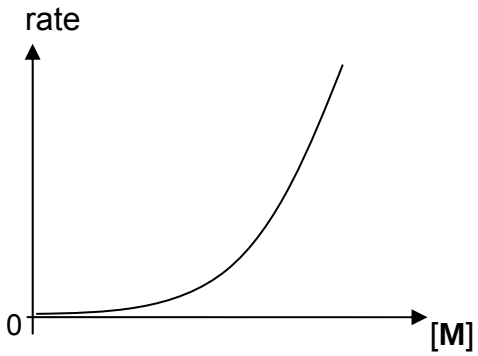
D One molecule of NO reacts with one molecule of F_2 in the slow step.

10 Which of the following graphs is correct of the following reaction, when **N** is in excess?

$$\mathbf{L} + \mathbf{M} + \mathbf{N} \rightarrow \mathbf{P} + \mathbf{Q}$$

The rate equation for this reaction is rate = k[**M**][**N**]

A



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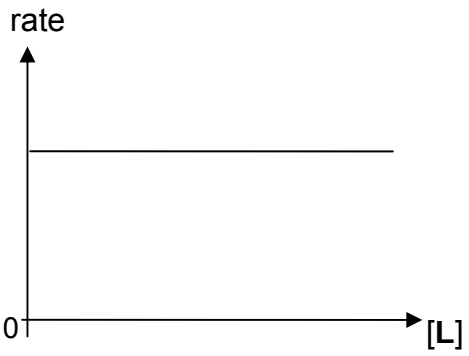

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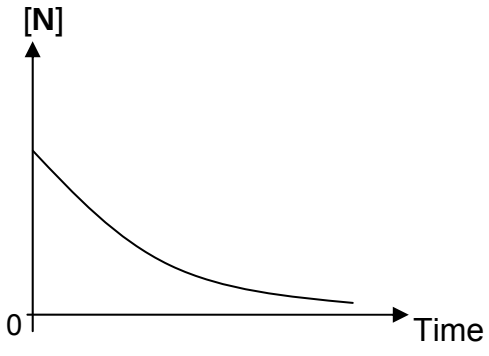

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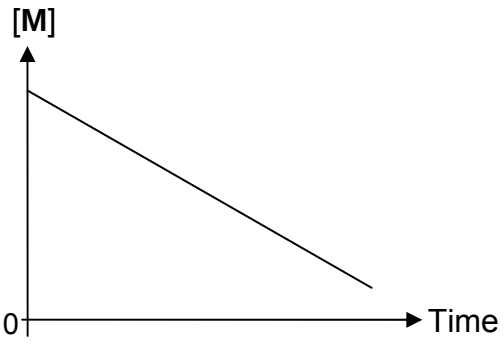

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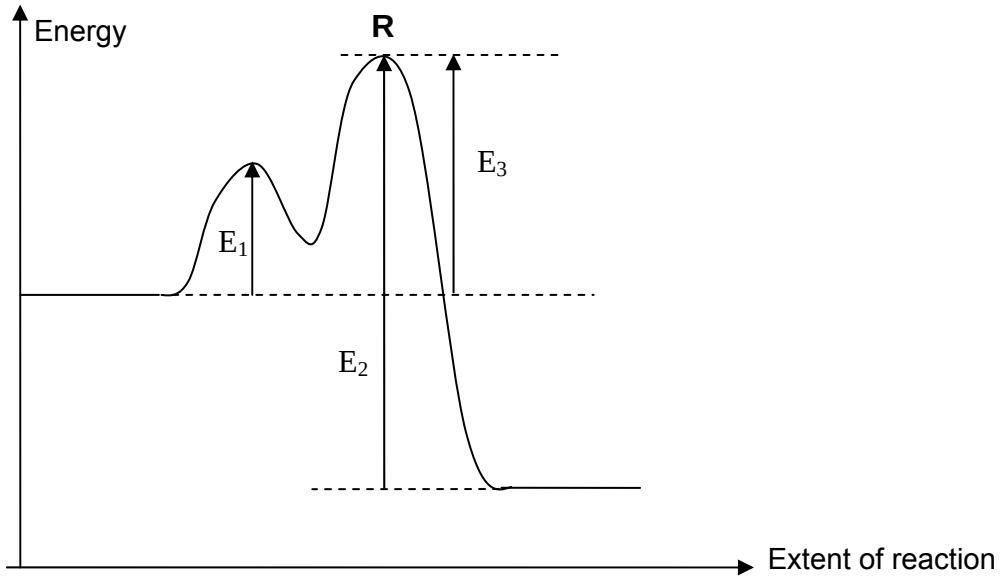


Which of the following statements is true about the energy profile above?

