SGHS
CHEMISTRY
Final Preliminary Examination
2001

Name…………………………

Instructions:
Time allowed: 70 minutes + 5 minutes reading time
All answers are to be written on the answer sheet provided.
A Periodic Table is provided.
Part A consists of 15 multiple choice worth one mark each.
Part B consists of questions of different indicated values worth a total of 30 marks.

PART A

Select the best of the alternative choices and fill in the appropriate space on the answer sheet provided.

1   Which of the following has the same number of electrons as the chloride ion ?

        A   potassium ion
        B   calcium atom
        C   neon atom
        D   fluoride ion

2   Dinitrogen pentoxide reacts with water to form nitric acid. Which of the following equations correctly represents this chemical reaction ?

        A $N_2O_5 + 2 H_2O \rightarrow 2H_2NO_3$
        B $N_5O_2 + 5H_2O \rightarrow 5H_2NO_3$
        C $N_2O_5 + H_2O \rightarrow 2HNO_3$
        D $2N_5O_2 + 5H_2O \rightarrow 10HNO_3$

3   The correct formula for silver (II) sulfide is

        A Ag_2S
        B AgS
        C Ag_2SO_4
        D Ag_2SO_3

4   Which of the following roles of water in the biosphere would be described as a chemical role?

A   Water is required for photosynthesis.
B   Water transports dissolved gases through our bloodstream.
C   Water moderates the temperature of living cells with its high specific heat.
D   Water allows nutrients to pass into cells by diffusion.

5   0.36 g of sodium nitrate was dissolved in 250 mL of water. The concentation of this solution is calculated in ppm. Select the correct value for this calculation.

A   1.44
B   90
C   900
D   1440

The table below relates to question 6 and 7. The table shows the atomic radius and the first ionisation energies for 6 consecutive elements of the periodic table.

Element	A	B	C	D	E	F
Atomic radius (nm)	50000	152000	112000	88000	77000	70000
Ionisation energy (kJ/mol)	1357	409	556	606	768	953

6   Ionization energy and atomic radius provide useful information about atoms and their position in the periodic table.
Which of the following statements is correct ?

A   Ionisation energy and atomic radius decrease across a row in the periodic table.
B   Ionisation energy and atomic radius increase down a group in the periodic table
C   Ionisation energy increases and atomic radius decreases across a row in the periodic table
D   Ionisation energy decreases and atomic radius increases across a row in the periodic table.

7   Which of the following statements is correct about the elements in the table?

A   Element C reacts with element F to form a covalent molecule
B   Element D forms a diatomic molecule in the gaseous state at $25°C$
C   Elements E and A form an ionic compound
D   Element B forms a metallic lattice with a delocalised sea of electrons.

8 A sample of carbon dioxide occupies a volume of 4.0 L at 101.3 kPa and 25 $^{\circ}$C.(SLC)
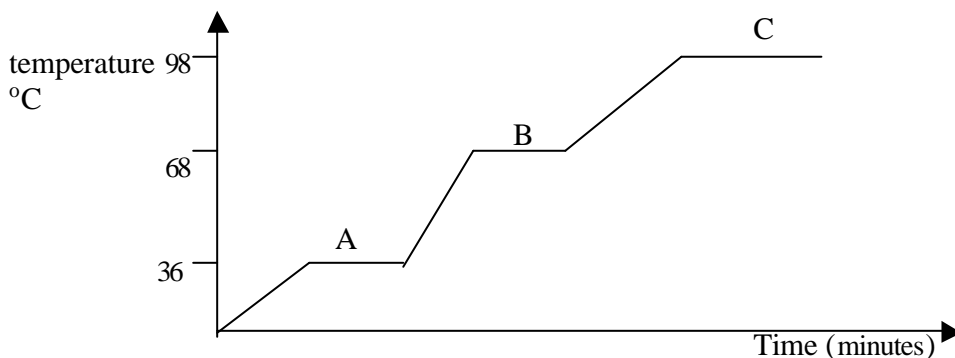Which of the following is a true statement.

A   The sample contains 0.16 moles of carbon dioxide.
B   The sample contains 1.5×10^{23} molecules of carbon dioxide
C   The same volume of oxygen at SLC would contain the same number of atoms
D   The same volume of oxygen at SLC would have the same mass as the carbon dioxide.

9 Ammonia (NH_3) has a higher boiling point than phosphine (PH_3). Which of the following is the best explanation for this experimental fact ?

