H

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY 9729/01

Paper 1 Multiple Choice **18 September 2020**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and tutor's name on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

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

A typical solid fertiliser for use with household plants and shrubs contains the elements N, P and K in the ratio of 15 g : 30 g : 15 g per 100 g of fertiliser. The recommended usage of fertiliser is 14 g of fertiliser per 5 dm^3 of water.

What is the concentration of nitrogen atoms in this solution?

A 0.015 mol dm^{-3}

B 0.030 mol dm^{-3}

C 0.075 mol dm^{-3}

D 0.149 mol dm^{-3}

2 Beams of charged particles are deflected by an electric field.

In an experiment, protons are deflected by an angle of +15 ^{o}.

In another experiment under identical conditions, particle **Y** is deflected by an angle of +5 ^{o}.

What could be the composition of particle **Y**?

	no. of protons	no. of neutrons	no. of electrons
A	1	2	1
B	3	3	5
C	4	5	1
D	4	5	3

3 In which pair do the species have different shapes from each other?

A $BeCl_2$ and CO_2

B BH_4^- and NH_4^+

C OF_2 and SCl_2

D PH_3 and SO_3

4 Liquids **X** and **Y** do not react with one another. They have identical boiling points.

When a particular volume of **X** is shaken with a similar volume of **Y**, they form a liquid mixture **Z**.

The average intermolecular forces in liquid **Z** are stronger than the average of the forces in **X** and the forces in **Y**.

Which deductions from this information are correct?

1 The mixing of **X** and **Y** is exothermic.

2 The vapour pressure of liquid **Z** will be less than that of either liquid **X** or liquid **Y** at the same temperature.

3 The boiling point of liquid **Z** will be lower than that of either liquid **X** or liquid **Y** at the same pressure.

A 1, 2 and 3

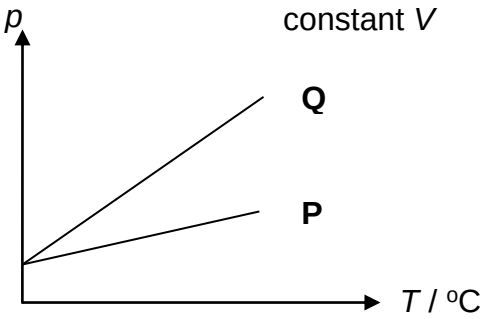
B 1 and 2 only

C 2 and 3 only

D 1 only

5 Which graph correctly describes the behaviour of two ideal gases **P** and **Q**, both having the same mass, where **P** has a larger M_r than **Q**?

A



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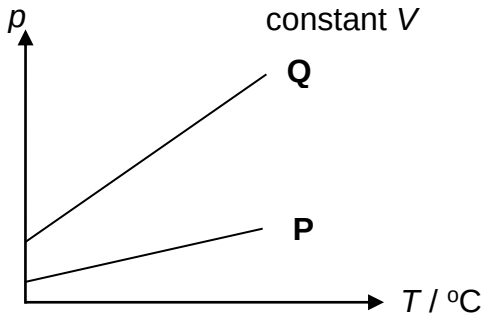

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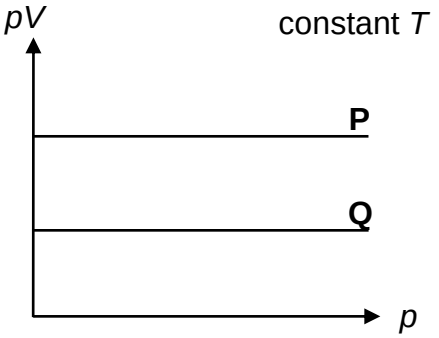

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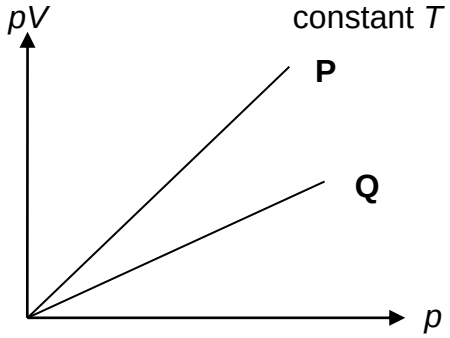


6 *Use of the Data Booklet is relevant to this question.*

A butane burner is used to heat water. The M_r of butane is 58.

