Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 CHEMISTRY 9647/01

Paper 1 Multiple Choice **20 September 2012**
1 hour

Additional Materials: Optical Answer Sheet
Data Booklet

INSTRUCTIONS TO CANDIDATES

1. Write your name, index number and class on this question paper.
2. 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 Optical Mark Sheet.
3. Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
4. Any rough working should be done in this booklet.
5. 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 To determine the mass of arsenic present in a sample of pesticide, all the arsenic was first converted to arsenate ion, AsO_4^{3-}. 1.25 x 10^{-3} mol of $AgNO_3$ was then added to precipitate AsO_4^{3-} as Ag_3AsO_4. The excess Ag^+ ions needed 3.64 cm^3 of 0.054 mol dm^{-3} KSCN to form silver thiocynate, AgSCN.

Calculate the mass of arsenic (A_r = 74.9) present in the sample of pesticide.

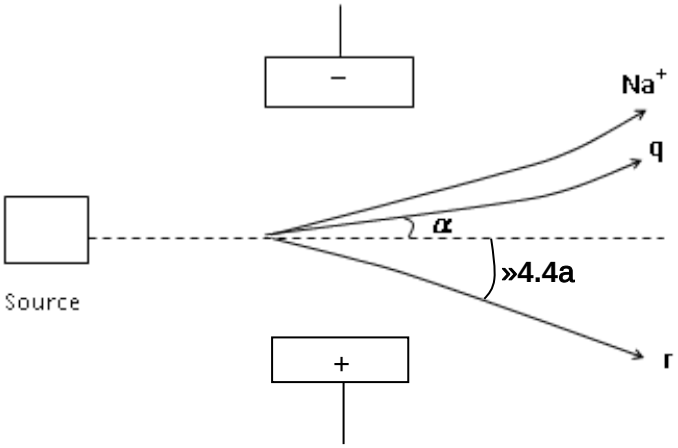
A 0.015 g

B 0.026 g

C 0.079 g

D 0.488 g

2 In an experiment, a sample was vapourised, ionised and passed through an electric field. Analysis of the deflection occurring at the electric region revealed the following data for the sample. It was observed that a beam of Na^+ gives an angle of deflection of 4.3°.



What are the possible identities of unknown particles, **q** and **r**, and the value of ***a***?

	q	**r**	***a***
A	Be^{2+}	Br^-	22.0°
B	Be^{2+}	S^{2-}	6.2°
C	Ba^{2+}	Br^-	1.2°
D	Ba^{2+}	S^{2-}	1.4°

3 How many moles of electrons must be removed from each mole of methylbenzene, $C_6H_5CH_3$, when it is oxidised to benzoic acid, C_6H_5COOH?

A 1

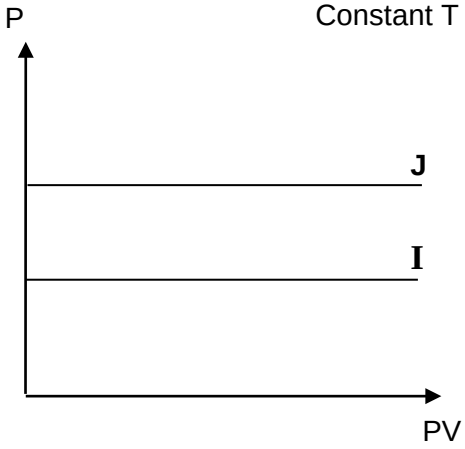
B 2

C 4

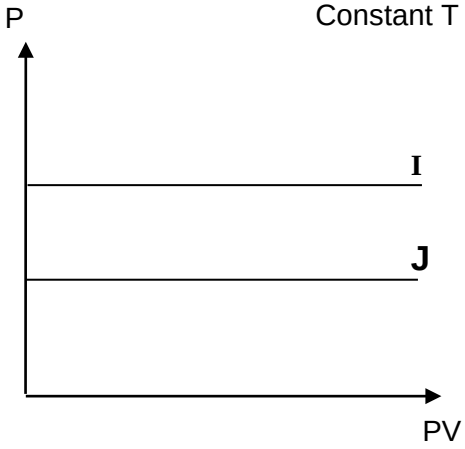
D 6

4 Which graph correctly describes the behaviour of fixed masses of the ideal gases **I** and **J**, where **I** has a higher M_r than **J**?