A   The N-H bonds in ammonia are stronger than the P-H bonds in phosphine.
B   Ammonia is a heavier molecule than phosphine so dispersion forces are greater.
C   Ammonia is a symmetrical polar molecule but phosphine is not symmetrical.
D   Nitrogen is more electronegative than phosphorus, so ammonia is more polar.

10 A student was asked to separate a mixture of the liquid hydrocarbons heptane, hexane and pentane, using fractional distillation. She measured how the temperature of the experiment varied with time and collected three separate fractions. The graph below shows her measurements. A, B and C are the boiling points of the fractions.

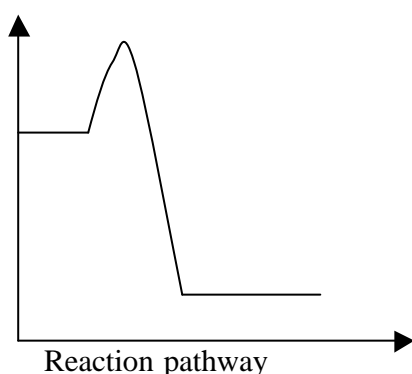Which of the following statements is correct ?

A   The first fraction collected was hexane.
B   Fraction C has the greatest activation energy.
C   Fraction A has the smallest dispersion forces.
D   Pentane has a boiling point of 68 $^{\circ}$C.

11 A water bath containing 200 mL of water was heated to 50°C using 0.01 moles of burning ethanol. The heat of combustion of ethanol is 1367 kJ mol^{-1}. The specific heat for water is 4.2 Jg^{-1} K^{-1}. Which of the following is the initial temperature of the water?

    A   28.7 °C
    B   33.7 °C
    C   36.3 °C
    D   43.5 °C

12 The graph below represents the energy profile of a chemical reaction.

Reaction pathway

Which of the following statements about the reaction could be true?

    A   The energy required to break bonds is greater than the energy of bond formation.
    B   A combustion reaction with an alkane fuel has occurred.
    C   Water has been electrolysed to form oxygen and hydrogen gas.
    D   Glucose has been manufactured by photosynthesis in the presence of a catalyst.

13 For reactions in solution, increasing the concentration of reactants results in increased reaction rate. Which of the following reasons explains this experimental observation ?

    A   The percentage of particles with greater energy than the activation energy increases.
    B   Increasing concentration tends to lower the activation energy for the reaction.
    C   A higher frequency of particle collisions results in a higher frequency of successful collisions.
    D   Increased kinetic energy of the particles results in a larger proportion of successful collisions.

Questions 14 and 15 refer to the following information

120 mL of 0.35 mol L^{-1} sulfuric acid was added to 25 mL of 0.38 mol L^{-1} sodium hydroxide.

14   Select the correct alternative for the reaction from the table below.

	Number of moles of NaOH	Number of moles of H_2SO_4	Limiting reagent
A	0.0095	0.0070	NaOH
B	0.0095	0.0070	H_2SO_4
C	9.5	7.00	NaOH
D	9.5	7.00	H_2SO_4

15.   Which of the following correctly predicts the number of moles of water formed in the reaction.

A   0.0095 g
B   0.0140 g
C   4.75 g
D   7.00 g

PART B

Marks allocated to each question are indicated on the question paper.

Q16   An element X reacts with another element Y to form a compound with the formula XY_2. Some properties of X, Y and XY_2 are listed below.   4

| Substance | Melting point °C | Electrical conductivity | |
		of solid material	of liquid material
X	1018	high	high
Y	88	none	none
XY_2	935	none	high

Give the name of two elements which could be X and Y.   Justify your choice using the information provided.

Q17   (i)   Draw a molecular model made to represent the pr opene molecule.   1

(ii)   Write a balanced equation, using molecular formula and including the energy term, for the complete combustion of propene. The heat of combustion for propene is 2058 kJ mol^{-1}.   2

(iii)   Draw to scale an energy profile diagram for the combustion of propene. The activation energy for the reaction is 267 kJ.   2

Q18   (i)   Name three allotropes of carbon.   1

(ii)   Use one of these allotropes to explain the relationship between its structure and its physical properties   2

(iii)   Compare the chemical properties of the allotropes.   1

Q19   Examine the table below which describes the history of metal discovery.

