ANDERSON JUNIOR COLLEGE

2014 JC2 PRELIMINARY EXAMINATIONS

CHEMISTRY **9647/01**

Higher 2 **22 September 2014**

Paper 1 Multiple Choice **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.

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 Multiple Choice Answer Sheet.

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.

Multiple Choice Answer Sheet

Write your name, PDG and NRIC / FIN number, **including** the reference letter.

Shade the NRIC / FIN number.

Exam Title: JC2 Prelim

Exam Details: H2 Chemistry / Paper 1

Date: 22/09/2014

This document consists of **19** printed pages.

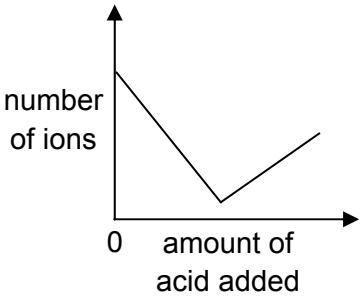
Section A

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

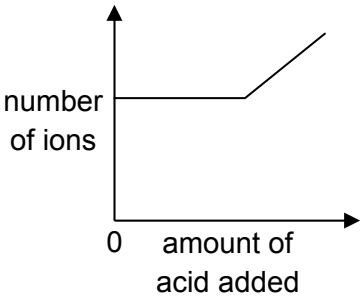
1 Dilute sulfuric acid was added to aqueous barium hydroxide until the acid was present in excess.

How will the total number of ions present in solution in the reacting mixture vary?

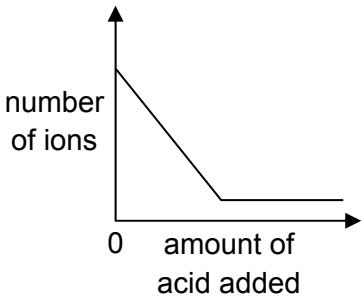
A



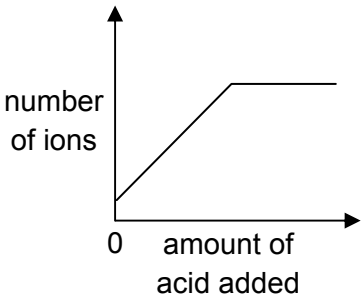
B



C



D

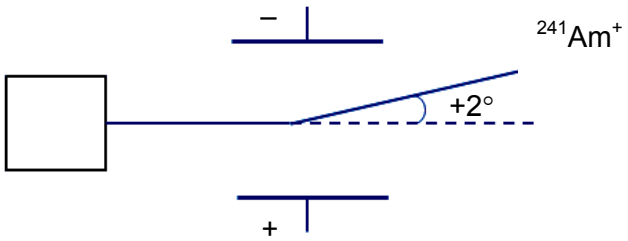


2 When iron reacts with aqueous iron(III) ions, iron(II) ions are formed as the only product.

A final mixture, after the reaction has taken place, contains equal numbers of moles of $Fe^{2+}(aq)$ and $Fe^{3+}(aq)$. Assuming the reaction has gone to completion, how many moles of Fe(s) and $Fe^{3+}(aq)$ were in the starting mixture?

	moles of Fe(s)	moles of $Fe^{3+}(aq)$
A	1	2
B	1	3
C	1	5
D	2	3

3 A sample of the element Americium (Am) was vaporised, ionised and passed through an electric field. It was observed that a beam of $^{241}Am^{+}$ particles gave an angle of deflection of +2°.



Assuming an identical set of experimental conditions, by what angle would a beam of $^{32}S^{-}$ particles be deflected?

A +15.1°

B –15.1°

C +30.1°

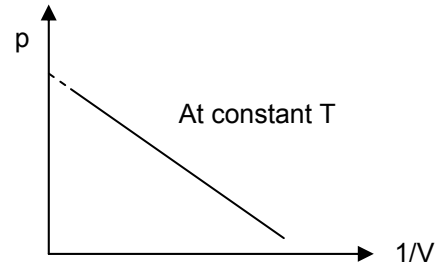
D –30.1°

4 Which diagram best shows the shapes and relative energies of the valence orbitals of carbon in a molecule of ethene?

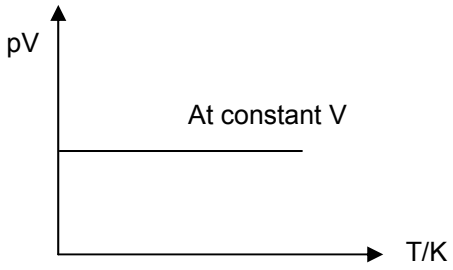
A	2s sp^3	energy
B	sp^3 2s	energy
C	sp^2 2p	energy
D	2p sp^2	energy