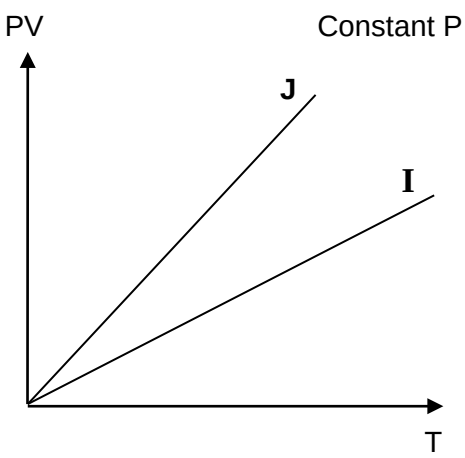
A



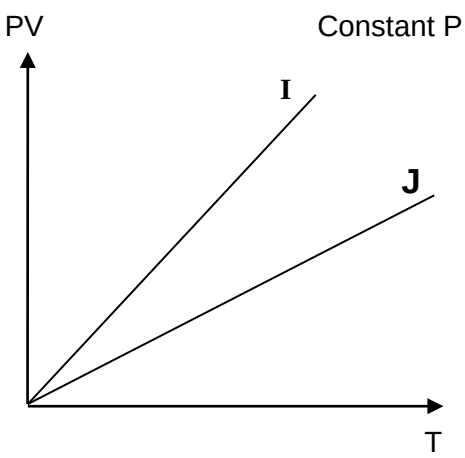
B



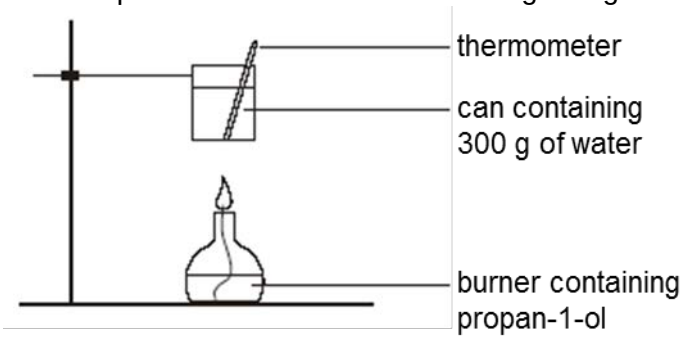
C



D



5 A student used the set–up below to heat a can containing 300 g of water.



The following data were recorded:

mass of propan–1–ol burnt = m g
change in temperature of water = DT °C

Given that:

relative molecular mass of propan–1–ol = 60.0
enthalpy change of combustion of propan–1–ol = –2021 kJ mol^{-1}
specific heat capacity of water = c J g^{-1} K^{-1}

What is the efficiency of this heating process?

A $\frac{m \times 2021 \times 1000}{300 \times c \times \mathrm{D}T \times 60.0} \times 100\%$

B $\frac{m \times c \times \mathrm{D}T \times 60.0}{300 \times 2021 \times 1000} \times 100\%$

C $\frac{300 \times c \times \mathrm{D}T \times 60.0}{m \times 2021} \times 100\%$

D $\frac{300 \times c \times \mathrm{D}T \times 60.0}{m \times 2021 \times 1000} \times 100\%$

6 Which of the following statements best explains why calcium and chlorine form CaCl_2 rather than CaCl?

A Less energy is required to remove one electron from the calcium atom than to remove two electrons.

B More energy is released in forming chloride ions from chlorine molecules in the formation of CaCl_2(s) than in the formation of CaCl(s).

C The lattice energy of CaCl(s) is less exothermic than that of CaCl_2(s).

D When CaCl(s) is formed from its elements, more energy is released than when CaCl_2(s) is formed from its elements.

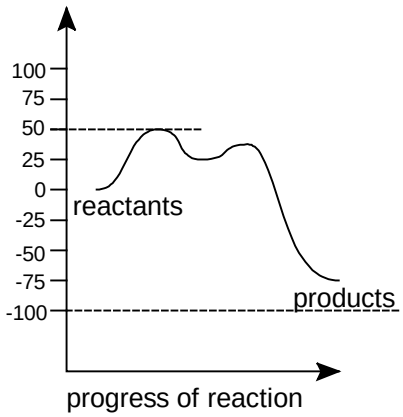
7 An exothermic chemical reaction proceeds by two stages.

$$\text{reactants} \xrightarrow{\textit{stage}\ 1} \text{intermediate} \xrightarrow{\textit{stage}\ 2} \text{products}$$

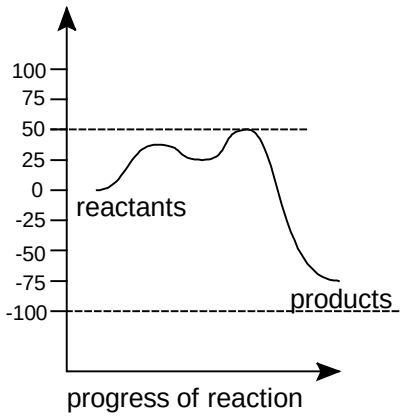
The activation energy of stage 1 is 50 kJ mol^{-1}. The overall enthalpy change of reaction is –100 kJ mol^{-1}.

Which diagram could represent the energy level diagram for the reaction?