- $\Delta H^{\ominus}_c$ of butane is –2877 kJ mol^{-1}.
- 250 g of water is heated from 12 °C to 100 °C.
- The burner transfers 47% of the heat released from the burning fuel to the water.

Assume that the butane undergoes complete combustion and none of the water evaporates.

What is the minimum mass of butane that must be burnt?

A 0.071 g **B** 1.85 g **C** 3.94 g **D** 4.48 g

7 Sulfur can be oxidised in two ways.

$S(s) + O_2(g) \rightarrow SO_2(g)$ ΔH = –296.5 kJ mol^{-1}

$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$ ΔH = –791.4 kJ mol^{-1}

Sulfur trioxide can be made from sulfur dioxide and oxygen.

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

What is the standard enthalpy change for this reaction?

A –1384.4 kJ mol^{-1}

B –989.8 kJ mol^{-1}

C –494.9 kJ mol^{-1}

D –198.4 kJ mol^{-1}

8 After the closure of a chemical plant in Switzerland, the reaction between 1-bromobutane and hydrogen sulfide ions (HS^-) was found to be taking place in the ground.

The following results were obtained.

Initial concentration of 1-bromobutane / mol dm^{-3}	Initial concentration of hydrogen sulfide ions / mol dm^{-3}	Initial rate of reaction / mol dm^{-3} s^{-1}
0.1	0.1	1.5×10^{-5}
0.2	0.1	3.0×10^{-5}
0.3	0.1	4.5×10^{-5}
0.1	0.2	3.0×10^{-5}
0.1	0.3	4.5×10^{-5}

Which of the following statements is correct?

A The reaction is first order with respect to 1-bromobutane only.

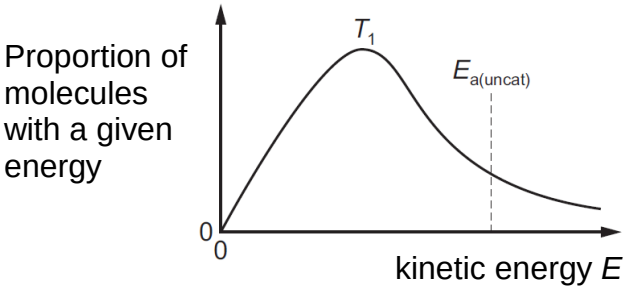
B The reaction is zero order with respect to hydrogen sulfide ions.

C Both 1-bromobutane and hydrogen sulfide ions are involved in the rate-determining step.

D The rate constant is 1.5×10^{-5} mol^{-1} dm^3 s^{-1}.

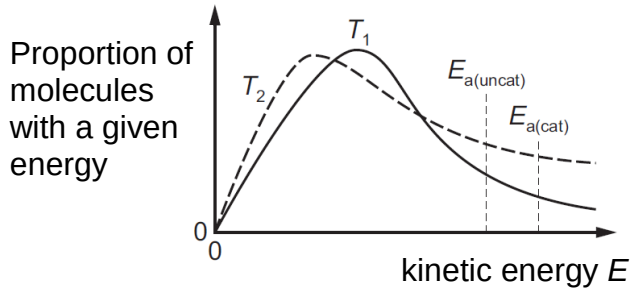
9 The diagram shows the distribution of kinetic energies in a sample of gas at a temperature T_1.

The activation energy for an uncatalysed reaction of this gas, $E_{a(uncat)}$, is shown.



Which diagram correctly shows the new distribution and new activation energy, $E_{a(cat)}$, when the temperature is increased to T_2, and a catalyst is used that increases the rate of the reaction?

A



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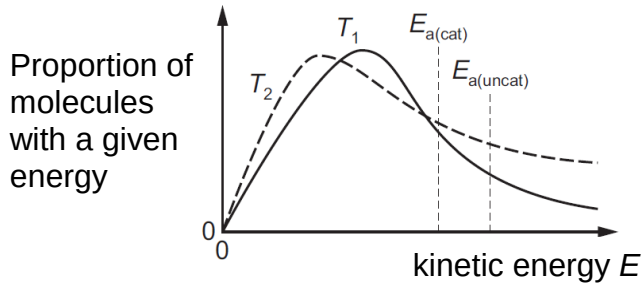

