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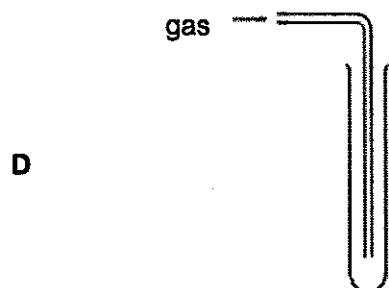
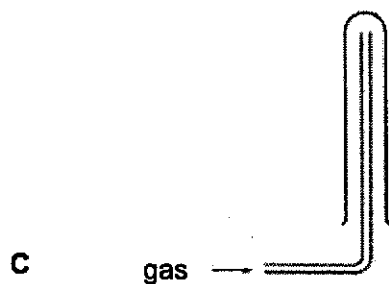
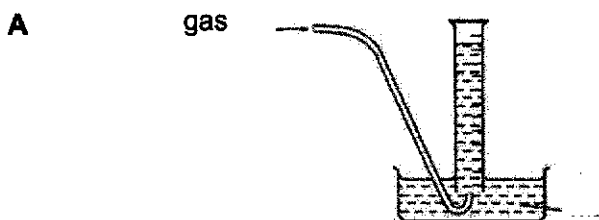
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Section A (10 marks)

Answer **all** the questions in this section. Write your answers in the boxes on page 6.

- 1 A student attempts to collect a gas that is less dense than air and is insoluble in water.

Which method **cannot** be used to collect the gas?



3

- 2 The table shows the boiling points of some of the gases present in air.

gas	boiling point/ °C
argon	-186
helium	-269
neon	-246
nitrogen	-196
oxygen	-183

When air is cooled from room temperature to -200°C , which gases remain unchanged in state?

- A argon and helium
B helium and neon
C neon and nitrogen
D nitrogen and oxygen
- 3 An atom of an element X has 12 neutrons and 13 protons.
- Which statement is true?
- A Element X forms ions with a charge of -1.
B Element X has a nucleon number of 12.
C Element X is a non-metal.
D Element X is located at Period 3 and Group III of the Periodic Table.
- 4 In the blast furnace, iron is extracted from its ore.
- Which substance is **not** used as a raw material in its production?
- A air
B haematite
C limestone
D slag

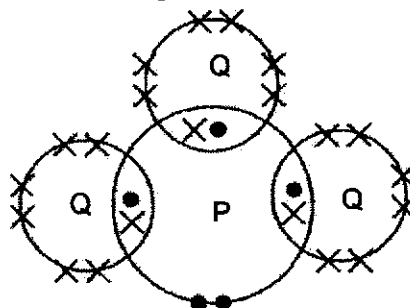
4

- 5 An element is represented by the symbol ${}^{90}_{38}\text{X}$.

How many protons, neutrons and electrons are present in an atom of this element?

	protons	neutrons	electrons
A	38	50	38
B	38	52	38
C	38	52	40
D	40	50	38

- 6 The diagram shows the electron arrangement of the atoms in a molecule of PQ_3 .



Which property does this compound have?

- A It can be easily separated into its elements by physical methods.
 B It dissolves readily in water.
 C It has a low melting point.
 D It is a good electrical conductor.
- 7 Which equation is balanced?
- A $\text{Ba}_3\text{N}_2 + 6 \text{H}_2\text{O} \rightarrow 3 \text{Ba}(\text{OH})_2 + 2 \text{NH}_3$
 B $\text{CaCl}_2 + 2 \text{Na}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6 \text{NaCl}$
 C $\text{HClO}_4 + \text{P}_4\text{O}_{10} \rightarrow 4 \text{H}_3\text{PO}_4 + 6 \text{Cl}_2\text{O}_7$
 D $3 \text{PCl}_5 + 4 \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 5 \text{HCl}$
- 8 A detergent contains sodium lauryl sulfate with a chemical formula of $\text{NaC}_{12}\text{H}_{25}\text{SO}_4$.
 Which statement is true about sodium lauryl sulfate?
- A It is an alloy.
 B It is made from six elements.
 C It is made of non-metals only.
 D There are 43 atoms in one formula unit of the substance.

- 9 What will be observed if chlorine gas is bubbled slowly into a solution of sodium bromide?

A Pale yellow-green gas of chlorine becomes dark yellow.
 B Purplish black crystals of iodine is formed.
 C Silvery sodium is seen.
 D Sodium bromide solution turns from colourless to red-brown.