Metal	Mineral	Mineral Composition	Discovered	Early method of extraction
sodium	halite	hydrated NaCl	1807	From mineral using electrolysis
magnesium	dolomite	$MgCO_3/CaCO_3$	1808	
aluminium	corundum	$Al_2O_3.3H_2O$	1825	
iron	haematite	Fe_2O_3	Iron Age	From mineral by heating with carbon
lead	galena	PbS		
copper	malachite	$CuCO_3/Cu(OH)_2$	Bronze age	
gold	gold		Early civilisation	Found naturally

(i)   Using a specific mineral from the table above describe how a mineral is different
       to the metal extracted from it, in terms of
       (a) a chemical property of the mineral and the metal
       (b) a physical property of the mineral and the metal.   4

(ii)   Is carbon acting as a catalyst when it is used to extract iron from haematite ?
       Explain using an equation in your answer.   2

(iii) Explain why the extraction of copper from its mineral in early furnaces lead to the
       bronze age and not to the copper age.   1

(iv)   Assess the relationship between technology and the discovery of different metals.
                                                                               2

Q20.   Measured volumes of hydrochloric acid of unknown concentration were added to
       a 0.40 g strip of magnesium. The hydrogen gas evolved was passed into a
       syringe where its volume was measured at SLC (101.3 kPa and 25°C).
       The following results were obtained.

Volume of HCl added (mL)	50	100	150	200	250	300
Volume of gas produced (mL at SLC)	112	224	336	402	402	402

(i)   Draw a graph of these results on the grid provided.   3

(ii)   Describe and explain the shape of the graph.   2

(iii) Calculate the molarity of the hydrochloric acid.   Use your graph.   3

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PART B

Q16 _____

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Q17 (i)

(ii)

(iii)

Q18   (i)   _____

       (ii)   _____

              _____

              _____

              _____

       (iii)   _____
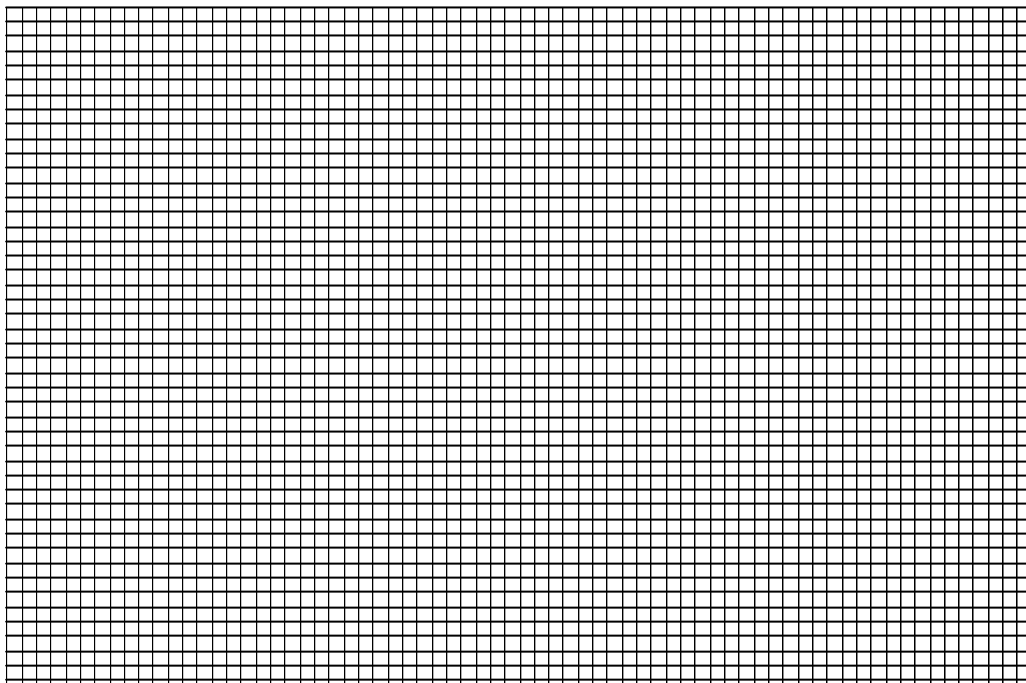
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Q19 (i) (a)   _____

              _____

              _____

       (b)   _____

              _____

              _____

       (ii)   _____

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              _____

       (iii) _____

              _____

       (iv)   _____

              _____

Q 20 (i)

(ii) _____

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(iii) _____

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