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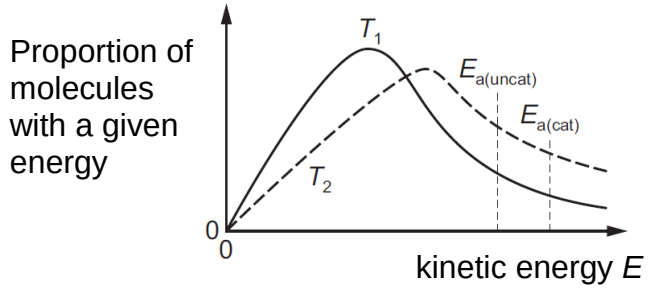
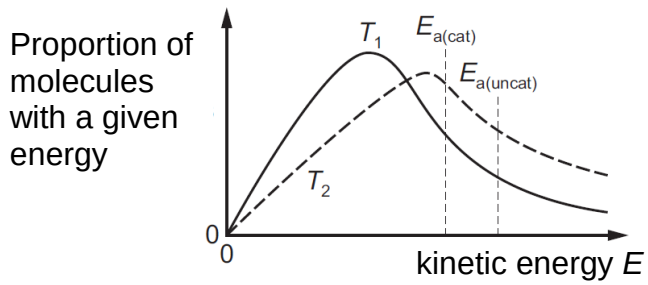


D



10 A pure sample of $NO_2(g)$ is introduced into an evacuated vessel. The vessel, of constant volume, is heated to a constant temperature such that the equilibrium below is established.

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

The value of the pressure p is then found to be 30% greater than if only $NO_2(g)$ were present.

What is the mole fraction, x, of oxygen in this equilibrium mixture?

A 0.17

B 0.23

C 0.37

D 0.43

11 The percentage yield and rate of chemical reactions is an important consideration in industrial applications like the Haber Process.

$$N_2 + 3H_2 \prod 2NH_3$$

Which of the following changes made to the Haber Process increases both the rate and percentage yield?

Option	Change made
1	Increase in temperature
2	Add a catalyst
3	Increase in pressure

A 1 and 2

B 1 and 3

C 3 only

D all of the above

12 In which reaction does ammonia behave as a Brønsted-Lowry base?

A $NH_3 + H_2O + CO_2 \rightarrow (NH_4)HCO_3$

B $NH_3 + CH_3CH_2Br \rightarrow CH_3CH_2NH_2 + HBr$

C $NH_3 + HNO_2 \rightarrow N_2 + 2H_2O$

D $NH_3 + NaH \rightarrow NaNH_2 + H_2$

13 The table gives the concentrations and pH values of the aqueous solutions of two compounds, **X** and **Y**. Either compound could be an acid or a base.

	X	**Y**
concentration	2 mol dm^{-3}	2 mol dm^{-3}
pH	6	9

Which of the following statements are true?

1 Student **P** concluded that **X** is a strong acid.

2 Student **Q** concluded that **Y** is a strong base.

3 Student **R** concluded that **X** is a weak acid.

4 Student **S** concluded that the extent of dissociation is smaller in **X**(aq) than in **Y**(aq).

A 3 and 4

B 3 only

C 2 and 4

D 1 and 2 only

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

The standard cell potentials for the redox equilibria of aqueous vanadium-containing ions and the colours of these ions are given below.

$VO_2^+ + 2H^+ + e \rightleftharpoons H_2O + VO^{2+}$ $\quad E^\ominus = +1.00$ V
yellow blue

$VO^{2+} + 2H^+ + e \rightleftharpoons H_2O + V^{3+}$ $\quad E^\ominus = +0.34$ V
blue green

$V^{3+} + e \rightleftharpoons V^{2+}$ $\quad E^\ominus = -0.26$ V
green purple

What is likely to be the final colour when excess metallic zinc is added to a solution containing VO^{2+}?