- 10 The reactions of five unknown metals, P, Q, R, S and T, with water, steam and dilute hydrochloric acid, as well as the reaction of their metal ores with carbon monoxide, are analysed in order to determine the order of their reactivity.

The observations are shown in the table below.

metal	reaction with			carbon monoxide gas passed over metal ore
	cold water	steam	dilute hydrochloric acid	
P	very few bubbles seen	bright white flame seen as a white solid is formed	effervescence seen	no visible change
Q	no visible change	no visible change	no visible change	shiny brown solid
R	sparks seen	not carried out	not carried out	no visible change
S	no visible change	a yellow solid is formed	effervescence seen	shiny silvery solid
T	effervescence	not carried out	not carried out	no visible change

What is the order of the reactivity of the metals from the most reactive to the least reactive?

A $P \rightarrow Q \rightarrow R \rightarrow T \rightarrow S$
 B $Q \rightarrow R \rightarrow T \rightarrow P \rightarrow S$
 C $R \rightarrow T \rightarrow P \rightarrow S \rightarrow Q$
 D $S \rightarrow Q \rightarrow R \rightarrow T \rightarrow P$

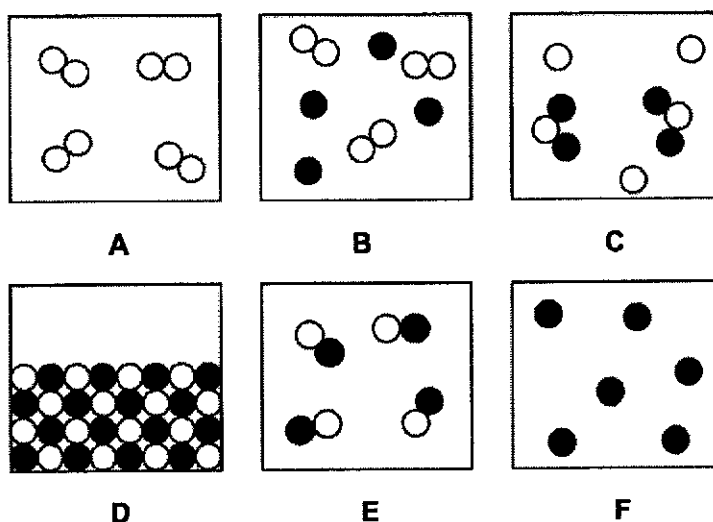
Answers to Section A

1		2		3		4		5	
6		7		8		9		10	

Section B (35 marks)

Answer **all** the questions in this section in the spaces provided.

- 1 The diagrams **A** to **F** below show the arrangement of particles in different substances. Each letter can be used as an answer once, more than once or not at all.