5 Which of the following diagrams correctly describes the behaviour of a fixed mass of an ideal gas?

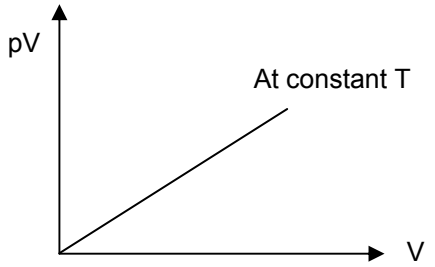
A



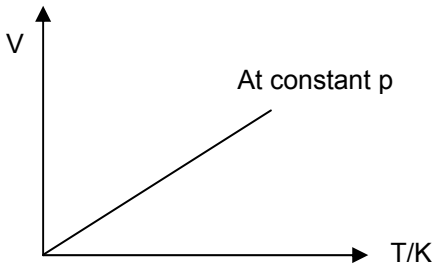
B



C



D



6 Which of the following reactions results in an increase in the bond angle of the underlined substances?

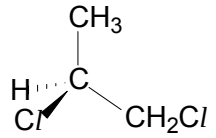
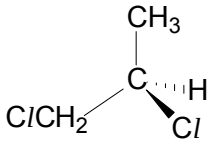
A $\underline{CO_2} + 2NaOH \longrightarrow Na_2\underline{CO_3} + H_2O$

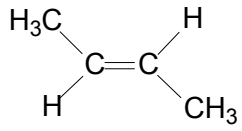
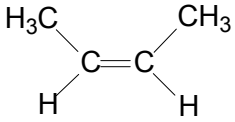
B $\underline{BH_3} + NaH \longrightarrow Na\underline{BH_4}$

C $Na\underline{NH_2} + H_2O \longrightarrow \underline{NH_3} + NaOH$

D $\underline{XeF_2} + F_2 \longrightarrow \underline{XeF_4}$

7 In which pair do the isomers have identical boiling points?

A  and 

B  and 

C $CH_3CH_2CH_2CH_2OH$ and $(CH_3)_2CHCH_2OH$

D $CH_3(CH_2)_4CH_3$ and $(CH_3)_2CHCH(CH_3)_2$

8 Which value is essential to calculate the lattice energy of the compound NaH?

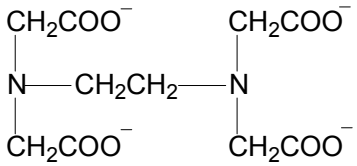
A electron affinity of hydrogen

B electron affinity of sodium

C first ionisation energy of hydrogen

D second ionisation energy of sodium

9 Given that $EDTA^{4-}$ has the following structure,



which of the following statements about the reaction involving the hexaaquacopper(II) ion below is **incorrect**?

$$[Cu(H_2O)_6]^{2+} + EDTA^{4-} \rightleftharpoons [Cu(EDTA)]^{2-} + 6H_2O$$

A The entropy change for the forward reaction is positive.

B The copper undergoes a change in oxidation state.

C The number of bonds broken and that of bonds formed are identical.

D Both $[Cu(H_2O)_6]^{2+}$ and $Cu(EDTA)]^{2-}$ are octahedral complexes.

10 What is the half–life of a radioactive isotope if its rate of decay decreases from 300 counts per minute to 37.5 counts per minute after 1 day?

A 4 hours

B 6 hours

C 8 hours

D 12 hours

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

Spatulas are often made from nickel.

By considering the relevant $E^{\ominus}$ values, which of the following aqueous ions should **not** be stirred with a nickel spatula because a reaction could occur?

