Section A

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

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

What is the number of atoms in 500 cm^3 of oxygen under room conditions?

A 1.25×10^{22} **B** 1.34×10^{22} **C** 2.50×10^{22} **D** 2.68×10^{22}

2 A pure hydrocarbon is used in bottled gas for cooking and heating.

When 10 cm^3 of the hydrocarbon is burned in 70 cm^3 of excess oxygen, the final gaseous mixture contains 30 cm^3 of carbon dioxide and 20 cm^3 of unreacted oxygen. All gaseous volumes were measured under identical conditions.

What is the formula of the hydrocarbon?

A C_2H_6 **B** C_3H_6 **C** C_3H_8 **D** C_4H_{10}

3 Oxygen difluoride, OF_2, will react with sulfur dioxide, SO_2, according to the following equation:

$$OF_2 + SO_2 \rightarrow SO_3 + F_2$$

What is oxidised and what is reduced in this reaction?

	fluorine	oxygen in OF_2	sulfur
A	oxidised	oxidised	reduced
B	oxidised	reduced	oxidised
C	reduced	oxidised	reduced
D	reduced	reduced	oxidised

4 A radioactive isotope of thallium, $^{81}_{201}Tl$, is used to assess damage in heart muscles after a heart attack.

Which one of the following statements about $^{81}_{201}Tl$ is correct?

A $^{82}_{201}Tl$ is an isotope of $^{81}_{201}Tl$.

B This isotope has a nucleon number of 120.

C The number of neutrons in one atom of this isotope is 201.

D The number of electrons in one atom of this isotope is 81.

5 Gallium nitride, GaN, could revolutionise the design of electric light bulbs because only a small length used as a filament gives excellent light at low cost.

GaN is an ionic compound containing the Ga^{3+} ion.

Which one of the following statements about GaN is **not** correct?

A The outer electronic configuration of Ga atom is $4s^2 4p^1$ since Ga is a Group 13 element.

B The electron arrangement of the nitrogen ion in GaN is $1s^2\ 2s^2\ 2p^3$.

C The electron arrangement of the nitrogen ion in GaN is $1s^2\ 2s^2\ 2p^6$.

D Ga^{3+} ion deflects less than Al^{3+} ion in an electric field.

6 Sodium borohydride, $NaBH_4$, and boron trifluoride, BF_3, are compounds of boron.

What are the shapes around boron in the borohydride ion and in boron trifluoride?

	borohydride ion	boron trifluoride
A	square pyramidal	trigonal pyramidal
B	square pyramidal	trigonal planar
C	tetrahedral	trigonal pyramidal
D	tetrahedral	trigonal planar

7 Why does aluminium chloride, Al_2Cl_6, sublime at a relatively low temperature of 180 °C?

A The intermolecular forces between Al_2Cl_6 molecules are weak.

B The co-ordinate bonds between Al and Cl atoms are weak.

C The covalent bonds between Al and Cl atoms are weak.

D The ionic bonds between Al^{3+} and Cl^- ions are strong.

8 The standard enthalpy changes of formation of iron(II) oxide, FeO(s), and aluminium oxide, Al_2O_3(s), are –266 kJ mol^{-1} and –1676 kJ mol^{-1} respectively.

What is the enthalpy change under standard conditions for the following reaction?

$$3FeO(s) + 2Al(s) \rightarrow 3Fe(s) + Al_2O_3(s)$$

A +878 kJ mol^{-1}

B –878 kJ mol^{-1}

C –1410 kJ mol^{-1}

D –2474 kJ mol^{-1}

9 Some bond energy values are listed below.

bond	bond energy / kJ mol^{-1}
C–H	410
C–C*l*	340
C*l*–C*l*	244
Br–Br	193

These bond energy values relate to the following four reactions.

P $Br_2 \rightarrow 2Br$

Q $2Cl \rightarrow Cl_2$

R $CH_3 + Cl \rightarrow CH_3Cl$

S $CH_4 \rightarrow CH_3 + H$

What is the order of enthalpy changes of these reactions from most negative to most positive?