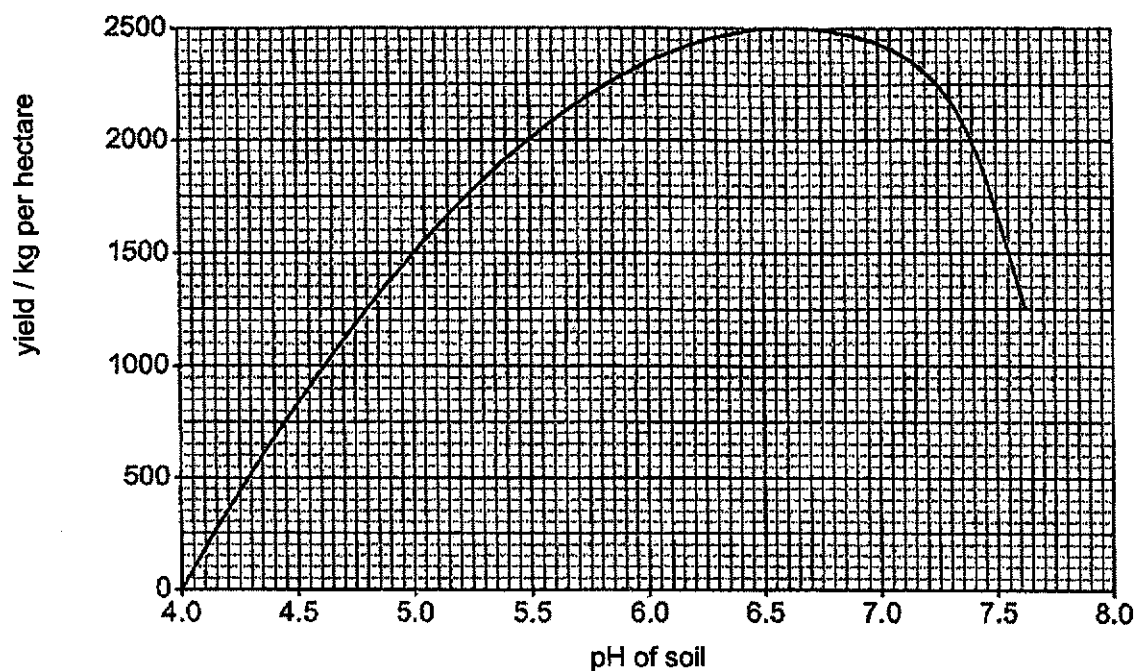


Which diagram best represents

- | | | |
|-----|--|-------|
| (a) | a mixture of two elements, | _____ |
| (b) | a noble gas, | _____ |
| (c) | a substance that boils over a range of temperatures, | _____ |
| (d) | negative and positive ions in sodium chloride. | _____ |

[4]

- 2 Soy bean is an important crop grown by farmers in many countries. The graph below shows how the yield of soy beans is affected by the pH of the soil in which they are grown.



- (a) What must the pH of the soil be if the farmer wants the best yield?
_____ [1]
- (b) What is the yield in kg per hectare if the soil is neutral?
_____ [1]
- (c) (i) If a farmer obtains a yield of 1200 kg per hectare of land used, was the soil acidic, neutral or alkaline when he first planted the soy beans? Explain your answer.
_____ [1]
- (ii) What could he have added to the soil in (i) before he planted the soy bean in order to change the pH to one that gives the best yield?
_____ [1]

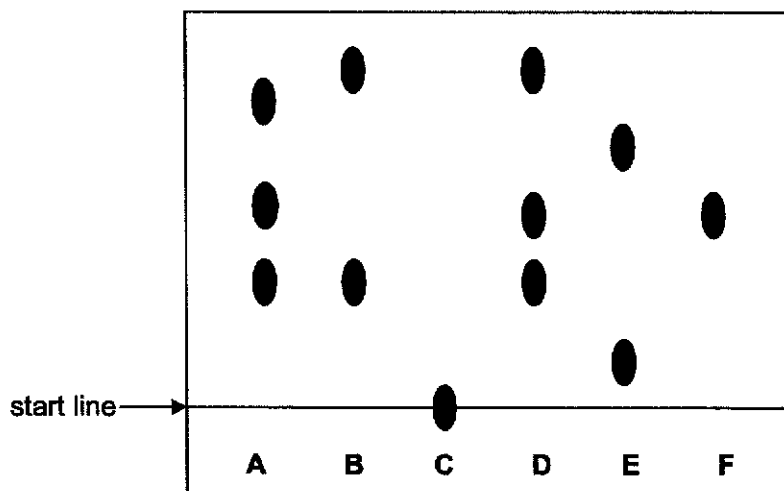
- 3 The names of some salts with their ions and use are shown in the table below.

name of substance	ions	use of substance
barium sulfate	Ba^{2+} and SO_4^{2-}	emphasize organs in x-rays
copper(II) chloride	Cu^{2+} and Cl^-	control fungal diseases of crops
silver chloride	Ag^+ and Cl^-	antidote for mercury poisoning
calcium nitrate		chemical fertiliser

- (a) State the chemical formulae for copper(II) chloride and barium sulfate.
 copper(II) chloride: _____ barium sulfate: _____ [1]
- (b) State the chemical symbols of the ions present in calcium nitrate.
 _____ [1]
- (c) How can a sample of silver chloride be determined to be pure?
 _____ [1]
- (d) If water is added to a mixture of all four salts and stirred until no more salt can dissolve, which salt(s) will remain as the residue after filtration?
 _____ [1]
- (e) Name a base and an acid that can be used to prepare copper(II) chloride.
 base _____ acid _____ [2]

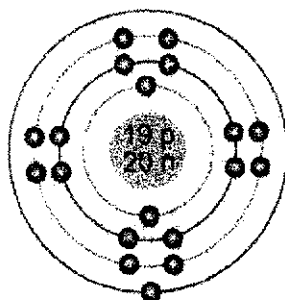
- 4 Paper chromatography was used to investigate a series of inks, A, B, C, D, E and F, using water as a solvent.

The following diagram shows the chromatogram obtained.