A Cr^{3+} **B** Mn^{2+} **C** Pb^{2+} **D** V^{2+}

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

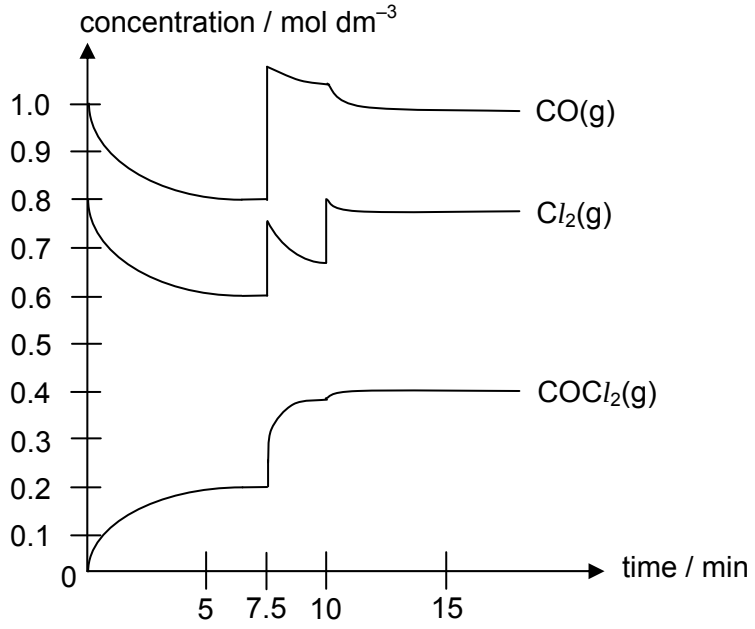
Sodium chlorate(V) is an important industrial chemical with many thousands of tons being used each year to manufacture chlorine dioxide bleach for the paper industry. It is made commercially by the electrolysis of concentrated sodium chloride (brine) using inert electrodes. The products of this process are chlorine, hydrogen and sodium hydroxide.

What is the maximum yield of each of these products when 58.5 kg of concentrated sodium chloride is electrolysed?

	chlorine	hydrogen	sodium hydroxide
A	35.5 kg	1 kg	40 kg
B	35.5 kg	2 kg	40 kg
C	71 kg	1 kg	80 kg
D	71 kg	2 kg	80 kg

13 The reaction between carbon monoxide and chlorine was studied in an experiment by mixing the two gases and changing the reaction conditions inside the reaction vessel at different times during the experiment. The concentrations of the gases in the vessel were followed with time, and the following graph is obtained.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g) \qquad \Delta H^{\ominus} = -113.4 \text{ kJ mol}^{-1}$$



Which one of the following conclusions deduced from the graph is **incorrect**?

A The rate of forward reaction equals the rate of backward reaction at 7 min.

B The equilibrium constant, K_c, for the system when determined at 7 min is 2.4 mol^{-1} dm^3.

C The change in concentration during the period 7.5 min to 10 min was produced by an increase in pressure at constant temperature.

D The change in concentration during the period 10 min to 15 min was produced by the addition of more chlorine.

14 In recent years, many new inventions have been aimed at developing methods to recover carbon dioxide due to its undesirable impact on raising global temperatures. One method involves the Bosch reaction where carbon dioxide and hydrogen are heated over a catalyst in the first stage.

$$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$$

In the second stage, the carbon monoxide is converted to solid carbon and more water.

A mixture of carbon dioxide and hydrogen in the mole ratio of 1 : 1 is passed over a heated catalyst at 1000 °C and 1 atm.

Given that the equilibrium constant, K_p, for the first stage of the Bosch reaction is 0.726 at 1000 °C, what will be the mole fraction of carbon monoxide present at equilibrium after the first stage?

A 0.23 **B** 0.46 **C** 0.50 **D** 1.54

15 Which statement explains the observation that magnesium hydroxide dissolves in aqueous ammonium chloride, but not in aqueous sodium chloride?

A The ionic radius of the NH_4^+ ion is similar to that of Mg^{2+} but not that of Na^+.

B NH_4Cl dissociates less fully than $NaCl$.

C The Na^+ and Mg^{2+} ions have the same number of electrons.

D The NH_4^+ ion can donate a proton.

16 What volume of 0.1 mol dm^{-3} NH_3 should be added to 10 cm^3 of 0.1 mol dm^{-3} NH_4Cl to produce a buffer solution of pH 9.0?

[pK_b of NH_3 = 4.74]

A 5.5 cm^3 **B** 8.2 cm^3 **C** 15.5 cm^3 **D** 18.2 cm^3

17 One mole of each of the following compounds is strongly heated with a Bunsen burner and any gas produced is collected at room temperature and pressure.

From which compound is 60 dm^3 of gas likely to be collected?

