Bukit Batok Secondary School

PRELIMINARY EXAMINATIONS 2018

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS / CHEMISTRY) **5076 / 01**

Paper 1 Multiple Choice

24 August 2018
0745 – 0845
1 hour

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

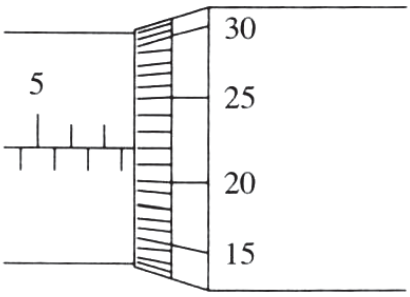
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D.**
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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.

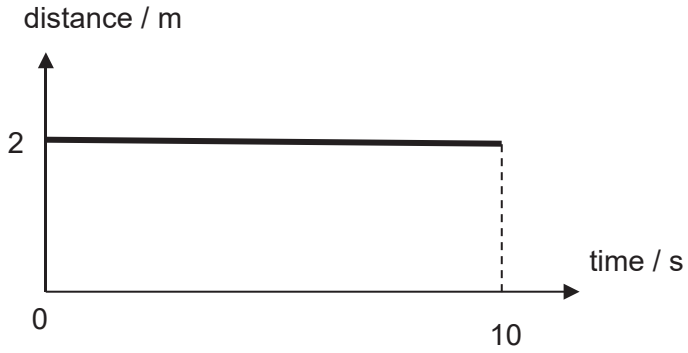
Electronic calculators may be used.
A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is given at the end of the paper.

1 What is the reading shown by the micrometer screw gauge?



A 5.272 mm
B 5.72 mm
C 7.22 mm
D 7.72 mm

2 Which of the following best describes the distance-time graph below?

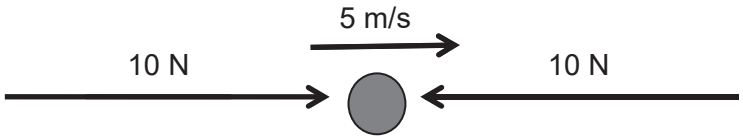


A An object at rest.
B An object moving with a constant speed of 2.0 m/s.
C An object moving with a constant velocity of 2.0 m/s.
D An object moving with a constant acceleration of 2.0 m/s^2.

3 Which of the following consist of only vector quantities?

A mass, distance, time
B friction, velocity, electromotive force
C tension, speed, energy
D weight, displacement, electrostatic force

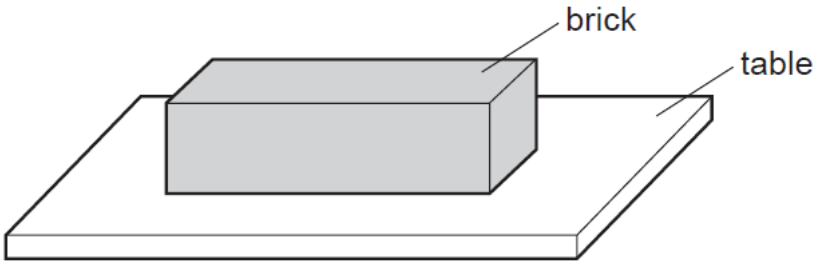
4 A particle moving at constant speed of 5 m/s is being acted on by two 10 N forces as shown.



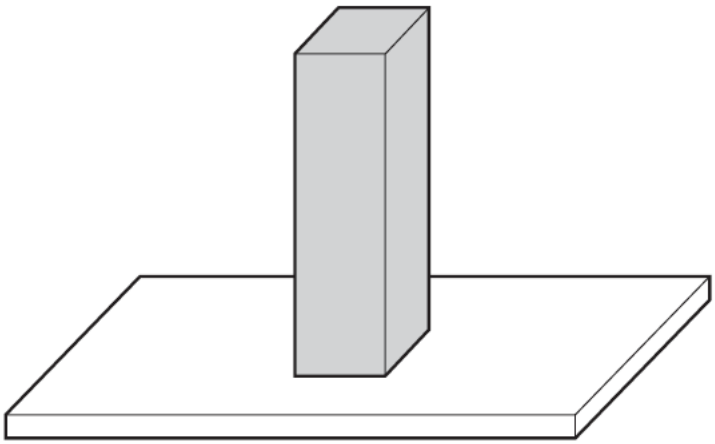
The particle will

A continue to move at 5 m/s in a straight line.
B increase its speed gradually.
C slow down gradually and stop.
D stop immediately.