- (a) Suggest a reason why ink C remains at the start line.
_____ [1]
- (b) Which water-soluble ink is a pure substance?
_____ [1]
- (c) Which inks could be mixed to form ink D?
_____ [1]
- (d) Describe an advantage chromatography has over other physical methods of separation such as fractional distillation.
_____ [1]

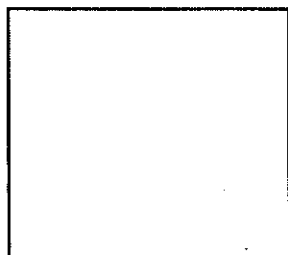
- 5 The diagram shows the atomic structure of a pure element Z.



- (a) Name element Z.
 _____ [1]
- (b) State the chemical symbol of the ion formed from an atom of element Z.
 _____ [1]
- (c) Describe how element Z should be stored.
 _____ [1]
- (d) Describe a physical property and a chemical property of element Z.
- physical property
 _____ [1]
- chemical property
 _____ [1]

12

- (e) (i) Draw the structure of the pure element Z when it is completely melted.



[1]

- (ii) Describe the movement of the particles in liquid Z.

[1]

- 6 The symbols of two hydrogen isotopes are shown below.

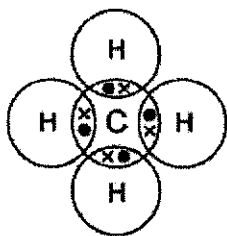


- (a) What do the atoms have in common and what is their difference?

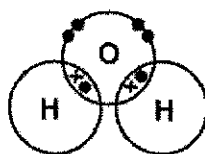
[1]

- (b) Methane, CH_4 , and water, H_2O , are compounds of hydrogen.

The 'dot and cross' diagrams of these compounds are shown below.



methane



water

- (i) What bonds are formed within these molecules?

[1]

13

(ii) How many such bonds as named in (i) are found within each molecule?

methane : _____ water : _____ [1]

(c) Hydrogen atoms can combine with nitrogen atoms to form an alkaline gas.

(i) Name the alkaline gas.

_____ [1]

(ii) Describe the test for the alkaline gas named in (i).

_____ [1]

7 Brass is an alloy of copper and zinc.

The table shows how the composition of brass influences its strength.

composition of brass		relative strength of alloy
% copper	% zinc	
90	10	2.6
80	20	3.0
70	30	3.3
60	40	3.6

(a) Using the information provided in the table above, describe how the composition of brass affect its strength.

_____ [1]

- (b) Using your knowledge of the structure of metals, explain why brass is stronger than pure copper.

[2]

- (c) Describe the differences in observations if brass, copper and zinc are added to dilute sulfuric acid separately.

brass : _____

copper : _____

zinc : _____ [2]

Section C (20 marks)

Answer all the questions in this section in the spaces provided.

- 1 Fluorine is a non-metal in Group VII of the Periodic Table. It reacts vigorously with sodium, a Group I metal, to form a solid at room temperature.

(a) (i) Draw a diagram to show the electronic structure of a fluorine atom.

[1]

(ii) Why is the fluorine atom considered to be unstable?

[1]

(b) Why is fluorine placed in Group VII of the Periodic Table of elements?

[1]

(c) (i) State the name and chemical formula of the solid that is formed when fluorine reacts with sodium.

name _____ chemical formula _____ [2]

(ii) Explain why the product formed between sodium and fluorine has a high melting point.

[1]

(iii) Draw a 'dot and cross' diagram to show the arrangement of electrons in the product formed from the reaction between sodium and fluorine.

[2]

- (d) (i) Name another element in Group I that can also react with fluorine but at a slower rate than reaction of sodium with fluorine.

_____ [1]

- (ii) Describe how this element named in (d)(i) differs from sodium in its melting point.

_____ [1]

2 Jim wanted to prepare a dry sample of magnesium sulfate crystals in a laboratory. He measured about 50 cm^3 of dilute sulfuric acid and poured it into a beaker. He then added magnesium carbonate powder to the acid slowly, taking care to stir the mixture constantly. He stopped adding magnesium carbonate after observing the reaction had stopped. The mixture was then filtered and the filtrate was further treated to obtain dry magnesium sulfate crystals.

- (a) Write a balanced chemical equation to represent the reaction that had taken place, including the state symbols.

_____ [2]

- (b) Name a suitable apparatus that was used to measure the required volume of sulfuric acid needed in the experiment.

_____ [1]

- (c) What did Jim observe that enabled him to conclude that the reaction had stopped?