A $CaCl_2$

B $CaCO_3$

C $Ca(NO_3)_2$

D $Ca(OH)_2$

18 Fluorine has anomalous properties in Group VII.

Which statement is correct?

A Fluorine is intensely coloured.

B HF is a strong acid.

C The F–F bond is unusually weak.

D The melting point of fluorine is high.

19 A powder was known to be either a single sodium halide or a mixture of two sodium halides.

A sample of the powder was dissolved in water and aqueous silver nitrate was subsequently added. A precipitate was formed, which, on addition of excess aqueous ammonia, partly dissolved leaving a yellow solid.

What did the powder consist of?

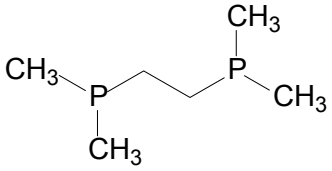
A NaBr only

B NaI only

C a mixture of NaC*l* and NaBr

D a mixture of NaC*l* and NaI

20 1,2–Bis(dimethylphosphino)ethane (dmpe) is a diphosphine ligand and it has the following structure.



dmpe

What is the coordination number and oxidation state of molybdenum (Mo) in the compound $Na_2[Mo(CN)_2(CO)_2(dmpe)]$?

	coordination number	oxidation state
A	5	0
B	5	+1
C	6	0
D	6	+1

21 Methane is a greenhouse gas but is destroyed in the troposphere by the action of hydroxyl radicals.

$$\bullet OH + CH_4 \longrightarrow \bullet CH_3 + H_2O$$

Which statement about this reaction is correct?

A The reaction involves heterolytic fission and σ bond formation.

B The reaction involves homolytic fission and σ bond formation.

C The reaction involves homolytic fission and π bond formation.

D The total number of electrons in the two reacting species is 20.

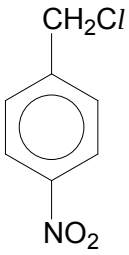
22 When heated with chlorine, an alkane, C_xH_y, undergoes free–radical substitution. In a propagation step, the free radical R• is formed by the loss of one hydrogen atom.

$$C_xH_y + Cl\bullet \longrightarrow R\bullet + HCl$$

How many different forms of R• are theoretically possible when 3–methylpentane is reacted with chlorine under this condition?

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

23 Which type of reaction does compound Z **not** likely to undergo?



Z

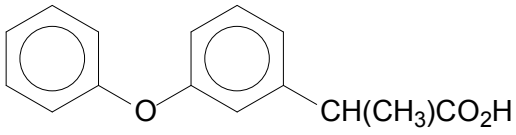
A electrophilic addition

B electrophilic substitution

C nucleophilic substitution

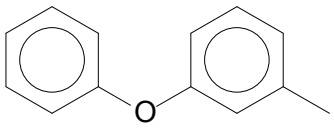
D reduction

24 *Fenoprofen* is a non–steroidal anti–inflammatory drug.



Fenoprofen

Which of the following could be part of a sequence for synthesising *Fenoprofen*?

[In the sequences below, R = ]

		step 1		step 2	
A	$RCH(OH)CH_3$	I_2, OH^-(aq), warm	intermediate	H^+(aq)	*Fenoprofen*
B	$RCH(CH_3)_2$	$KMnO_4$, OH^-(aq), heat	intermediate	H^+(aq), heat	*Fenoprofen*
C	$RCH(CH_3)OCOCH_3$	$KMnO_4$, OH^-(aq), heat	intermediate	H^+(aq)	*Fenoprofen*
D	$RCHBrCH_3$	NaCN(ethanolic), heat	intermediate	H^+(aq), heat	*Fenoprofen*

25 Which reaction will give the best yield of 1–chloropropane?

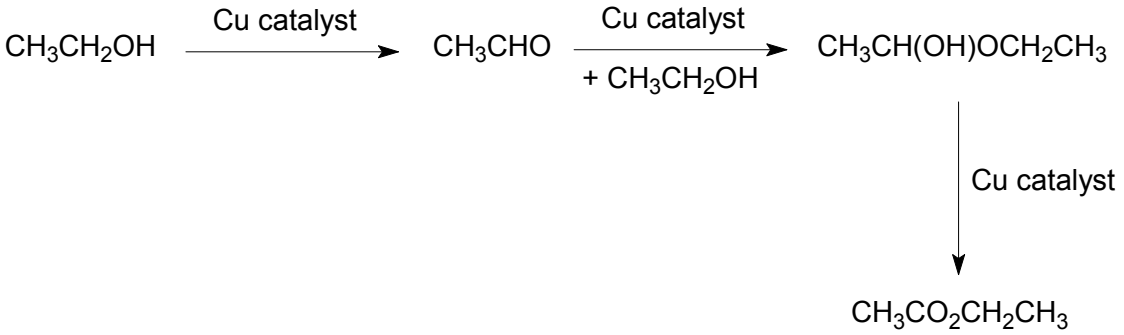
A chlorine gas with propene gas in the dark