5 A brick with flat, rectangular sides rests on a table.



The brick is now turned so that it rests on the table on its smallest face.



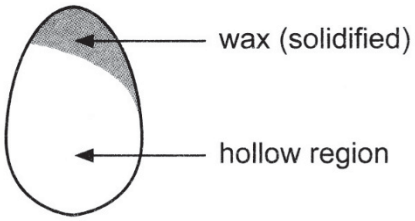
How has this affected the force and the pressure exerted by the brick on the table?

	force	pressure
A	increased	increased
B	increased	unchanged
C	unchanged	increased
D	unchanged	unchanged

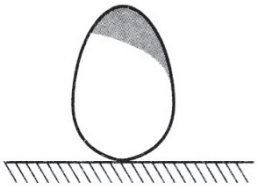
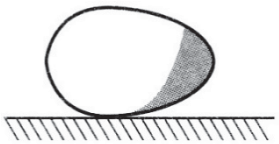
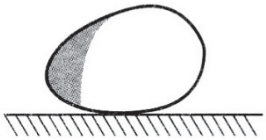
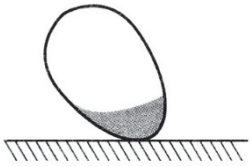
6 When solid A of mass 15 g is immersed in a displacement can filled with water, it displaced the same volume of water as solid B of mass 10 g. Which of the following best describes the densities of solid A and solid B?

A Solid A and solid B have the same density.
B Density of solid A is 0.667 times the density of solid B.
C Density of solid A is 1.5 times the density of solid B.
D Density of solid A is 5 times the density of solid B.

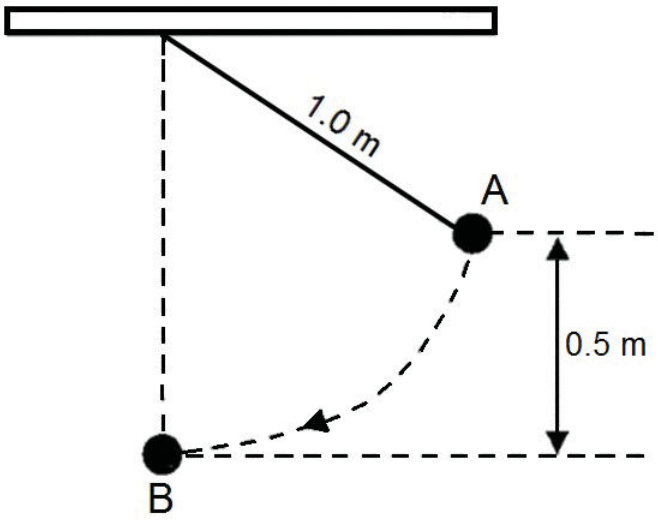
7 An empty egg shell has molten wax solidified inside it as shown in the figure below.



In which position is the egg shell most stable when placed on a flat, horizontal surface?

A	B	C	D
			

8 A pendulum with length of 1.0 m is displaced to position A and released as shown.



Ignoring air resistance, what is the speed of the pendulum bob as it passes its lowest point B?

A 1.5 m/s
B 2.3 m/s
C 3.2 m/s
D 4.1 m/s

9 A cube of ice is heated to water, then to steam.
Which of the following is true?

A The molecules expand as ice changes to steam.
B The molecules move slower as ice changes to steam.
C The molecules move further apart as the ice changes to steam.
D The molecules move closer to one another as ice changes to steam.

10 A beaker of water is heated at the bottom to form a convection current in the water.
An explanation on how convection occurs contains four statements.

1 Density of expanded water decreases.
2 Warm water that is less dense rises and cold water moves in to replace it.
3 Water at the bottom gains heat and becomes warmer.
4 Water expands.

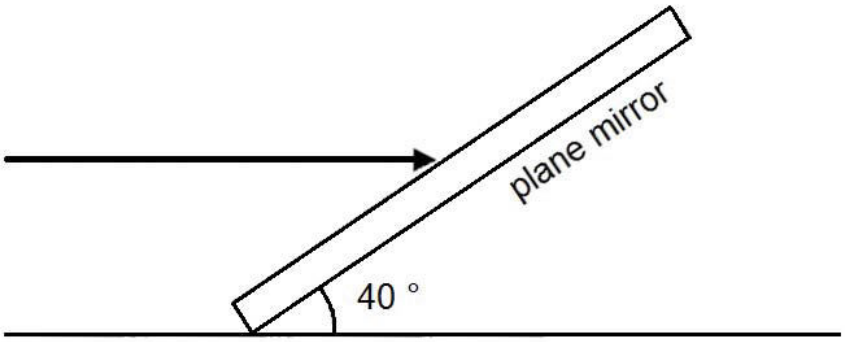
What is the correct order of these four statements?