A **R** is the intermediate formed.

B The enthalpy change of the reaction is $E_3 - E_2$.

C The reaction is catalysed by a heterogenous catalyst.

D E_2 corresponds to the activation energy for the reaction in the second step.

12 Electrolysis of aqueous hydrochloric acid results in gases produced at both the anode and cathode. What is the current required to produce 70 cm^3 of gas at the anode in 15 min at room temperature and pressure?

A 0.625 A

B 1.25 A

C 6.25 A

D 21.4 A

13 When 0.15 g of magnesium was added to an excess of dilute sulphuric acid in a calorimeter (with negligible heat capacity), a maximum temperature rise of 6.2 ^{o}C was recorded. What is the enthalpy change for the reaction?

(heat capacity of acid = 494 J K^{-1})

A - 3.06 kJ mol^{-1}

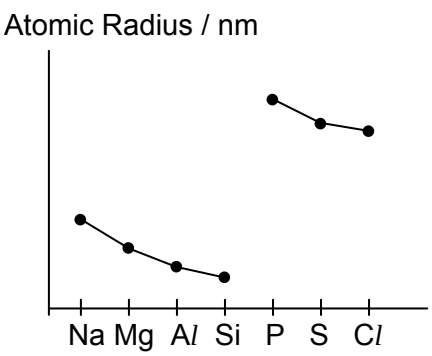
B - 496 kJ mol^{-1}

C - 632 kJ mol^{-1}

D - 744 kJ mol^{-1}

14 Which of the following sketches shows the correct trend in the stated property, for the elements in the third period of the Periodic Table?

A



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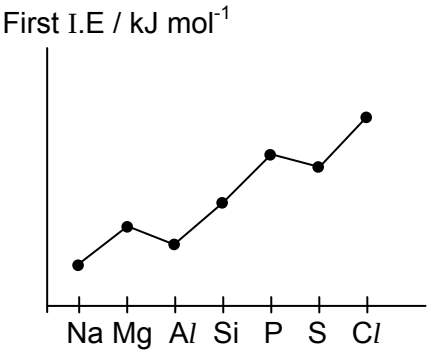

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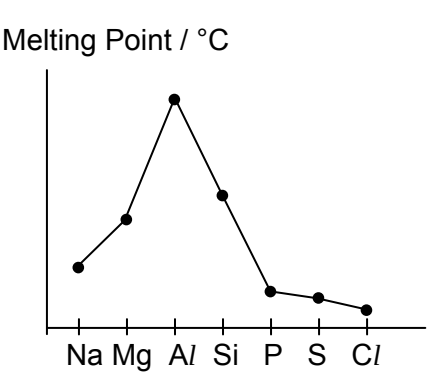

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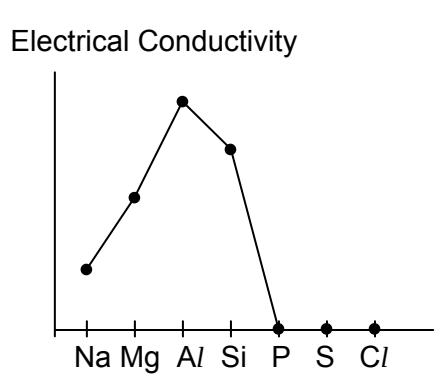


15 Cu_2SO_4 and anhydrous $CuSO_4$ are both white while $CuSO_4.5H_2O$ is blue.

Which of the following statements best explains the above observation?

A Copper in all three compounds has partially filled 3d orbitals.

B Copper in Cu_2SO_4 has a fully filled 3d orbital while copper in anhydrous $CuSO_4$ and $CuSO_4.5H_2O$ has partially filled 3d orbitals.

C Copper in $CuSO_4.5H_2O$ has partially filled 3d orbitals.

D Electrons in the 3d orbitals of copper in $CuSO_4.5H_2O$ can undergo transitions from a 3d orbital of lower energy to another 3d orbital of higher energy.