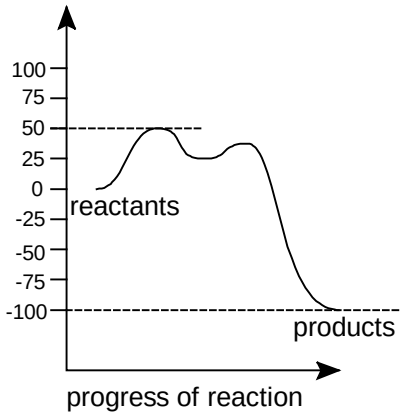
A



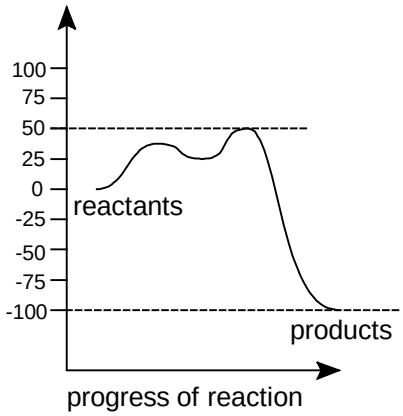
B



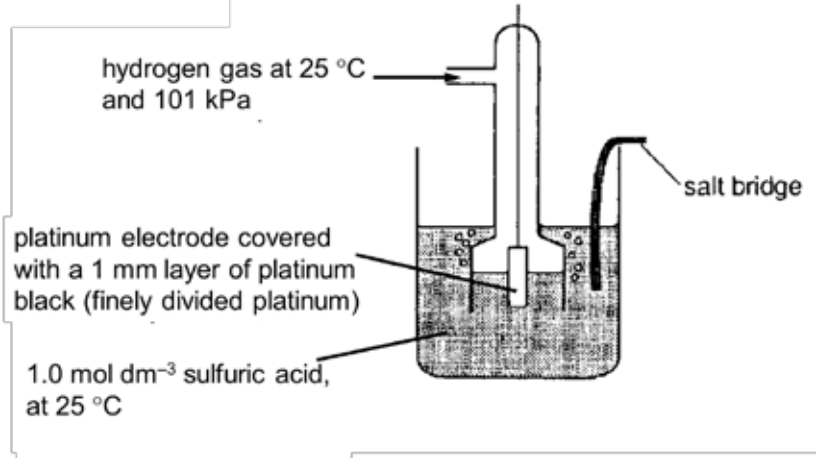
C



D



8 A student set up the hydrogen electrode shown in the diagram below.



What would have to be changed to make this a standard hydrogen electrode?

A the acid solution used

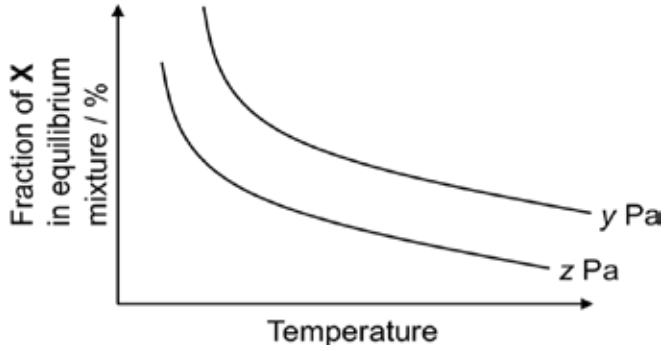
B the temperature of the gas and of the acid solution

C the pressure of the gas

D the metal comprising the electrode

9 The graph below shows how the fraction of a substance, **X**, represented by one of the following compounds in the equilibrium mixture shown below varies with temperature at pressures of *y* Pa and *z* Pa.

$4NH_3(g) + 3O_2(g) \rightleftharpoons 2N_2(g) + 6H_2O(g)$ $\quad \Delta H = -1267 \text{ kJ mol}^{-1}$



Identify **X** and the correct magnitudes of *y* and *z*.

	X	Pressure
A	NH_3	$z > y$
B	N_2	$z > y$
C	O_2	$y > z$
D	H_2O	$y > z$

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

temperature / °C	K_w / mol^2 dm^{-6}
0	0.1×10^{-14}
10	0.3×10^{-14}
25	1.0×10^{-14}

What can be deduced from this information?

A Molar concentration of H^+ ions decreases with temperature.

B The ionic dissociation of water decreases by a factor of 10 between 0 °C and 25 °C.

C The association of water molecules by hydrogen bonding increases as temperature increases.

D Water is no longer a neutral liquid at temperatures below 25 °C.

11 Ozone in the earth's atmosphere decomposes according to the equation:

$$2O_3(g) \rightarrow 3O_2(g)$$

This reaction is thought occur via a two–step mechanism:

Step 1	$O_3(g) \rightleftharpoons O_2(g) + O(g)$	fast, reversible
Step 2	$O_3(g) + O(g) \rightarrow 2O_2(g)$	slow

What rate law is consistent with this mechanism?

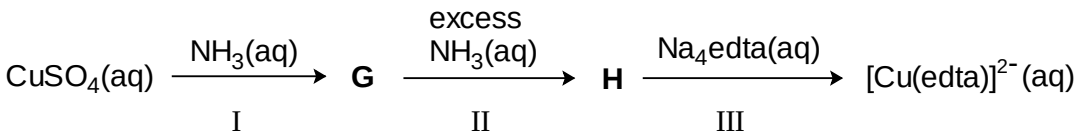
A Rate = $k[O_3]^2 / [O_2]$ **B** Rate = $k[O_3]^2 / [O_2]^3$

C Rate = $k[O_3]$ **D** Rate = $k[O_3]^2$

12 **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 2 **B** 3 **C** 4 **D** 5

13 A reaction scheme starting from aqueous copper(II) sulphate solution is shown below. Both **G** and **H** are copper–containing species.



Which of the following statements is correct?

A NH_3 is a ligand in reaction I.

B Reaction II is a redox reaction.

C **H** is a deep blue solution containing $[Cu(NH_3)_3(H_2O)_3]SO_4$.

D The entropy of the system increases when reaction III occurs.

14 ***W***, ***X***, ***Y*** and ***Z*** are elements in Period 3.