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

11 The diagram shows an electric flask.
Which of the following statement is true?

A The plastic lid is a good conductor of heat.
B The plastic lid increases heat loss through convection.
C The white colour exterior reduces rate of heat loss by radiation.
D The transparent water level marking increases heat loss by radiation.

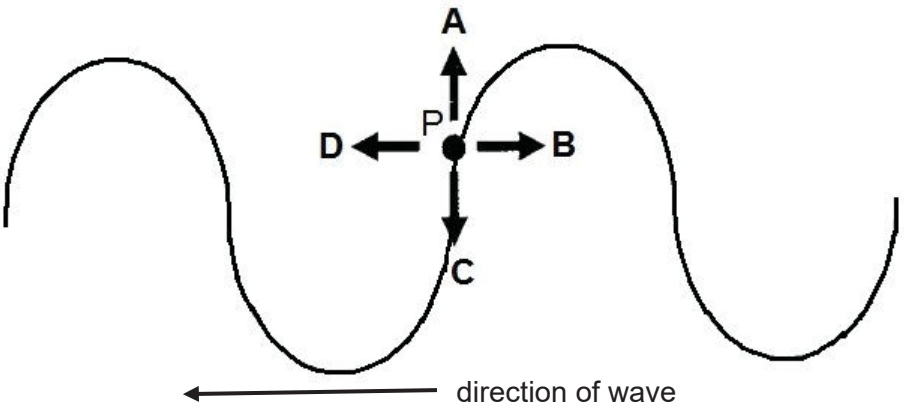
12 A light ray is parallel to the floor and strikes a plane mirror as shown.



What is the angle of incidence?

A 40°
B 50°
C 90°
D 140°

13 A rope is set to oscillate up-and-down to create a transverse wave that moves to the left. At the particular instant below, what is the direction of movement of point P?



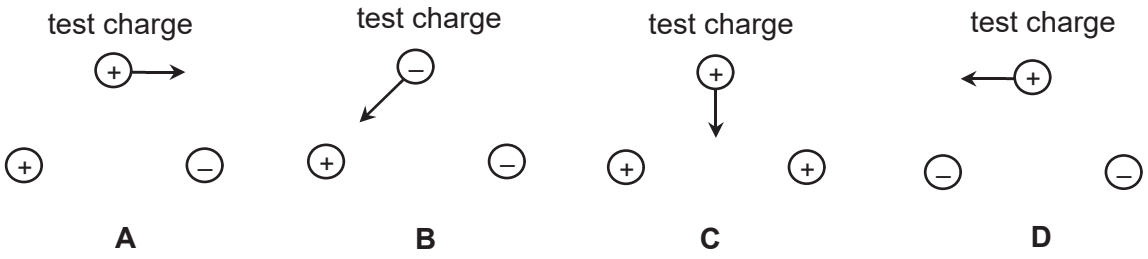
14 What is the speed of X-rays in a vacuum?

A 380 m/s
B 3.0×10^8 m/s
C Slightly less than 3.0×10^8 m/s
D Slightly more than 3.0×10^8 m/s

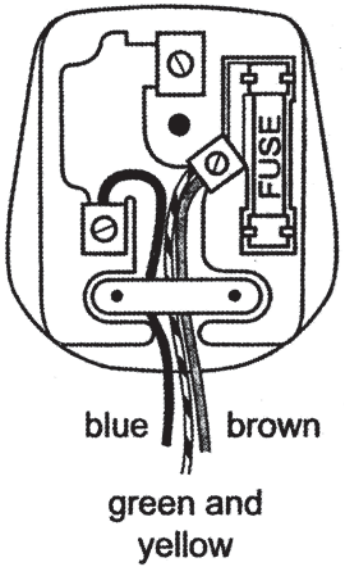
15 Which of the following is **not** an application of gamma rays?

A checking welds
B intruder alarm
C sterilizing equipment
D treatment of cancer

16 Which of the following diagrams correctly shows the direction of the resultant electrostatic force acting on a small test charge?



17 The plug of the vacuum cleaner is wrongly wired as shown.



What is the effect of using the plug wired this way?