_____ [1]

- (d) Why was there a need for Jim to add magnesium carbonate powder till the reaction had stopped?

_____ [1]

- (e) What was the purpose of filtering the mixture after the reaction had stopped?

_____ [1]

- (f) Describe how Jim would have treated the filtrate in order to obtain a dry sample of magnesium sulfate from its filtrate.

[3]

- (g) Suggest an alternative substance that could be used to replace the magnesium carbonate powder used in the experiment to produce the same magnesium sulfate salt.

[1]

The Periodic Table of Elements

Group																	
I	II	Key						1	VII						0		
		proton (atomic) number atomic symbol name relative atomic mass						H hydrogen 1									
3 Li lithium 7	4 Be beryllium 9								5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	11 Na sodium 23	12 Mg magnesium 24	13 Al aluminum 27
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57-71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	89-103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	118 Og oganeson -	119 Ts tennessine -	120 Nh nihonium -	121 Lr lawrencium -

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Answers for BSS/ 2019 EOY/3E Sc Chem**Section A**

1. D
2. B
3. D
4. D
5. B
6. C
7. A
8. D
9. D
10. C

Section B

- 1
 - (a) B
 - (b) F
 - (c) B and C
 - (d) D

- 2
 - (a) Accept any value from pH from 6.45 to 6.7
 - (b) 2450 kg per hectare
 - (c) (i) acidic, pH less than 7 [both ans required]
(ii) add calcium hydroxide

- 3
 - (a) CuCl_2 and BaSO_4 [both correct]
 - (b) Ca^{2+} and NO_3^- [both correct]
 - (c) Find either mp or bp; must be constant or fixed [both required]
 - (d) barium sulfate and silver chloride [both correct]
 - (e) copper(II) oxide/ hydroxide[1]
hydrochloric acid [1]

- 4
 - (a) Ink C is not soluble in water
 - (b) ink F
 - (c) inks B and F
 - (d) In chromatography, only a small amount is required, unlike fractional distillation

- 5 (a) potassium
 (b) Z^+ or K^+
 (c) in oil
 (d) physical property [1m for any one]
 silvery and shiny/ good heat conductor or good electrical conductor/ malleable and ductile/ sonorous/ low mp and bp/ low density/ soft and easily cut with a blade/ less dense than water
chemical property [1m for any one]
 -reacts explosively with water to form an alkali/ potassium hydroxide/ hydrogen gas [accept reactions with steam and acid if products are correct]
 (e) (i) (3 layers of atoms in liquid state)
 (ii) slide past each other slowly and freely
- 6 (a) same number of protons, different number of neutrons [both correct]
 (b) (i) covalent bonds
 (ii) methane: 4 ; water: 2 [both correct]
 (c) (i) ammonia
 (ii) Put a damp red/ pink litmus into gas. It turns blue.
- 7 (a) As % of copper decreases [or % of zinc increases], the strength of alloy increases
 (b) brass has different types of atoms with different sizes;
 orderly arrangement in pure metal is disrupted; structure becomes disorderly;
layers of atoms cannot slide over each other easily
 [2m for 3 pts; 1m for 1 to 2 pts only]
 (c) effervescence observed with brass in acid;
no effervescence (or bubbles) observed with copper in acid;
lots of effervescence observed with zinc in acid;
 [2m for 3 pts; 1m for 1 to 2 pts only]

Section C

- 1 (a) (i) correct atomic structure of a fluorine atom
- (ii) fluorine atom does not have the full, stable structure of a noble gas.
- (b) it has 7 valence electrons
- (c) (i) sodium fluoride [1], NaF [1]
- (ii) It has strong ionic bonds ; lots of energy required to break them
- (iii) correct charge on each ion [1]
correct electronic configuration on each ion [1]
[or 1m for each correct ion]
- (d) (i) lithium
- (ii) mp is higher than sodium
- 2 (a) $\text{MgCO}_3 (\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{MgSO}_4 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$
[equation 1m; state 1m]
- (b) measuring cylinder
- (c) effervescence stopped; no more solid could react and dissolve
- (d) to remove all the acid as acid cannot be easily removed by filtration
- (e) to remove excess magnesium carbonate
- (f) Heat the filtrate to point of saturation/ crystallisation;
Cool
Decant/ filter to obtain crystals
Dry in between filter papers
- Any 3 points [3]
- (g) magnesium or magnesium oxide or magnesium hydroxide