B propan–1–ol with dilute NaC*l*(aq)

C propan–1–ol with PCl_5

D propene with dilute HC*l*(aq)

26 A new industrial preparation of ethyl ethanoate has been developed using cheap sources of ethanol.



Which process is involved at some stage in this reaction sequence?

A electrophilic addition

B nucleophilic addition

C nucleophilic substitution

D reduction

27 0.1 mol of each of the four compounds below were added separately to 1 dm^3 of water.

chloroethanoic acid, ethanoic acid, ethanoyl chloride, ethyl ethanoate

Which of the following shows the correct order of increasing pH of the solutions formed?

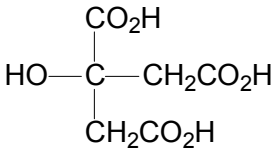
A ethanoyl chloride, ethyl ethanoate, chloroethanoic acid, ethanoic acid

B ethanoyl chloride, chloroethanoic acid, ethanoic acid, ethyl ethanoate

C ethyl ethanoate, ethanoic acid, chloroethanoic acid, ethanoyl chloride

D ethanoic acid, chloroethanoic acid, ethyl ethanoate, ethanoyl chloride

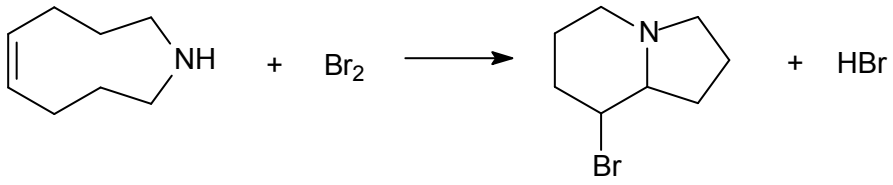
28 How many moles of hydrogen are evolved when an excess of sodium metal is added to one mole of citric acid?



citric acid

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

29 What type of reaction could be involved in the formation of the organic product below?



A oxidation

B electrophilic substitution

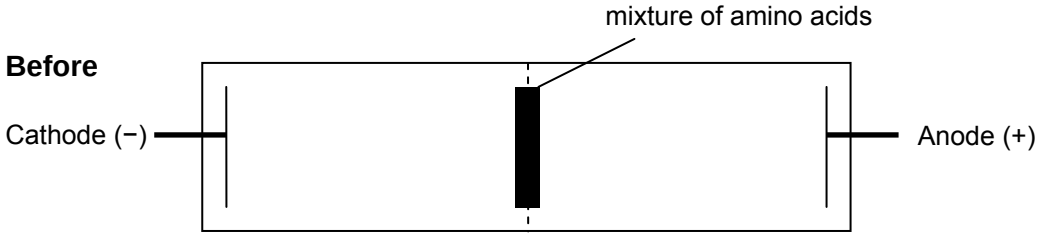
C free–radical substitution

D nucleophilic substitution

30 The table below shows the isoelectric points of some amino acids:

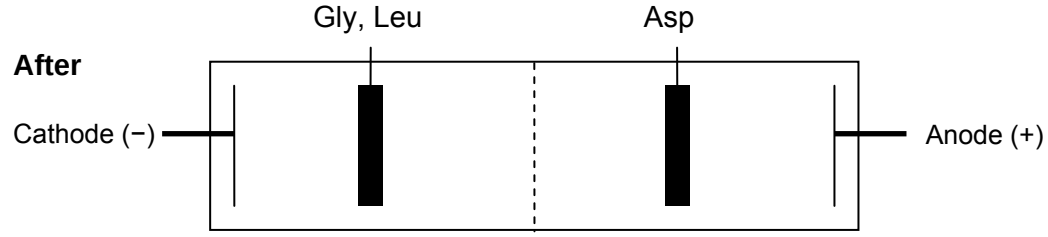
Amino acid	glycine (Gly)	aspartic acid (Asp)	leucine (Leu)
Structure	$H_2NCH_2CO_2H$	CO_2H | CH_2 | H_2NCHCO_2H	$CH(CH_3)_2$ | CH_2 | H_2NCHCO_2H
Isoelectric point	6.0	2.8	6.0

A mixture of the above three amino acids can be separated by electrophoresis. The following shows the electrophoresis gel at the start of electrophoresis.