W has greater electrical conductivity than ***Y*** but lower first ionisation energy than ***X***. ***Y*** has higher melting point than ***W***, and ***Z*** has a greater atomic radius than ***W***.

Based on this information, which of the following is a possible arrangement of these elements in increasing proton number?

A ***W, X, Y, Z***

B ***X, Y, W, Z***

C ***Y, X, Z, W***

D ***Z, W, Y, X***

15 An aqueous solution of sodium carbonate is added very slowly, till excess, to a solution containing 0.2 mol dm^{-3} of zinc nitrate and 0.1 mol dm^{-3} of silver nitrate at 25 °C.

The numerical value of the solubility product of zinc carbonate at 25 °C is 1.4×10^{-11} and that of silver carbonate is 8.1×10^{-12}.

Which statement describes what happens in the solution?

A Both zinc carbonate and silver carbonate are precipitated at the same time.

B Zinc carbonate is precipitated first, followed by silver carbonate.

C Silver carbonate is precipitated first, followed by zinc carbonate.

D Only silver carbonate is precipitated.

16 Which of the following statements about the Group VII compounds is correct?

A The halogens increase in oxidising power down the group.

B The K_{sp} values of the silver halides decrease down the group.

C The lattice energy of the silver halides becomes more exothermic down the group.

D The hydration energy of the gaseous halide ions becomes more negative down the group.

17 What is the total number of different chloroethanes, of formula $C_2H_{6-n}Cl_n$, where n can be any integer from 1 to 6?

A 6 **B** 8 **C** 9 **D** 10

18 In which sequence is it correctly stated that the value of pK_a **decreases** continuously?

A $C_2H_5OH > C_6H_5OH > CH_3CO_2H > CCl_3CO_2H$

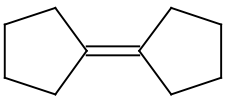
B $C_6H_5OH > C_2H_5OH > CH_3CO_2H > CCl_3CO_2H$

C $CH_3CO_2H > CCl_3CO_2H > C_2H_5OH > C_6H_5OH$

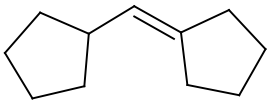
D $CCl_3CO_2H > CH_3CO_2H > C_2H_5OH > C_6H_5OH$

19 Oxidation of an alkene **X** gives a diol; further oxidation gives a diketone. Which one of the following could be **X**?

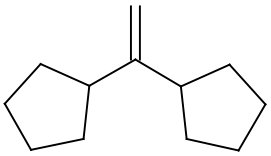
A



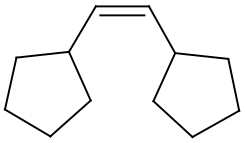
B



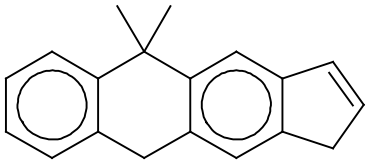
C



D

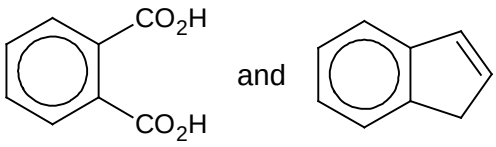


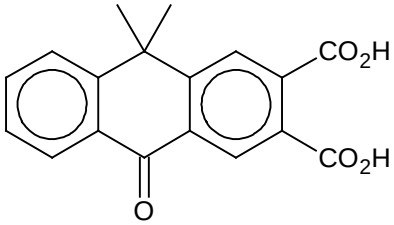
20 Compound **Z**, which has an aromatic ring structure, is subjected to oxidative degradation under suitable conditions.

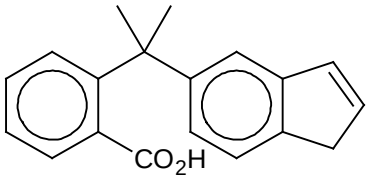


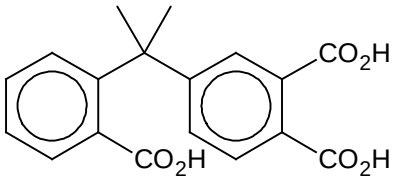
Z

What are the most likely organic products from this reaction?

A 

B 

C 

D 

21 An account in a student's notebook read:

'An excess of aqueous bromine was added to aqueous phenol in a test–tube. 2,4,6–Tribromophenol was produced as a creamy–white precipitate suspended in a yellow alkaline solution.'

Which statement in this account must have been **wrong**?

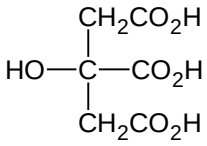
A The precipitate is 2,4,6–tribromophenol

B The precipitate obtained is creamy–white.

C The resultant solution is alkaline.

D The resultant solution is yellow.

22 Citric acid, which causes the sharp taste of lemon juice, has the following formula.



Which of the following reacts completely with 1 mol of citric acid?

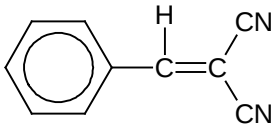
A 3 mol of $PCl_5(s)$

B 3 mol of $Na_2CO_3(aq)$

C 4 mol of NaOH(aq)

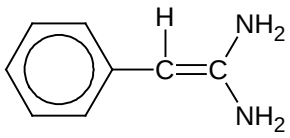
D 4 mol of Na(s)

23 CS has the structure shown below, is an active component of 'tear gas' and is readily hydrolysed.

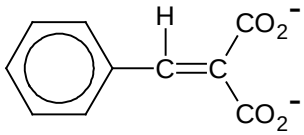


Which of the following is a possible hydrolysis product of CS?