A **P** → **Q** → **R** → **S**

B **Q** → **R** → **S** → **P**

C **R** → **Q** → **P** → **S**

D **S** → **P** → **Q** → **R**

10 One mole of phosphorus(V) chloride, PCl_5, is heated to 600 K in a sealed flask of volume 1 dm^3.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

Equilibrium is established and measurements are taken.

The experiment is repeated with one mole of PCl_5 heated to 600 K in a sealed flask of volume 2 dm^3.

How will the measurements vary?

A The equilibrium concentration of $PCl_5(g)$ is lower in the second experiment.

B The equilibrium concentrations of all three gases are the same in both experiments.

C The equilibrium concentrations of $PCl_3(g)$ and $Cl_2(g)$ are higher in the second experiment.

D The value of the equilibrium constant is higher in the second experiment.

11 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

A mixture of 2.00 mol of nitrogen, 6.00 mol of hydrogen, and 2.40 mol of ammonia is allowed to reach equilibrium in a sealed vessel of volume 1 dm^3 under certain conditions. It was found that 2.32 mol of nitrogen were present in the equilibrium mixture.

What is the value of K_c under these conditions?

A $\dfrac{(2.40)^2}{(2.32)(6.00)^3}$

B $\dfrac{(2.08)^2}{(2.32)(6.32)^3}$

C $\dfrac{(1.76)^2}{(2.32)(6.96)^3}$

D $\dfrac{(1.76)^2}{(2.32)(6.32)^3}$

12 A buffer solution is composed of HCO_3^- and CO_3^{2-}.

What is the overall ionic equation that represents the reaction of hydrochloric acid with this buffer?

A $HCl(aq) + HCO_3^-(aq) \rightarrow Cl^-(aq) + H_2CO_3(aq)$

B $H_3O^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + HCO_3^-(aq)$

C $H_3O^+(aq) + HCO_3^-(aq) \rightarrow H_2O(l) + H_2CO_3(aq)$

D $HCl(aq) + CO_3^{2-}(aq) \rightarrow Cl^-(aq) + HCO_3^-(aq)$

13 Magnesium hydroxide dissolves in aqueous ammonium chloride, but not in aqueous sodium chloride.

Which one of the following statements explains this observation?

A The NH_4^+ ion acts as an acid.

B NH_4Cl dissociates less fully than $NaCl$.

C Na^+ and Mg^{2+} ions are isoelectronic (have the same number of electrons).

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

14 An experiment was carried out to investigate the initial rate of reaction between ammonium peroxodisulphate, $(NH_4)_2S_2O_8$, an oxidising agent, and potassium iodide, KI.

The initial concentrations of the $(NH_4)_2S_2O_8$ and KI solutions in the mixture together with the time taken for the mixture to darken for the various experimental runs are given below.

initial concentration of $(NH_4)_2S_2O_8$ / mol dm^{-3}	initial concentration of KI / mol dm^{-3}	time taken to darken / s
0.10	0.20	35
0.05	0.20	70
0.10	0.067	105
0.02	0.75	?

What is the expected time taken (in s) to darken when the experiment is repeated using initial concentrations of $(NH_4)_2S_2O_8$ and KI to be 0.02 mol dm^{-3} and 0.75 mol dm^{-3} respectively?