A yellow

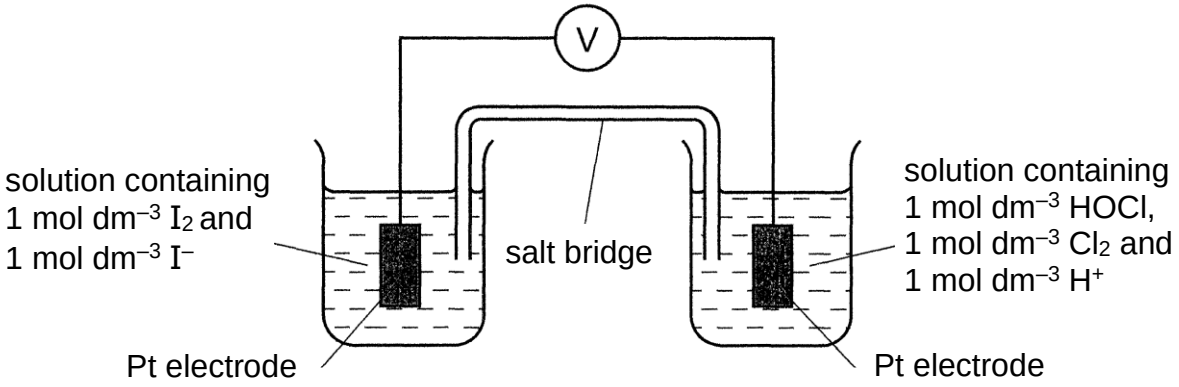
B blue

C green

D purple

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

The following electrochemical cell was set up.



Which of the following statements are true?

1 The $E\ominus_{cell}$ of the above reaction is +1.10 V.

2 An increase in surface area of the Pt electrode will cause an increase in the $E\ominus_{cell}$.

3 The ΔG of the above reaction is +212.3 kJ mol^{-1}.

4 When silver nitrate crystals are added to the I_2/I^- half cell, $E\ominus_{cell}$ becomes less positive.

A 1 and 4 only

B 1 and 3 only

C 1, 2 and 3

D 1, 3 and 4

16 Which group of particles is in order of increasing size?

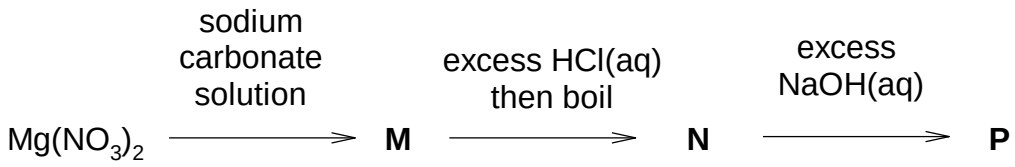
A N O F

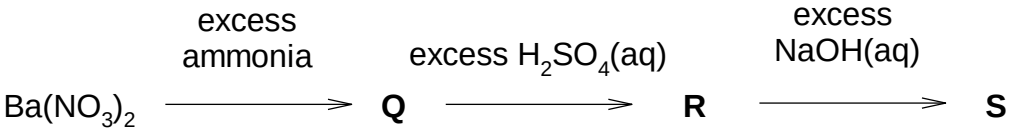
B N^{3-} O^{2-} F^-

C Na^+ Mg^{2+} Al^{3+}

D Na^+ Ne F^-

17 Solutions of 0.1 mol dm^{-3} $Mg(NO_3)_2$ and 0.1 mol dm^{-3} $Ba(NO_3)_2$ separately undergo a series of reactions using pure reagents.





M, **N** and **P** are magnesium compounds. **Q**, **R** and **S** are barium compounds. How many of **M, N, P, Q, R** and **S** are white precipitates?

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

18 Properties of chlorine, iodine and their compounds are compared. Property **Q** of chlorine is greater than that of iodine.

What can property **Q** be?

1 oxidising ability of the element

2 solubility of the silver halide in $NH_3(aq)$

3 strength of intermolecular forces between molecules of the element

4 thermal decomposition temperature of the hydrogen halide

A 1 and 2 only

B 3 and 4 only

C 1, 2 and 3 only

D 1, 2 and 4 only

19 The following report appeared in a newspaper.

Drums of liquid bromine broke open after a vehicle crash on the motorway. Traffic was diverted as orange gaseous bromine drifted over the road (it is denser than air), causing irritation to drivers' eyes. Firemen sprayed water over the scene of the accident, dissolving the bromine and washing it away.

What is **wrong** with the report?