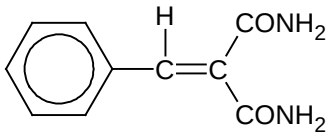
A



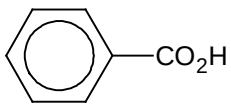
B



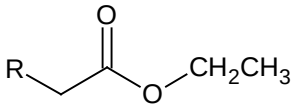
C



D

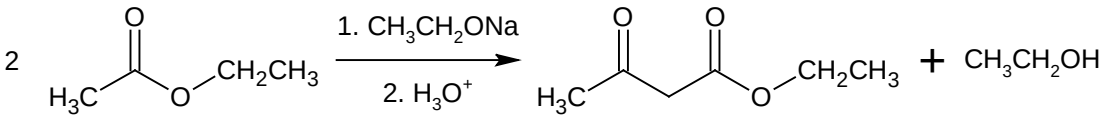


24 Members of an ethyl ester homologous series have the general formula



where R = C_nH_{2n+1}, and n = 0, 1, 2 …

Each member undergoes Claisen condensation with either itself or another member of the series to form a b–keto ester. For example, the first member of the series, ethyl ethanoate, combines with itself in the presence of sodium ethanoate, followed by acidification, to form ethyl 3–oxobutanoate. Ethanol is eliminated in the process.

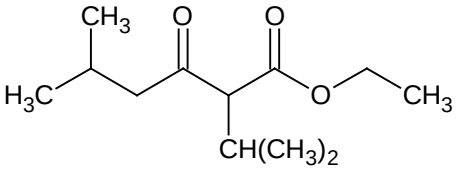


ethyl ethanoate

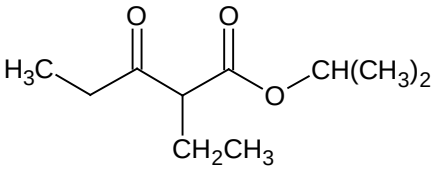
ethyl 3-oxobutanoate
(b-keto ester)

Which one of the following is a possible product of the Claisen condensation between ethyl ethanoate and the fourth member of the series?

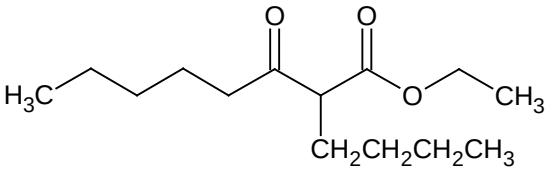
A



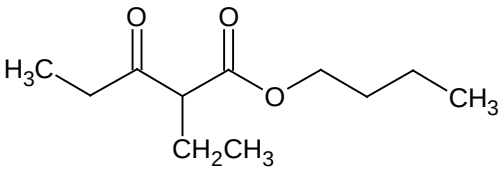
B



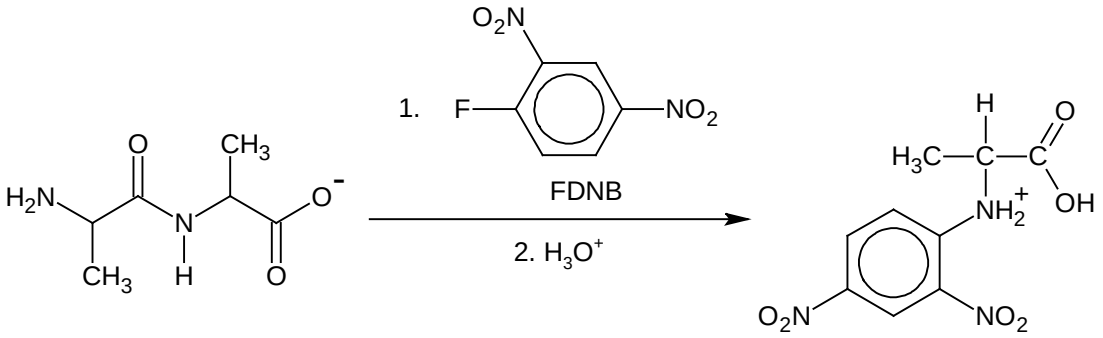
C



D



25 At alkaline pH, Sanger's reagent, also known as FDNB, reacts with the amine group in terminal amino acid residues of polypeptide chains. Upon hydrolysis, coloured dinitrophenyl compounds are produced. An example of such a reaction is as follows:



Which of the following terms or phrases best describes the type of reaction illustrated above?