16 **S** is a transition element. The 3d sub-shell of **S** in the compound $K[\mathbf{S}(C_2O_4)_2(NH_3)_2]$ contains 3 electrons. How many unpaired electrons does **S** contain when it is in the elemental state?

A 3

B 4

C 5

D 6

17 3 moles of chlorine gas was passed into a small sealed container containing an unknown mixture. After complete reaction, it was found that after adding silver nitrate till in excess, 5 moles of silver chloride precipitate was obtained. What substance(s) could the unknown mixture contain?

A Concentrated sulphuric acid

B Concentrated sulphuric acid and manganese(IV) oxide

C Dilute sodium hydroxide at 15 ^oC

D Dilute sodium hydroxide at 70 ^oC

18 When 0.010 moles of an unknown gas was completely dissolved in 1.0 dm^3 of water, the resulting solution was found to have a pH of 4.5. What could be the identity of this gas?

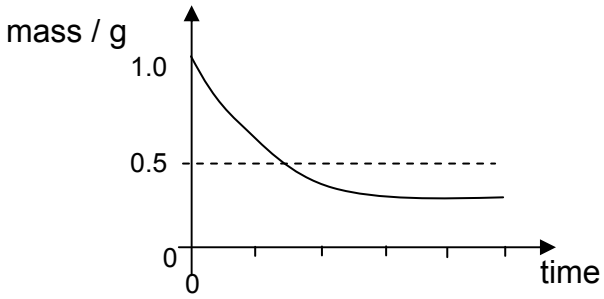
A HI

B HF

C NH_3

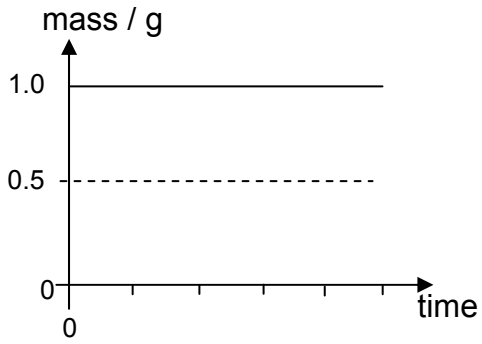
D CH_3NH_2

19 The graph represents the change in mass that occurs when 1.0 g of powdered magnesium carbonate, $MgCO_3$, is heated at its decomposition temperature 664 ^oC.

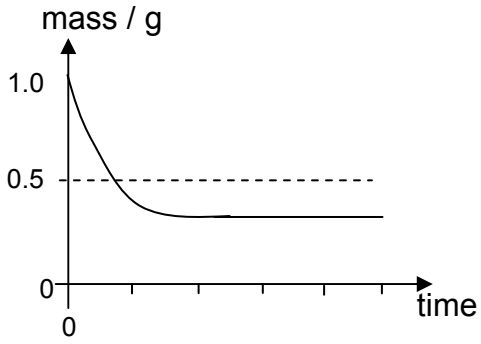


Which graph would be obtained by heating 1.0 g of powdered calcium carbonate, $CaCO_3$, at 664 ^oC?

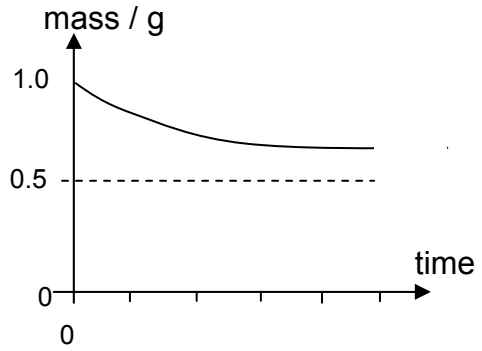
A



C



B



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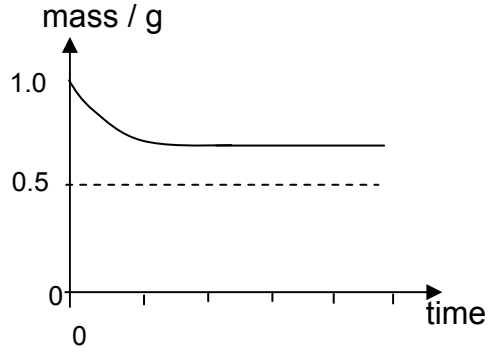


20 For the sequence hydrogen chloride, hydrogen bromide and hydrogen iodide, there is a decrease in

A thermal stability.