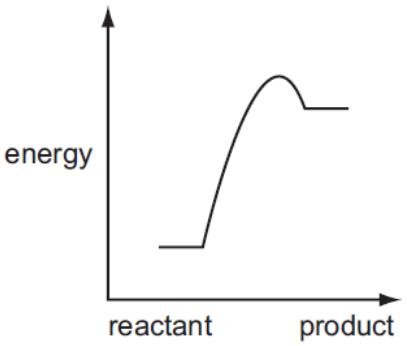
A 40 **B** 47 **C** 60 **D** 72

15 Four reactions of the type shown below are studied at the same temperature:

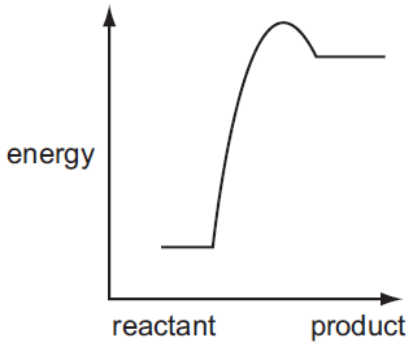
$$X(g) + Y(g) \rightarrow Z(g)$$

Which one of the following is the correct reaction pathway diagram for the reaction that would proceed most rapidly and with good yield?

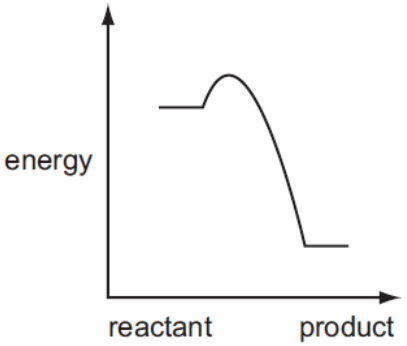
A



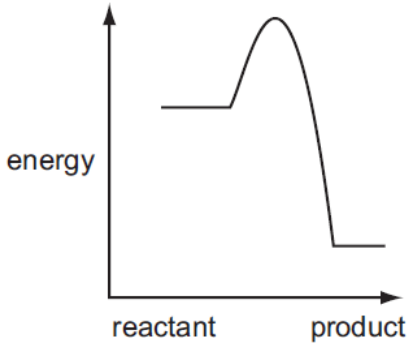
B



C



D



16 Elements **W**, **X**, **Y** and **Z** have proton numbers less than 18. They occupy the following Groups in the Periodic Table.

Element	**W**	**X**	**Y**	**Z**
Group	12	14	15	16

Which two elements could combine to form a compound with giant molecular structure?

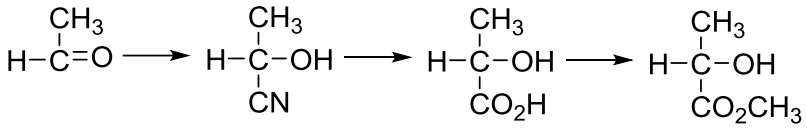
A **W** and **X**
B **W** and **Z**
C **X** and **Y**
D **X** and **Z**

17 Element **A** does not react with cold water but reacts vigorously when burnt in chlorine gas to give its chloride. The chloride dissolves in water to give a solution with pH of approximately 3.

What is element **A**?

A Mg
B A*l*
C Si
D P

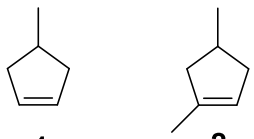
18 A reaction sequence is shown below:



Which one of the following reactions is **not** shown in the reaction sequence?

A addition
B condensation
C hydrolysis
D oxidation

19 The diagram shows two different compounds



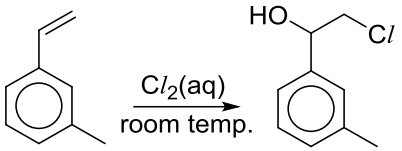
1 **2**

What is the total number of constitutional (structural) isomers, including **compound 2** that could be formed by adding a second methyl group to the ring of **compound 1**?