A Nucleophilic substitution

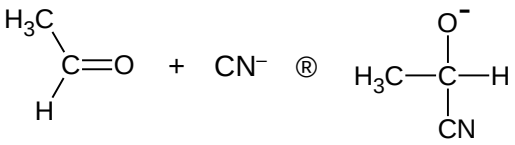
B Elimination

C Electrophilic addition

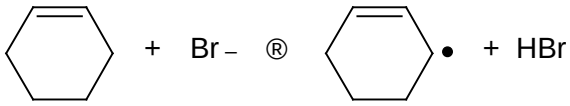
D Electrophilic substitution

26 Which of the following mechanistic steps is **least** likely to occur?

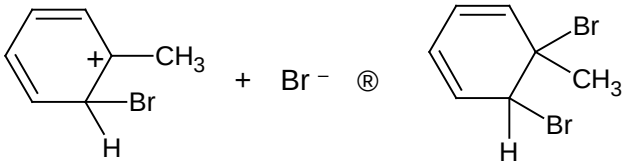
A



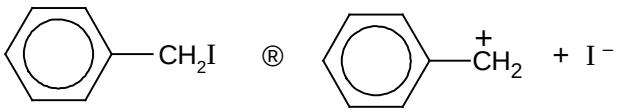
B



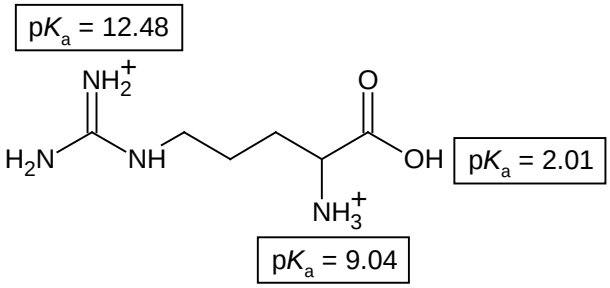
C



D



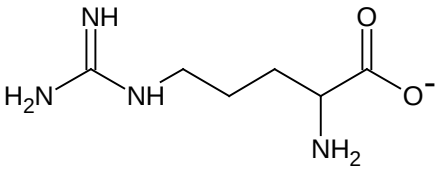
Questions **27** and **28** refer to amino acid, arginine, which has the structure below.



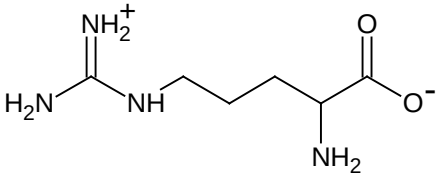
arginine

27 Which of the following is the zwitterion form of arginine?

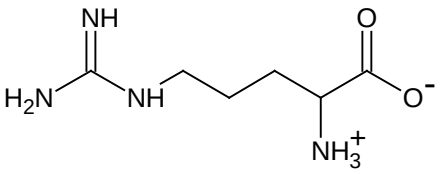
A



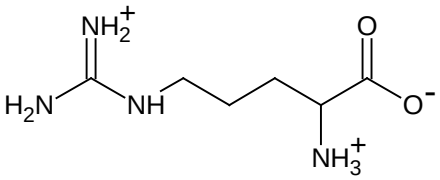
B



C



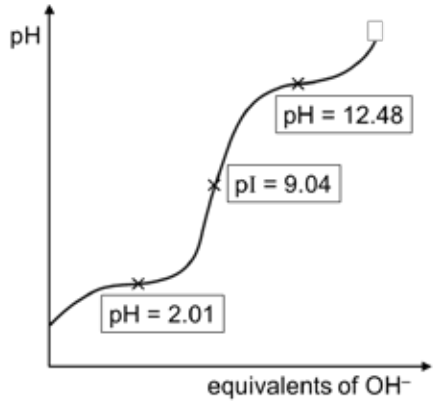
D



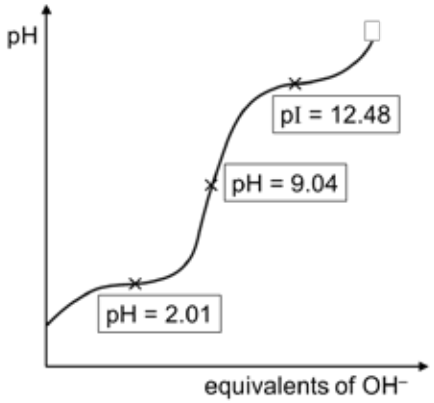
28 An aqueous alkali is gradually added to a certain volume of an acidic solution of arginine. The concentration of each solution is similar. Which of the following graphs best represents the change of pH during the reaction?

(pI represents the isoelectric point of arginine, and equivalents of OH^- represent the number of moles of OH^- that reacts with one mole of H^+ in an acid–base reaction.)

