

## PART 1

1. Measured values of the pressure, volume and temperature of a known mass of a gaseous compound are to be substituted into the equation  $pV = nRT$  in order to calculate the relative molecular mass,  $M_r$ , of the compound. Which conditions of pressure and temperature would give the most accurate value of  $M_r$ ?

	Pressure	Temperature
<b>A</b>	High	High
<b>B</b>	High	Low
<b>C</b>	Low	High
<b>D</b>	Low	Low

2. Which of the following solids has a simple molecular lattice?

- A magnesium oxide
- B sodium
- C silicon (IV) oxide
- D sulphur

3. Which pollutant is formed in the internal combustion engine and, if not removed by the catalytic converter, may become involved in the formation of acid rain?

- A C      B  $C_8H_{18}$       C CO      D NO

4. Which reaction is not an electrophilic addition?

- A  $CH_2=CH_2 + HI \rightarrow CH_3CH_2I$
- B  $CH_3CH=CH_2 + Br_2 \rightarrow CH_3CHBrCH_2Br$
- C  $CH_3CH=CH_2 + H_2O \rightarrow CH_3CH(OH)CH_3$
- D  $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$

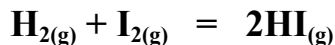
5. Gaseous phosphorus pentachloride can be decomposed into gaseous phosphorus trichloride and chlorine by heating. The table below gives the bond energies.

Bond	Bond Energy / $KJmol^{-1}$
P-Cl (in both chlorides)	330
Cl-Cl	240

What is the enthalpy change in the decomposition of  $PCl_5$  to  $PCl_3$  and  $Cl_2$ ?

- A  $-420 \text{ kJ mol}^{-1}$       B  $-90 \text{ kJ mol}^{-1}$       C  $+90 \text{ kJ mol}^{-1}$       D  $+420 \text{ kJ mol}^{-1}$

6. When 0.20 mol of hydrogen gas and 0.15 mol of iodine gas are heated at 723 K until equilibrium is established, the equilibrium mixture is found to contain 0.26 mol of hydrogen iodide. The equation for the reaction is as follows.



What is the correct expression for the equilibrium constant  $K_c$ ?

A  $\frac{2 \times 0.26}{0.20 \times 0.15}$

B  $\frac{(2 \times 0.26)^2}{0.20 \times 0.15}$

C  $\frac{(0.26)^2}{0.07 \times 0.02}$

D  $\frac{(0.26)^2}{0.13 \times 0.13}$

7. Why is ethanoic acid a stronger acid in liquid ammonia than in aqueous solution?

A Ammonia is a stronger base than water.

B Ammonium ethanoate is completely ionised in aqueous solution.

C Ammonium ethanoate is strongly acidic in aqueous solution.

D Liquid ammonia is a more polar solvent than water.

8. It is often said that the rate of a typical reaction is roughly doubled by raising the temperature by 10°C. What explains this observation?

A Raising the temperature by 10°C doubles the average energy of each molecule.

B Raising the temperature by 10°C doubles the average velocity of the molecules.

C Raising the temperature by 10°C doubles the number of molecular collisions in a given time.

D Raising the temperature by 10°C doubles the number of molecules having more than a certain minimum energy.

9. A mixture of the oxides of two elements of the third period is dissolved in water. The solution is approximately neutral. What could be the constituents of the mixture?

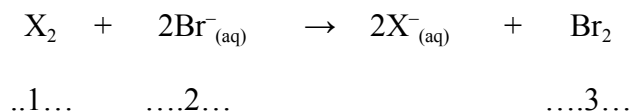
A  $\text{Al}_2\text{O}_3$  and  $\text{MgO}$

B  $\text{Na}_2\text{O}$  and  $\text{MgO}$

C  $\text{Na}_2\text{O}$  and  $\text{P}_4\text{O}_{10}$

D  $\text{SO}_3$  and  $\text{P}_4\text{O}_{10}$

10. The equation shows the reaction between a halogen and aqueous bromide ions.



Which words should be written in gaps 1, 2 and 3?

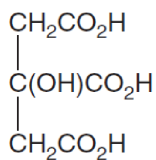
	1	2	3
<b>A</b>	chlorine	brown	colorless
<b>B</b>	chlorine	colorless	brown
<b>C</b>	iodine	brown	colorless
<b>D</b>	iodine	colorless	brown

## PART 2

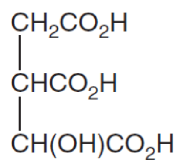
11. How many structural and *cis-trans* isomers are there for dichloropropene,  $C_3H_4Cl_2$ ?

**A** 3      **B** 5      **C** 6      **D** 7

12. The isomers, citric acid and isocitric acid, are intermediates in the Krebs cycle of the oxidation of glucose in living cells.



citric acid



isocitric acid

How many chiral centres does each acid possess?

	citric acid	isocitric acid
<b>A</b>	0	1
<b>B</b>	0	2
<b>C</b>	1	1
<b>D</b>	1	2

13. In its reaction with sodium, 1 mol of a compound X gives 1 mol of  $H_2(g)$ . Which compound might X be?

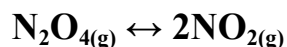
A  $CH_3CH_2CH_2CH_2OH$

B  $(CH_3)_3COH$

C  $CH_3CH_2CH_2CO_2H$

D  $CH_3CH(OH)CO_2H$

14. If  $N_2O_4$  gas is placed in a sealed vessel the following equilibrium is established.



The forward reaction is endothermic. What happens when the temperature is increased?

1. The equilibrium constant increases.

2. The partial pressure of  $NO_2$  increases.

3. The activation energy is unchanged.

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

15. Which types of bonding are present in ammonium carbonate,  $(NH_4)_2CO_3$ ?

1. ionic

2. covalent

3. co-ordinate (dative covalent)

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

### PART 3

16. Sulfur dioxide and sulfites are used in food preservation. Why are they used for this purpose?

1. They are reducing agents which slow down the oxidation of food.

2. They inhibit the growth of aerobic bacteria.

3. They react with  $NO_{2(g)}$  converting it to  $NO_{(g)}$ .

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

17. The organic compound X gives a precipitate when warmed with aqueous silver nitrate. This precipitate dissolves when concentrated aqueous ammonia is added.

What is a possible identity for X?

1. 1-bromopropane

2. 2-chlorobutane

3. 2-iodo,2-methylpropane

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

18. An organic compound Y, molecular formula  $C_6H_{14}O$ , may be oxidised to compound Z, molecular formula  $C_6H_{12}O_2$ .

What could be the structural formula of Y?

1.  $CH_3CH_2CH(CH_2OH)CH_2CH_3$

2.  $(CH_3)_3CCH_2CH_2OH$

3.  $CH_3CH_2CH(CH_3)CH_2CH_2OH$

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

19. Which reactions can be used to make an alcohol in the laboratory?

1. hydrolysis of a bromoalkane with  $NaOH_{(aq)}$

2. reduction of a ketone with  $NaBH_4$

3. reduction of an aldehyde with  $NaBH_4$

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

20. The compounds below are treated with hydrogen cyanide.

Which compounds react and produce a molecule containing a chiral centre?

1. butanal

2. pentan-3-one

3. 2-chlorobutane

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

1. C
2. D
3. D
4. D
5. D
6. C
7. A
8. D
9. C
10. B
11. D
12. B
13. D
14. A
15. A
16. B
17. B
18. A
19. A
20. D