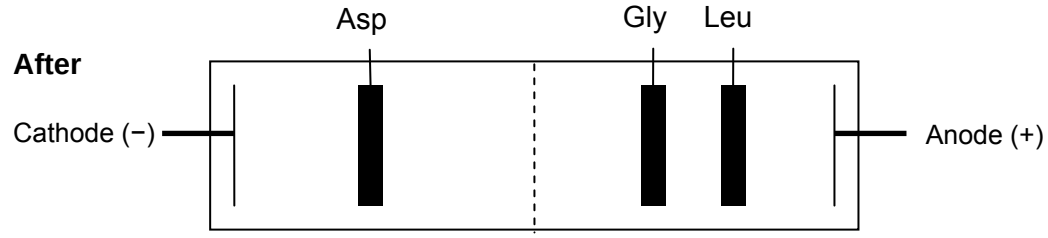


Which of the following diagrams shows the result of the separation of the amino acid mixture at pH 4.0 after current flows through for a period of time?

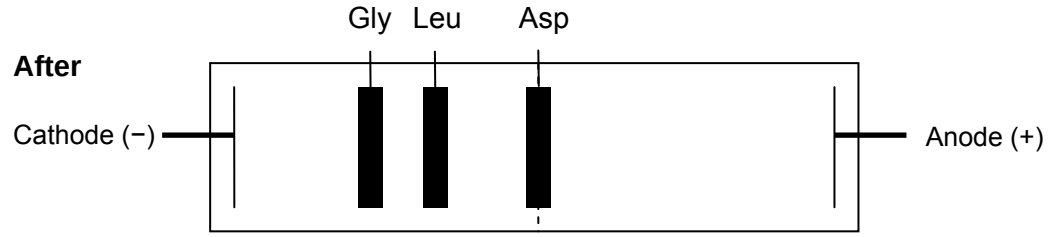
A



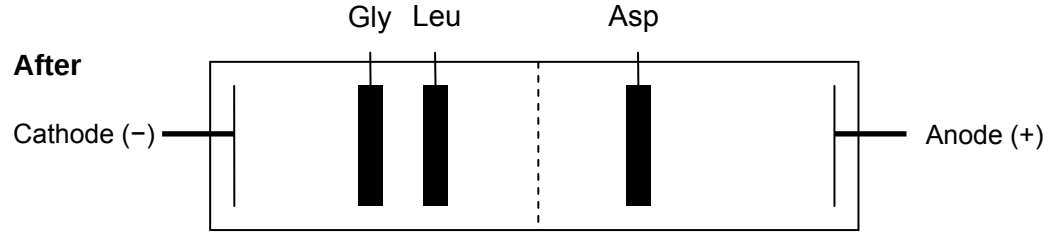
B



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 X is a particle with 18 electrons and 20 neutrons.

What could be the symbol of X?

1 $^{38}_{18}Ar$

2 $^{40}_{20}Ca^{2+}$

3 $^{39}_{19}K^{+}$

32 The enthalpy change of formation of carbon monoxide and carbon dioxide are –110 kJ mol^{-1} and –393 kJ mol^{-1} respectively.

Which of the following statements are correct?