B ease of oxidation.

C bond length.

D acidic property.

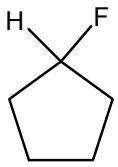
21 The following compounds all have M_r = 88. Which one contains over 60% by mass of carbon and also exhibits hydrogen bonding?

A $H_2N(CH_2)_4NH_2$

B $CH_3CH_2CH_2COOH$

C $CH_3CH_2CH_2CH_2CH_2OH$

D



22 Which one of the following can exhibit both geometrical and optical isomerism?

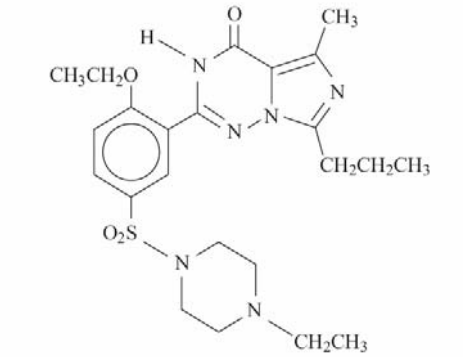
A $(CH_3)_2C=CHCH(CH_3)CH_2CH_3$

B $CH_3CH_2CH=CHCH(CH_3)CH_2CH_3$

C $(CH_3)_2C=C(CH_2CH_3)_2$

D $CH_3CH_2CH(CH_3)CH(CH_3)C=CH_2$

23 Levitra, an alternative to Viagra, has the following structure.



Which one of the following reagent would **not** react with Levitra?

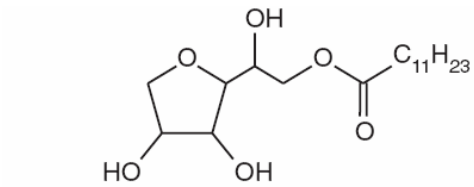
A Dilute hydrochloric acid

B Hot aqueous sodium hydroxide

C $LiAlH_4$ in dry ether at room temperature

D 2,4-dinitrophenylhydrazine

24 The demand for 'natural' shampoos and detergents has led to the development of more biodegradable detergents such as sorbitan monolaurate, which is made from plants. Its structure is shown.



Which statement is correct?

A There will be no colour change on heating the compound with acidified potassium dichromate(VI) solution.

B It is optically inactive.

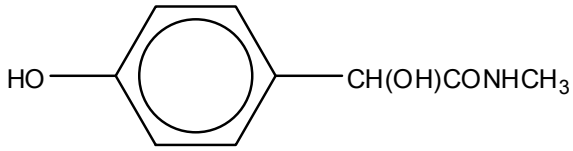
C It can react with concentrated sulphuric acid on heating.

D It is a cyclic ester.

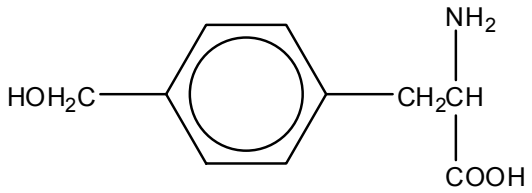
25 One mole of compound **T** gives one mole of hydrogen gas with excess sodium metal and one mole of NH_3 when heated with aqueous NaOH.

Which of the following could compound **T** be?

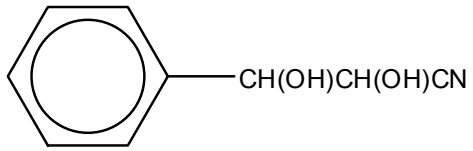
A



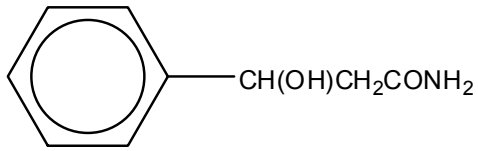
B



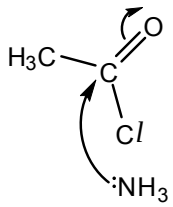
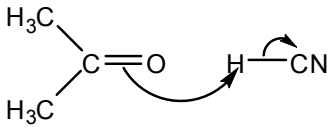
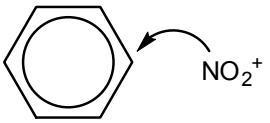
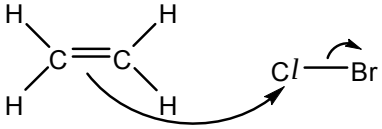
C