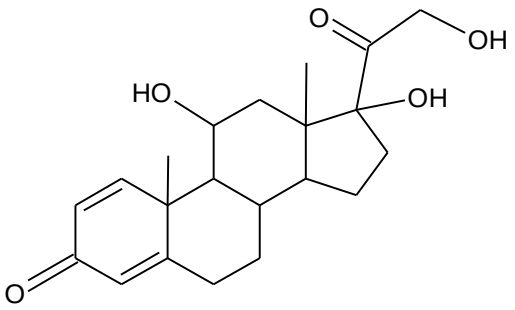
A Bromine does not dissolve in water.

B Bromine does not vapourise readily.

C Bromine is less dense than air.

D Gaseous bromine is not orange.

20 The drug prednisolone has the formula shown.



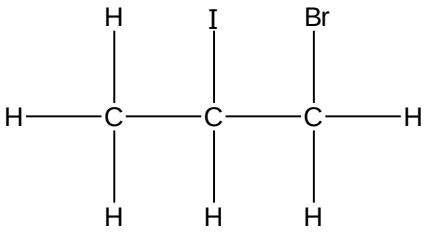
How many chiral centres are present in the prednisolone molecule?

A 6 **B** 7 **C** 8 **D** 9

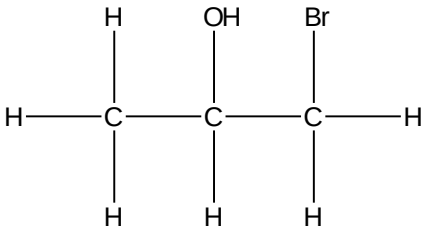
21 When propene reacts with iodine monobromide, IBr in the presence of concentrated aqueous sodium nitrate, a mixture of products is obtained.

Which of the following is a possible major product formed in this reaction?

A



B



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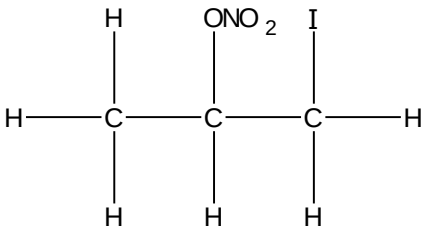
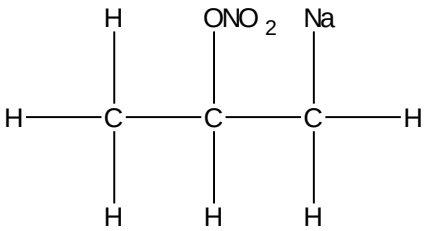


D



22 Which of the following reactions result in the largest change in M_r of the organic compound?

A ethene with cold, dilute acidified $KMnO_4$

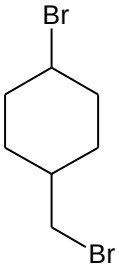
B ethylbenzene with hot, dilute acidified $KMnO_4$

C chloroethane with excess NH_3 heated in a sealed tube

D chloroethane with ethanolic NaCN heated under reflux, followed by $LiAlH_4$ in dry ether

23 Which compounds, on heating with ethanolic sodium hydroxide, produce **only** one product with molecular formula C_7H_{10}?

1



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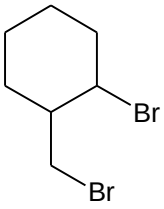

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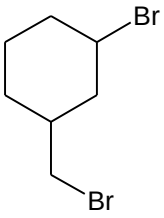


A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 only

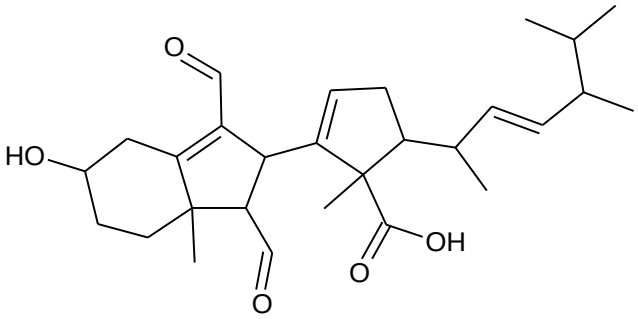
24 When a substance **X** is shaken with aqueous silver nitrate at room temperature, there is no immediate precipitate. However, when **X** is boiled under reflux for some time with aqueous sodium hydroxide, cooled, acidified with dilute nitric acid and aqueous silver nitrate added, a white precipitate readily forms.

What could **X** be?