A The fuse in the plug blows.
B The metal case becomes live.
C The vacuum cleaner catches fire.
D The vacuum cleaner does not work.

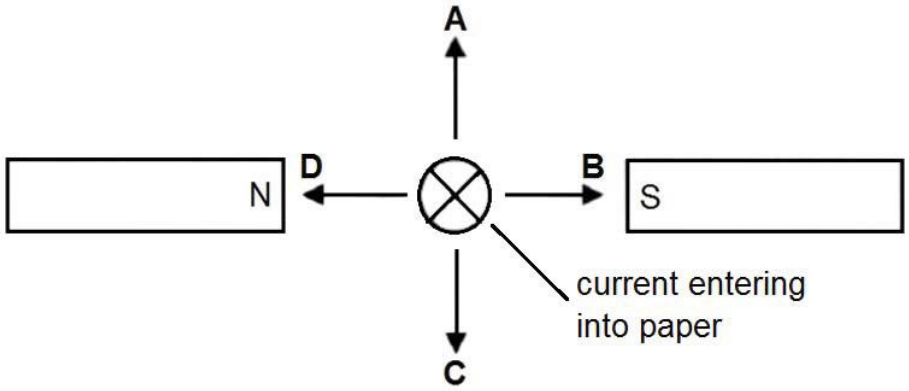
18 Which material is used to make the needle of a plotting compass?

A aluminium
B brass
C iron
D steel

19 One kilowatt-hour of electricity costs $0.20.
How much does it cost to switch on a heater marked “120 V, 3 A” for 90 minutes.

A $0.11
B $2.70
C $64.80
D $108.00

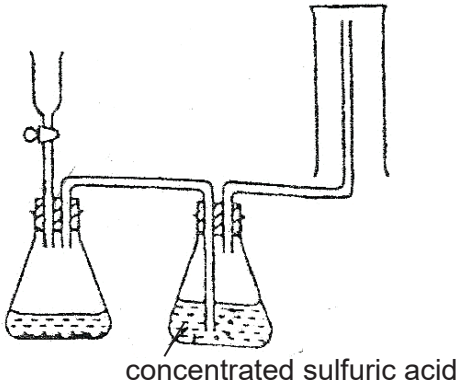
20 The figure below shows a current-carrying conductor between two magnets.
Which of the arrows indicates the direction of the force acting on the conductor?



21 Which of the following is a compound?

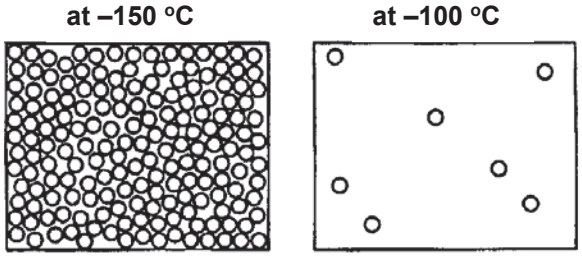
A fluorine
B lithium
C petroleum
D sugar

22 Which of the following gases can be prepared and collected using the apparatus shown?



A ammonia
B carbon dioxide
C hydrogen
D oxygen

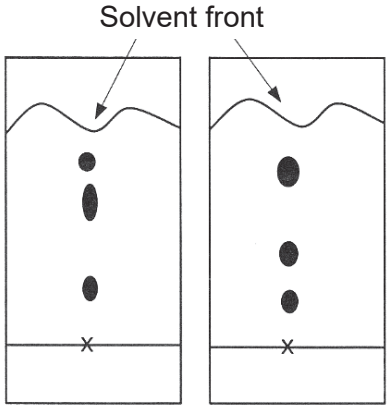
23 The diagrams show the arrangement of molecules in a substance at a pressure of 1 atm and at two different temperatures.



Which substance could the diagrams represent?

Substance	Melting point / °C	Boiling point / °C
A	-183	-89
B	-182	-162
C	-169	-104
D	-114	-85

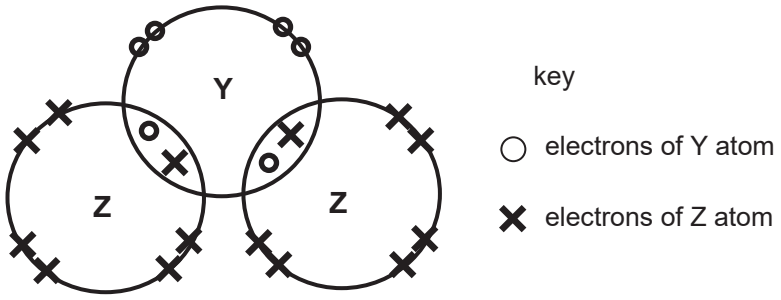
24 Two students carried out chromatography experiments to examine the dyes in a black ink. They used the same ink. The chromatograms obtained by the students are shown below.