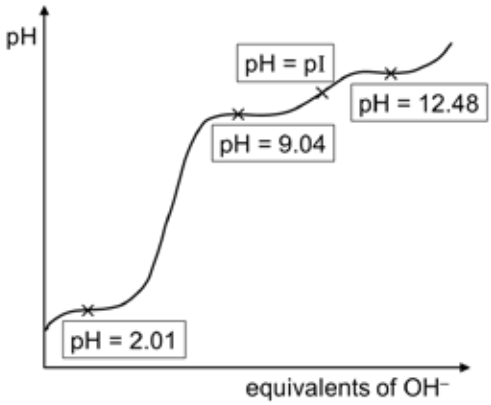
A



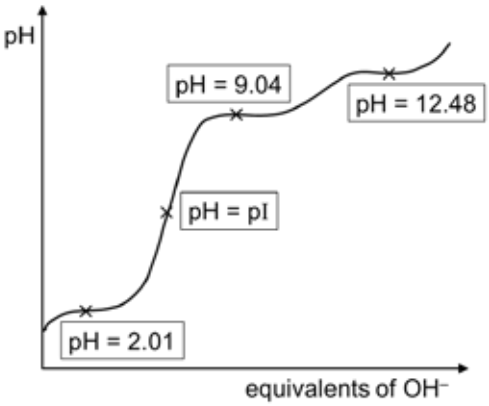
B



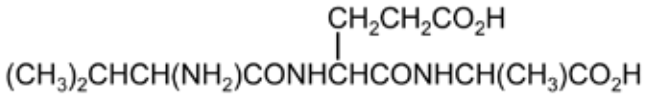
C



D



29 Partial hydrolysis of insulin, the hormone essential for carbohydrate metabolism, gives the following tripeptide.

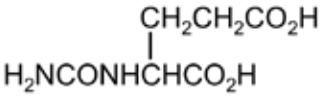


Which compound could be obtained by further hydrolysis of this tripeptide?

A $CH_3CH(CO_2H)_2$

B $(CH_3)_2CHCH(NH_2)CONH_2$

C



D $CH_2(CO_2H)CH_2CH(NH_2)CONHCH(CH_3)CO_2H$

30 A hexapeptide, **P**, is hydrolysed to the following dipeptides:

Ileu–Val

Ala–Pro

Lys–Leu

Carboxypeptidase, an enzyme which hydrolyses the peptide bond of an amino acid residue at the C–terminus, acts on **P** to liberate valine. 2,4–dinitrofluorobenzene, which reacts with an amino acid residue at the N–terminus to form dinitrophenyl–*amino acid*, reacts with **P** to yield, after hydrolysis, 2,4–dinitrophenylalanine. Which of the following is the amino acid sequence of polypeptide **P**?

A Ala–Pro–Lys–Leu–Ileu–Val

B Val–Ileu–Lys–Leu–Pro–Ala

C Ileu–Val–Ala–Pro–Lys–Leu

D Lys–Leu–Ala–Pro–Ileu–Val

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

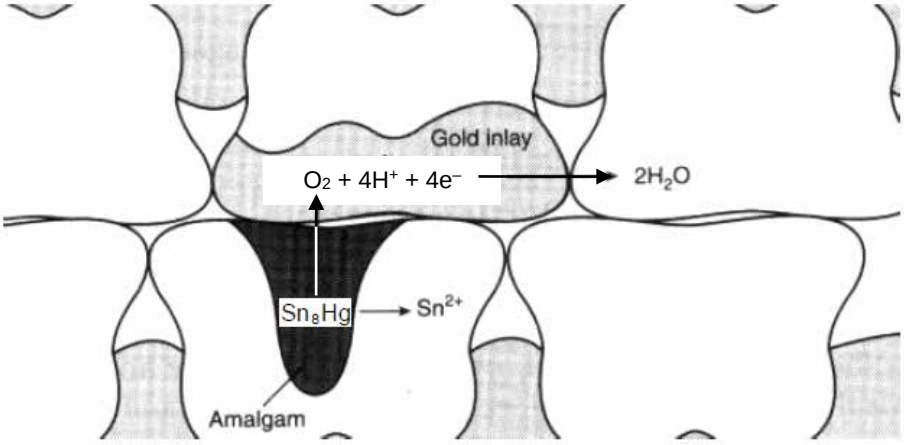
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

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 An amalgam is formed when mercury is used to dissolve another metal. The amalgam used in dental filling is a mixture of mercury and tin, Sn_8Hg. The diagram below shows an electrochemical cell formed between an amalgam filling and a gold inlay.



Some standard electrode potentials are given below.

Sn^{2+}/Sn_8Hg	–0.13 V
Au^{3+}/Au	+1.50 V
Al^{3+}/Al	–1.66
O_2/H_2O	+1.23

Which of the following statement(s) about the amalgam is/are **true**?

1 Regular consumption of acidic beverages promotes the corrosion of the amalgam filling.

2 When a piece of aluminium foil is in contact with the amalgam filling, the amalgam filling becomes the cathode.

3 Sn^{2+} ions are momentarily discharged when the amalgam filling is in contact with the gold inlay.

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

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

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

32 Ammonia is manufactured industrially by the Haber Process as shown.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H < 0$$

The operating conditions are:
400 to 450 °C; a pressure of 200 atm; an iron catalyst

Which of the following statement(s) is/are **true** about the Haber process for the manufacture of ammonia?

1 At higher temperatures, the production of ammonia becomes thermodynamically less feasible.

2 At higher pressures, the yield goes down but the rate of production of ammonia is faster.

3 The presence of a catalyst shifts the equilibrium position to the right and increases the yield.

33 Three unsaturated compounds undergo hydrogenation to form cyclohexane as follows.

	ΔH / kJ mol^{-1}	
	Predicted	Experimental
cyclohexene + H_2 ®		–120
cyclohexa–1,3–diene + $2H_2$ ®	–240	–232
benzene + $3H_2$ ®	–360	–208

Which of the following deduction(s) can be made from the data above?

1 The delocalisation of p electrons in benzene lowers the predicted energy content of benzene by 152 kJ mol^{-1}.

2 Cyclohexane is the most stable amongst all four substances.

3 Cyclohexa–1,3–diene has a higher energy content than cyclohexene.

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 Sodium hydrogensulfide, NaSH, is used to remove hair from animal hides. Which statement(s) about the SH^- ion is/are **correct**?