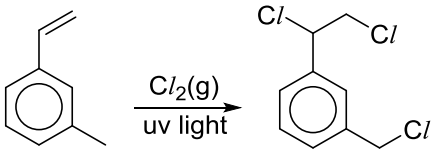
A 2 **B** 3 **C** 4 **D** 5

20 Which one of the following products is **unlikely** to form based on the given reagents and conditions?

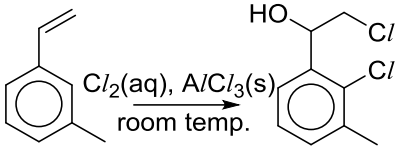
A



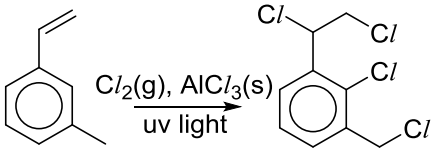
B



C

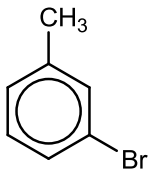


D

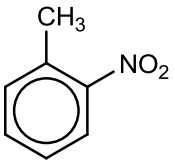


21 Which one of the following compounds **cannot** be made directly from methylbenzene?

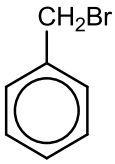
A



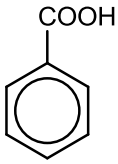
B



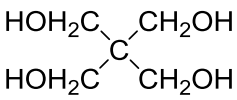
C



D



22 The structure of *pentaerythritol* is shown below. It is used in the manufacture of paint.



pentaerythritol

Which one of the following statements best describes a single molecule of *pentaerythritol*?

A It has an empirical formula of CH_3O.

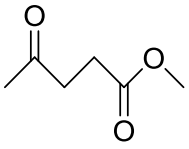
B It has a planar arrangement about the five carbon atoms.

C It reacts with hot excess concentrated sulfuric acid to form alkenes.

D It reacts with carboxylic acid in the presence of hot concentrated sulfuric acid to form esters.

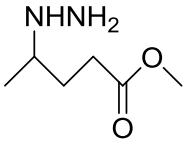
23 Hydrazine, NH_2NH_2, undergoes condensation reaction with carbonyl compounds, similar to 2,4–dinitrophenylhydrazine.

Which one of the following is likely to be the product when compound **Y** reacts with hydrazine?

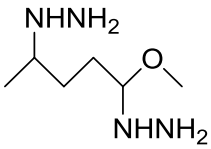


compound **Y**

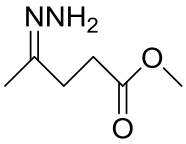
A



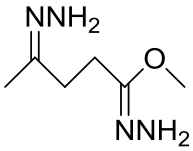
B



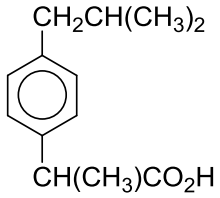
C



D

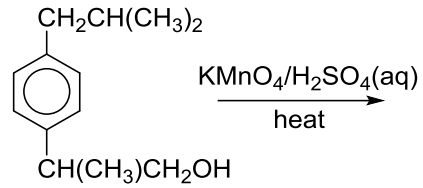


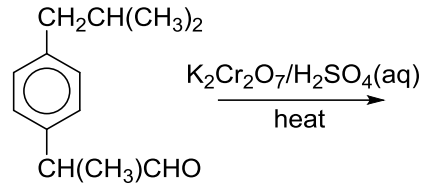
24 *Ibuprofen* is an anti-inflammatory drug.

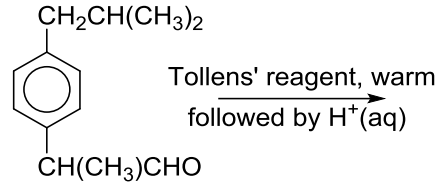


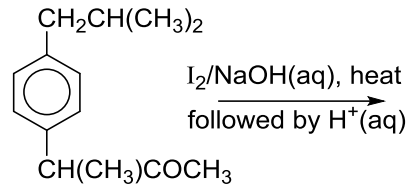
ibuprofen

Which one of the following reactions is **unlikely** to lead to its formation?

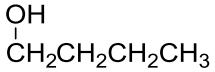
A 

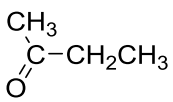
B 

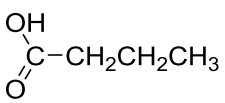
C 

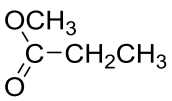
D 

25 How many of the following compounds can react with hot aqueous sodium hydroxide to form a sodium salt?









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

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.