1 Carbon dioxide is energetically more stable than carbon monoxide.

2 The enthalpy change of combustion of carbon monoxide is –283 kJ mol^{-1}.

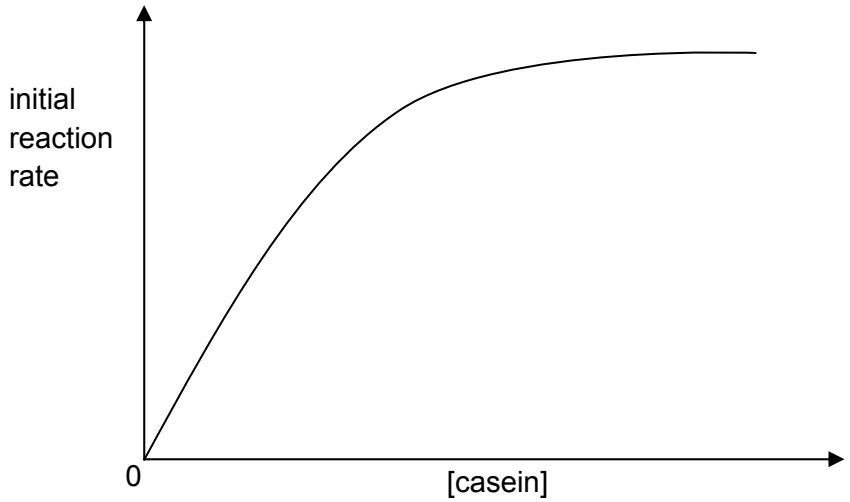
3 The enthalpy change of combustion of carbon is more exothermic than the enthalpy change of combustion of carbon monoxide.

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.

33 The graph shows the results of an investigation of the initial rate of hydrolysis of casein by the enzyme trypsin. In the experiments, the initial concentration of casein was varied but that of trypsin was kept constant.



Which conclusions can be deduced from these results?

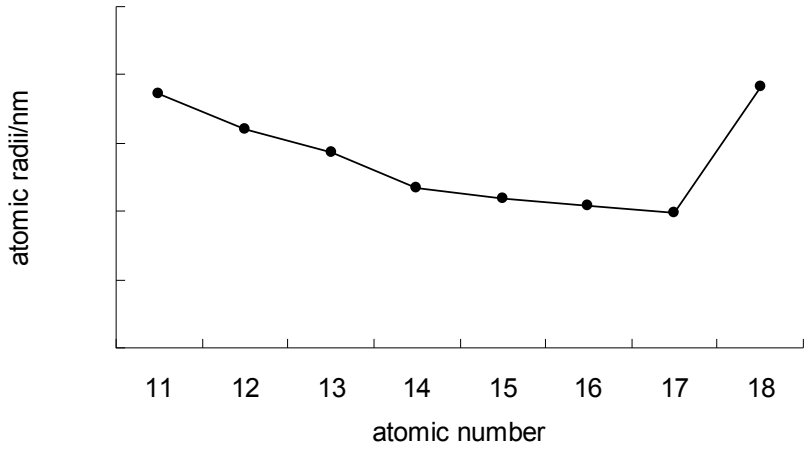
1 When [casein] is high, the rate is independent of [trypsin].

2 When [casein] is high, the rate is independent of [casein].

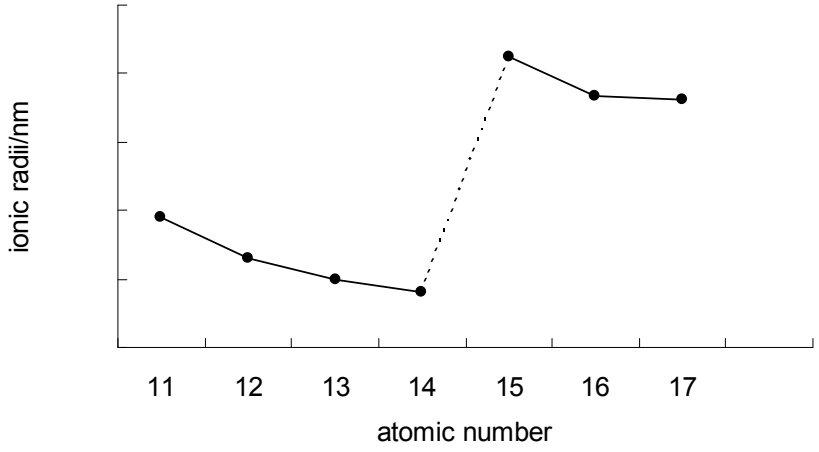
3 When [casein] is low, the rate is first order with respect to [casein].

34 Which of the following graphs correctly represents the variation in the specified property of the elements in Period 3?