D



26 Correct mechanistic steps in the reactions between the following reagents include

	Reagents	**Step**
A	ethanoyl chloride and ammonia	
B	propanone and hydrogen cyanide	
C	benzene and nitric acid	
D	ethene and bromine monochloride	

27 Compound **U**, $C_6H_{12}O$, is oxidised by acidified sodium dichromate(VI) to compound **V**. Compound **V** reacts with ethanol in the presence of a little concentrated sulphuric acid to give liquid **W**.

What is the formula of **W**?

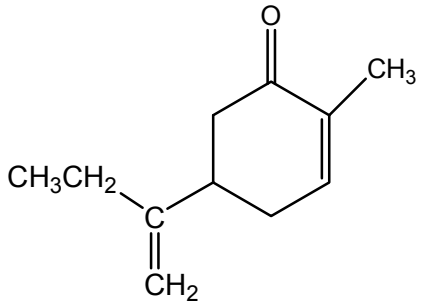
A $CH_3(CH_2)_4CO_2CH_2CH_3$

B $CH_3(CH_2)_4CH_2COCH_2CH_3$

C $CH_3(CH_2)_2CH = CHCO_2H$

D $CH_3CH_2CO_2(CH_2)_4CH_3$

28 A compound derived from plant essential oil has the following structure.



When the compound is reacted with HBr in CCl_4, how many chiral carbon centres does the major product have?

A 2

B 3

C 4

D 5

29 What is the maximum number of structural isomers for an amide with molecular formula C_3H_7NO?

A 3

B 4

C 5

D 6

30 A sample of a peptide of an unknown sequence was treated with enzymes. The sequences of the smaller peptides produced were

Leu – Ser

Lys – Leu

Leu – Ala – Phe – Gln

Ser – Tyr – Leu

What was the sequence of the original peptide?

A Ser – Tyr – Leu – Ala – Phe – Gln – Lys – Leu

B Lys – Leu – Ala – Phe – Gln – Ser – Tyr – Leu

C Lys – Leu – Ser – Tyr – Leu – Ala – Phe – Gln

D Leu – Ser – Tyr – Leu – Ala – Phe – Gln – Lys

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 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 An electrochemical cell is set up using $Co^{3+}(aq)$ / $Co^{2+}(aq)$ half cell using platinum electrode and $Pb^{2+}(aq)$ / Pb(s) half cell.

Which of the following are features of the cell?

1 Lead is the negative electrode.

2 Reduction occurs at the lead terminal and the lead electrode increases in size.

3 Electron flow in the external circuit from the platinum electrode to the lead electrode.

32 Sulphur dioxide reacts with chlorine in the presence of charcoal to give sulphur dichloride dioxide, SO_2Cl_2 and is oxidised to sulphur trioxide by oxygen in the presence of vanadium (V) oxide.

$$SO_2(g) + Cl_2(g) \rightarrow SO_2Cl_2(l) \quad \text{Reaction I}$$

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g) \quad \text{Reaction II}$$

Which of the following statements are true of the reactions above?

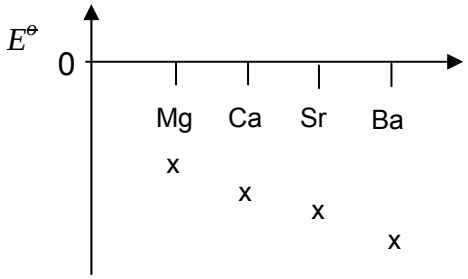
1 In both reactions, the oxidation state of sulphur changes from +4 to +6.

2 Reaction II has a negative entropy change.

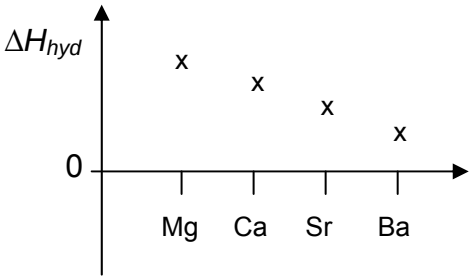
3 Vanadium(V) oxide acts as a homogenous catalyst as it is able to have variable oxidation states.