Why were the chromatograms different?

A One student used the wrong solvent.
B One student did not use enough solvent.
C The two students used different solvents.
D The solvent moved up the paper at different speeds.

25 The diagram shows the arrangement of electrons in the outer shells of the atoms in the compound YZ_2.



Which pair of elements could be Y and Z?

	Y	Z
A	calcium	fluorine
B	carbon	sulfur
C	oxygen	hydrogen
D	sulfur	chlorine

26 Which ion has the same number of protons as the hydroxide ion?

A O^{2-}
B F^{-}
C Na^{+}
D Mg^{2+}

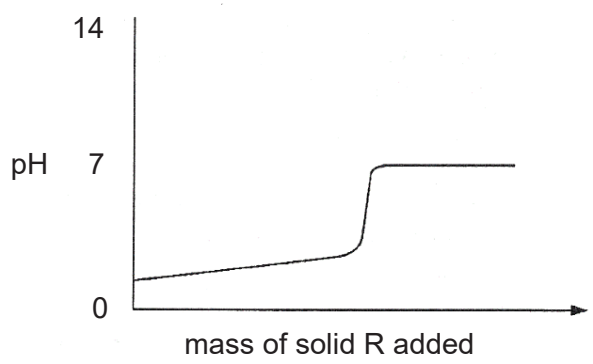
27 Rubidium is in Group I of the Periodic Table.
Which of the following are properties of rubidium chloride?

	formula	melting point	solubility in water
A	RbCl	70°C	insoluble
B	RbCl	700°C	soluble
C	$RbCl_2$	70°C	soluble
D	$RbCl_2$	700°C	insoluble

28 Which of the following is **unlikely** to react with aqueous sodium hydroxide?

A carbon dioxide
B aluminium oxide
C zinc oxide
D copper (II) oxide

29 Solid R is gradually added to aqueous solution S. The changes in pH are shown in the graph below.



What are R and S?

	R	S
A	insoluble metal oxide	hydrochloric acid
B	insoluble non-metal oxide	sodium hydroxide
C	soluble metal oxide	hydrochloric acid
D	soluble non-metal oxide	sodium hydroxide

30 Test on a sample of polluted water from a factory gives the following results.

Reagent	Result
Hydrochloric acid and aqueous barium chloride	White precipitate
Aqueous ammonia	White precipitate soluble in excess

Which compound is present in the water?

A lead (II) chloride
B lead (II) sulfate
C zinc chloride
D zinc sulfate

31 Magnesium reacts with hydrochloric acid.

$$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\ (aq)} + H_{2\ (g)}$$

Which volume of hydrogen at room temperature and pressure is produced if 6g of magnesium reacts with an excess of the acid?

A 1 dm^3
B 6 dm^3
C 12 dm^3
D 24 dm^3

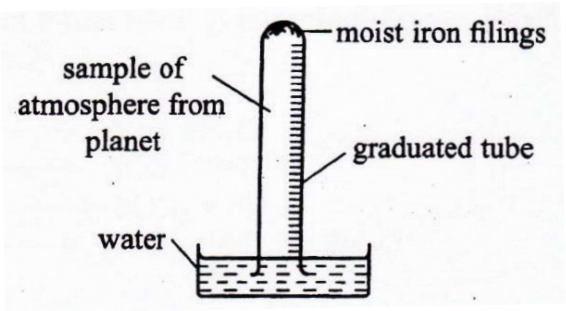
32 Which statement about the production of iron from haematite is correct?

A Coke is used to oxidize the slag.
B Limestone is used to remove basic impurities.
C Molten iron floats on slag at the furnace base.
D The haematite is reduced by carbon monoxide.

33 The atmosphere of a newly discovered planet contains the following gases.

carbon dioxide	20%
nitrogen	40%
oxygen	30%
noble gases	10%

The apparatus below was set up with a 100 cm^3 sample of the atmosphere of the planet in the graduated tube. The volume of the sample was measured at intervals until no further change in volume took place.



What volume of the sample would remain?