A $CH_3CH_2CH_2CH_2Cl$ **B** CH_3COCl

C C_6H_5Cl **D** C_6H_5COCl

25 Solanioic acid has been isolated from the fungus *Rhizoctonia solani* obtained from tubers of the medicinal plant *Cyperus rotundus*.



solanioic acid

When solanioic acid is first treated with hydrogen in the presence of a platinum catalyst, and then the product of this reaction is treated with hot acidified $KMnO_4$, a final product **S** is obtained.

How many atoms of hydrogen in each molecule of product **S** can be displaced with sodium metal?

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

26 Which salt will be the least basic in aqueous solution?

A $CH_3CH_2CH_2COO^- Na^+$

B $CH_3CH_2CHClCOO^- Na^+$

C $ClCH_2CH_2CH_2COO^- Na^+$

D $H_2NCH_2CH_2COO^- Na^+$

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

A sample of ethyl propanoate is hydrolysed by heating under reflux with aqueous sodium hydroxide. The two organic products of the hydrolysis are separated, purified and weighed.

Out of the total mass of products obtained, what is the percentage by mass of each product?

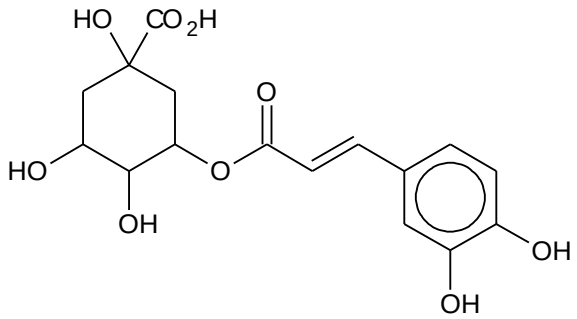
A 32.4 % and 67.6 %

B 38.3 % and 61.7 %

C 41.5 % and 58.5 %

D 42.3 % and 57.7 %

28 Chlorogenic acid is the major polyphenolic compound in coffee, isolated from the leaves and fruits of dicotyledonous plants.



chlorogenic acid

Which statements about chlorogenic acid are correct?

1 1 mol of chlorogenic acid reacts with 4 mol of Br_2(aq).

2 1 mol of chlorogenic acid reacts with 4 mol of HBr(g).

3 Effervescence was observed when chlorogenic acid was heated with acidified $K_2Cr_2O_7$(aq).

4 Orange precipitate was observed when chlorogenic acid was warmed with 2,4-dinitrophenylhydrazine.

A 1 only

B 1 and 2 only

C 2 and 4 only

D 1, 2 and 3 only

29 Which reaction does **not** yield a carbon compound incorporating deuterium, D? [D = ^{2}H]

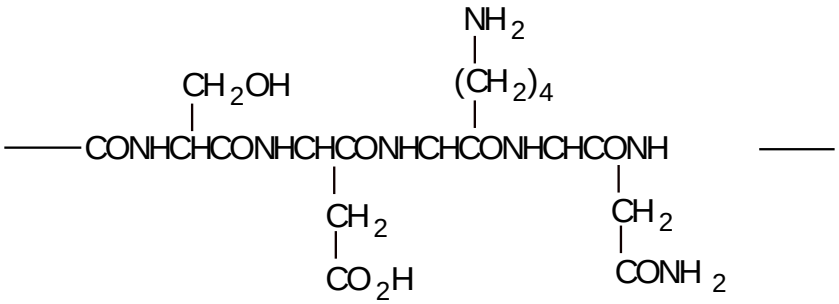
A $CH_3CH{=}CHCH_3 \xrightarrow[D_2O]{Br_2}$

B $CH_3CH_2CH(OH)CH_2I \xrightarrow[D_2O]{I_2,\ NaOD,}$

C $CH_3CH_2CONHCH_3 \xrightarrow[\text{dry ether}]{LiAlD_4}$

D $(CH_3)_3COD \xrightarrow[\text{heat}]{\text{conc } D_2SO_4}$

30 Part of a polypeptide chain is shown below.



Which statements about the amino acids that make up this part of the polypeptide are correct?

1 They are α–amino acids.

2 They are soluble in water predominantly due to the formation of intermolecular hydrogen bonding.

3 When they are separated by electrophoresis buffered at pH 2, only one of the species will migrate to the cathode.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1 only