33 Which of the following diagrams are correct in showing the variation in property of the Group II elements Mg, Ca, Sr, Ba?

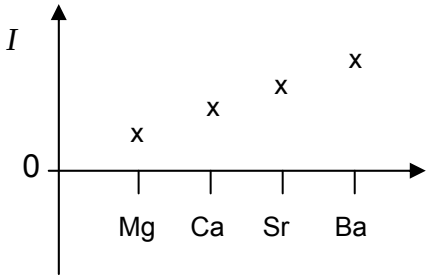
1 $E^{\ominus}$, the standard electrode potential of the $M^{2+}(aq)|\ M(s)$ electrode



2 ΔH_{hyd}, the enthalpy change of hydration of $M^{2+}(g)$



3 I, the first ionisation energy



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

Which of the following can possibly function as a catalyst in the decomposition of a solution of hydrogen peroxide?

1 MnO_2

2 Mn^{3+}

3 Cr^{3+}

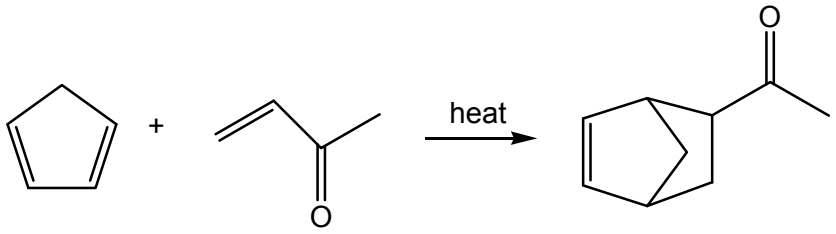
35 The oxides of iron, ruthenium and osmium are used as catalysts in the industries. Which properties are iron, ruthenium and osmium likely to have in common?

1 Variable oxidation states

2 High melting points

3 Similar atomic radii

36 Which of the following statements is correct about the reaction shown below?



1 It is an addition reaction.

2 The product gives a yellow precipitate when heated with aqueous alkaline iodine.

3 One mole of the product requires one mole of hydrogen gas when heated in the presence of nickel catalyst for complete reaction.

37 Serine is an amino acid commonly found in human body. Its structural formula is $CH_2OHCH(NH_2)CO_2H$. Which of the following statements about serine are correct?

1 In a buffer solution of pH 9, serine is attracted towards the anode when a potential difference is applied.

2 In a polypeptide, the hydroxyl group of serine maintains the secondary structure by forming hydrogen bonds with polar R groups of other amino acid residues.

3 For serine, the isoelectric point is at pH 3.5.

38 Which statements about ammonia, methylamine and phenylamine are correct?

1 They all form amides with ethanoyl chloride.

2 They all can act as nucleophiles using the lone pair on the nitrogen atom.

3 They are trigonal planar with respect to the nitrogen atom.

39 Which of the following statements are true?

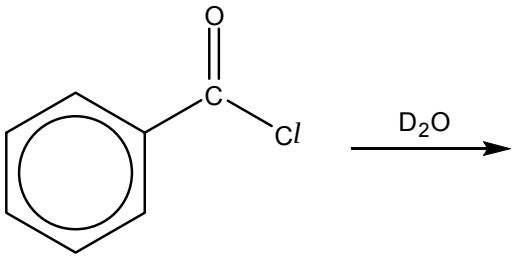
1 The carbon to carbon bond enthalpy increases from ethene to benzene to ethane.

2 The melting point increases from pentan-3-one to pentan-2-ol to 2-aminopropanoic acid.

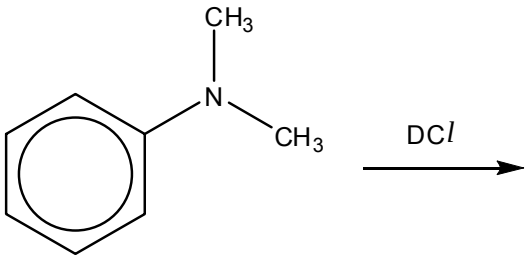
3 The pH of a 1.0 mol dm^{-3} solution increases from sulphuric acid to hydrochloric acid to ethanoic acid.

40 Which of the following will yield an organic compound containing deuterium? (D = ^2H)

1



2



3