26 In which of the following pairs do **A** have a higher boiling point than **B**?

	A	B
1	CH_3CH_2CN	$CH_3CH_2CH_2CH_3$
2	$H_2C{=}CHCH_2OH$	CH_3CH_2CHO
3	$CH_3CH_2CH_2I$	$CH_3CH_2CH_2Cl$

27 Carboxylic acids react with alcohols to form esters in an equilibrium reaction as shown:

$$CH_3COOH(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3COOCH_2CH_3(l) + H_2O(l) \qquad \Delta H > 0$$

Which of the following will lead to an increase in the yield of the ester?

1 Heating the mixture

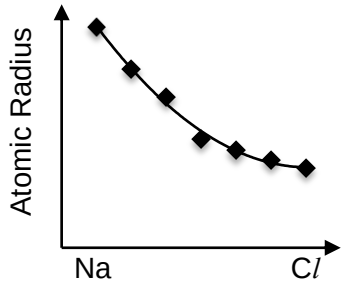
2 Adding water into the mixture

3 Adding excess sodium hydroxide into the mixture

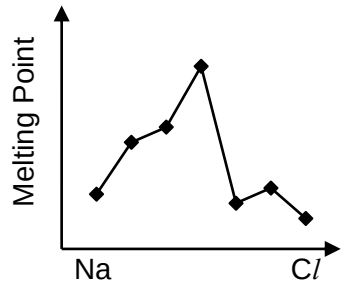
A	B	C	D
1, 2 and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

28 Which of the following graphs show the correct trend of the respective physical properties of elements across the third period (Na to C*l*)?

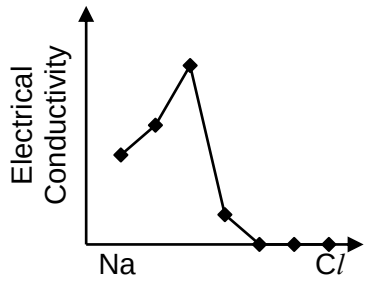
1



2



3



29 Hep–4–enal is present in cow's milk.

$CH_3CH_2CH{=}CHCH_2CH_2CHO$

hep–4–enal

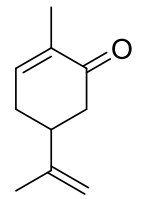
Which of the following options show the correct product for the indicated reducing agent?

1 with H_2/Ni $CH_3CH_2CH_2CH_2CH_2CH_2CHO$

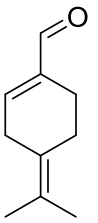
2 with $NaBH_4$ $CH_3CH_2CH{=}CHCH_2CH_2CH_2OH$

3 with $LiAlH_4$ $CH_3CH_2CH{=}CHCH_2CH_2CH_2OH$

30 The structures of two carbonyl derivatives of cyclohexene are shown below.



compound **W**



compound **X**

Which of the following statements about the two molecules are likely to be correct?

1 **W** and **X** cannot exhibit cis–trans isomerism.

2 **W** and **X** can be distinguished using Fehling's solution.

3 **W** and **X** can undergo addition reaction with hot alcoholic NaCN.

VICTORIA JUNIOR COLLEGE

2017 JC2 PRELIM EXAMINATIONS

H1 CHEMISTRY PAPER 1 ANSWERS

1	**C**	6	**D**	11	**C**	16	**D**	21	**A**	26	**A**
2	**C**	7	**A**	12	**B**	17	**B**	22	**D**	27	**D**
3	**B**	8	**B**	13	**A**	18	**D**	23	**C**	28	**A**
4	**D**	9	**C**	14	**B**	19	**B**	24	**A**	29	**C**
5	**B**	10	**A**	15	**C**	20	**C**	25	**B**	30	**B**