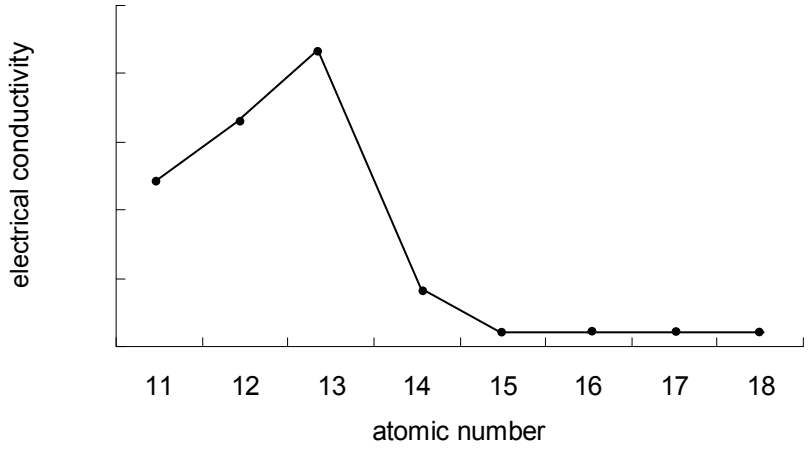
1



2



3



35 Which of the following compounds reacts with chlorine to give two products in which chlorine has a different oxidation number?

1 potassium hydroxide

2 concentrated sulfuric acid

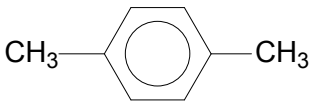
3 sodium iodide

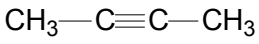
The responses **A** to **D** should be selected on the basis of

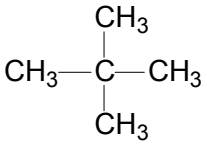
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

36 In which of the following structures are all the carbon atoms lying in one plane?

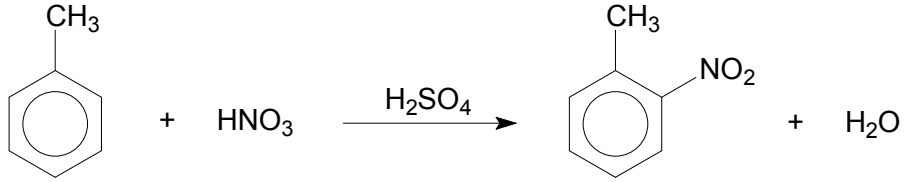
1 

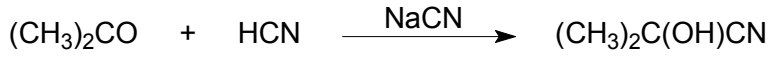
2 

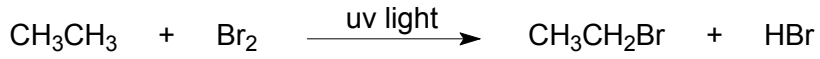
3 

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

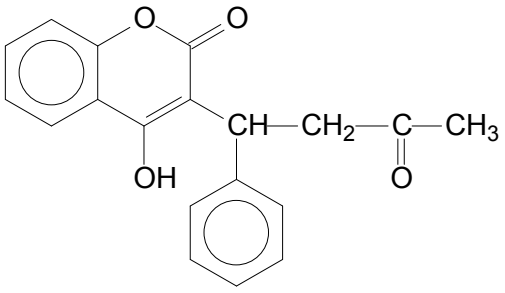
To which of the following reactions does this statement apply?

1 

2 

3 

38 *Warfarin* (M_r = 308) is an anticoagulant used to prevent the formation of blood clots.



Warfarin

Which of the following statements about *Warfarin* are correct?

1 There is only one chiral centre present in the *Warfarin* molecule.

2 On complete combustion, 0.10 g of *Warfarin* produces 0.23 g of CO_2.

3 One mole of *Warfarin* reacts with two moles of 2,4–dinitrophenylhydrazine.

39 Which of the following substances will yield an alcohol on heating with aqueous sodium hydroxide?

1 $CH_3CH_2CO_2CH_2CH_3$

2 C_6H_5Br

3 $C_6H_5CONH_2$

40 Egg foams can be incorporated into a variety of dishes such as meringues, cakes, soufflés, sauces, mousses and cocktails. They are made by consistently beating the egg white and folding air into it while whisking to cause denaturation and foaming. Egg white contains 90% water and 10% protein.

Which of the following statements are correct?

1 The mechanical action of whisking breaks the weak van der Waals' forces and hydrogen bonds between the amino acid residues in the protein chain.

2 The mixing of air and egg white creates an acidic condition that disrupts the hydrogen bonds between the >C=O and >N–H groups of the peptide linkages in the protein chain.

3 Foaming of the egg white destroys the peptide linkages in the protein chain.