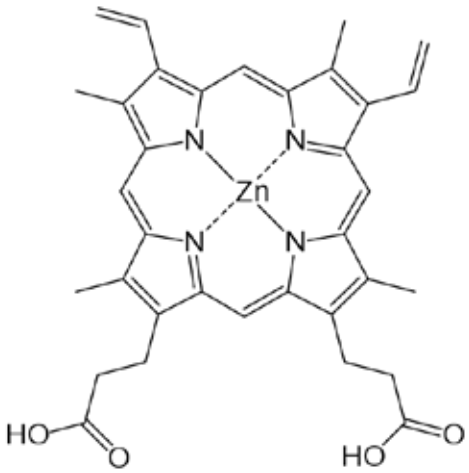
1 Three lone pairs of electrons surround the sulfur atom.

2 Its conjugate acid contains a total of 18 electrons.

3 Sulfur has an oxidation state of +2.

35 Zinc protoporphyrin (ZPP) is a compound found in red blood cells when heme production is inhibited by the presence of lead or by a lack of iron in blood.

A structure of a molecule of ZPP is shown as follows.



Zinc is situated in the centre of a planar arrangement of four nitrogen atoms.

What does **this** structure suggest about the bonding around zinc?

1 dative covalency

2 s bonding

3 oxidation state of zinc is zero

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.

36 In an experiment, **r** mol of chlorine gas was bubbled into excess hot aqueous potassium hydroxide. Which of the following statement(s) is/are **incorrect** regarding this reaction?

1 Oxidation number of chlorine changes from 0 to –1 and 0 to +5

2 3**r** mol of potassium hydroxide was required and $\frac{5}{3}$**r** mol of potassium chloride was produced.

3 A disproportionation reaction occurred and the final products obtained included potassium chlorate(I) and potassium chlorate(V).

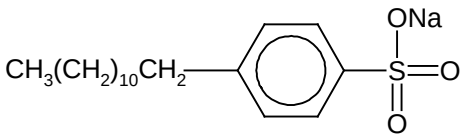
37 Which of the following statement(s) about Group II elements from Mg to Ba is/are correct?

1 The pH of the solution from the reaction of the metal oxides with water decreases down the group.

2 The reactivity of the elements with water increases down the group.

3 The decomposition temperature of the carbonates increases down the group.

38 Long–chain alkanes are converted on an industrial scale into alkylsulfates for use as detergents, e.g. sodium dodecyl benzene sulfonate (SDBS).



SDBS

What deduction(s) about the properties of SDBS can be made from this structure?

1 Part of the structure is polar and is water–attracting.

2 The alkyl chain is soluble in oil droplets.

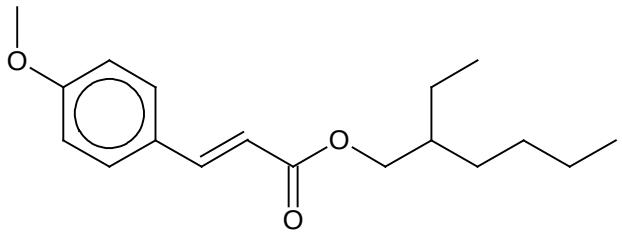
3 The shape of the molecule is tetrahedral about the sulfur atom.

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

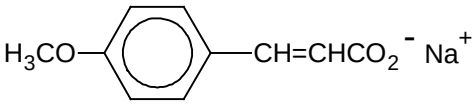
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

39 A sun protection cream contains the following ester as its active ingredient.



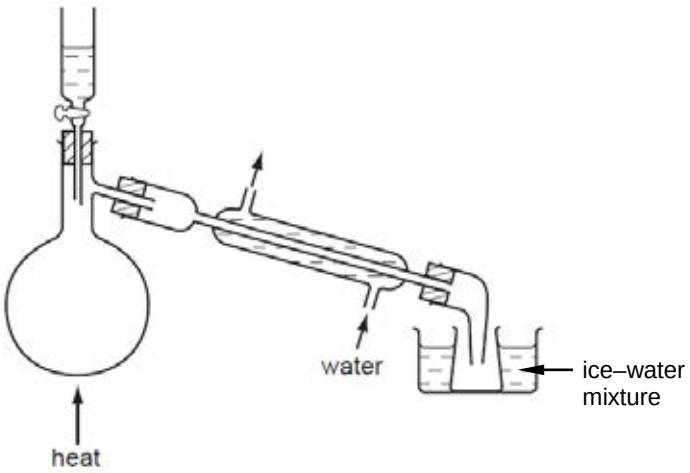
What are the products of its partial or total hydrolysis by aqueous sodium hydroxide?

1 

2 $CH_3CH_2CH_2CH_2CH(CH_2CH_3)CH_2O^-Na^+$

3 $CH_3CH_2CH_2CH_2CH(CH_2CH_3)CO_2^-Na^+$

40 The following diagram shows some laboratory apparatus.



Which preparation(s) could this apparatus be used for?

1 bromoethane, from ethanol, sodium bromide and concentrated sulfuric acid.

2 propanal, from propanol, sodium dichromate(VI) and sulfuric acid.

3 1,2–dibromopropane, from bromine and propene.