A 30 cm^3
B 40 cm^3
C 60 cm^3
D 70 cm^3

34 Which process is endothermic?

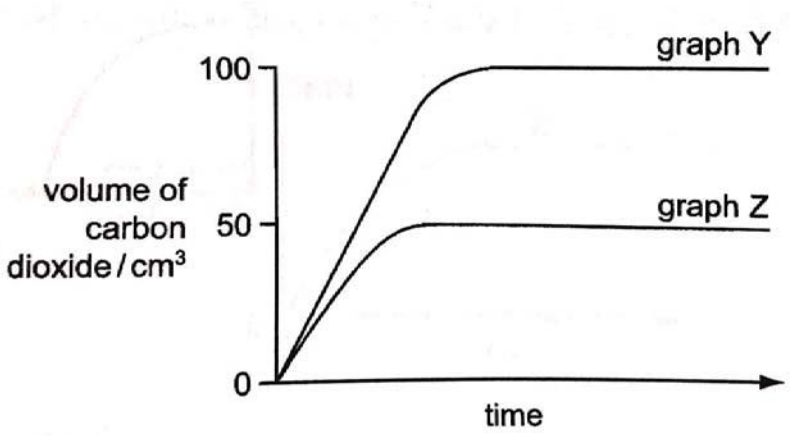
A The formation of a hydrogen-chlorine bond.
B The formation of rust.
C The formation of water from ice.
D The formation of water molecule from oxygen and hydrogen atoms.

35 Which of the following statement described the conversion of a sodium atom, Na, to a sodium ion, Na^+?

A The change is reduction; there is a gain of electron.
B The change is reduction; there is a loss of electron.
C The change is oxidation; there is a gain of electron.
D The change is oxidation; there is a loss of electron.

36 Some crystals of magnesium carbonate were added to an excess of sulfuric acid at room temperature. The volume of carbon dioxide gas produced was measured over a period of time. The results are shown in graph Y.

The experiment was repeated and graph Z was obtained.



Which change was used to obtain the results shown in graph Z?

A Acid of the same volume and half the original concentration was used.
B Half the mass of magnesium carbonate was used.
C Larger crystals of magnesium carbonate was used.
D Using a lower temperature.

37 The table below shows the boiling point ranges of fractions collected from the distillation of a sample of crude oil.

Which fraction contained the smallest molecules?

Fraction	Boiling point range / °C
A	20 – 50
B	50 – 100
C	100 – 150
D	150 - 250

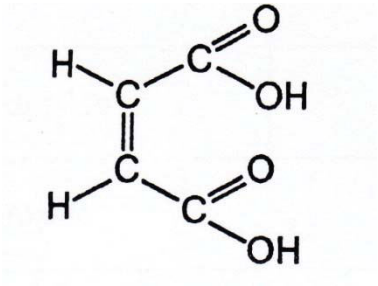
38 'Meta-fuel', $C_8H_{16}O_4$, is a fuel used in camping stoves.
What is the equation for its complete combustion?

A $C_8H_{16}O_4 + 2O_2 \longrightarrow 8C + 8H_2O$
B $C_8H_{16}O_4 + 5O_2 \longrightarrow 8CO + 8H_2O$
C $C_8H_{16}O_4 + 10O_2 \longrightarrow 8CO_2 + 8H_2O$
D $C_8H_{16}O_4 + 8O_2 \longrightarrow 4CO_2 + 4CO + 8H_2O$

39 Which of these reactions does **not** produce carbon dioxide?

A combustion of methane
B fermentation of sugar
C oxidation of ethanol to ethanoic acid
D reaction of ethanoic acid with calcium carbonate

40 A compound, Z, has the molecular structure as shown. How can Z be described?



A an alkane and an acid
B an alkene and an acid
C an alkane and an alcohol
D an alkene and an alcohol

- End of Paper 1 -

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

DATA SHEET

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										2 He Helium 4
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 Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
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 –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
actinoids	89 Ac Actinium –	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium –	94 Pu Plutonium –	95 Am Americium –	96 Cm Curium –	97 Bk Berkelium –	98 Cf Californium –	99 Es Einsteinium –	100 Fm Fermium –	101 Md Mendelevium –	102 No Nobelium –	103 Lr Lawrencium –

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

Name:…… Class register no…… Class:……

Bukit Batok Secondary School

PRELIMINARY EXAMINATIONS 2018

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS / CHEMISTRY) **5076/02**

Paper 2 Physics

17 August 2018
0745 – 0900
1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use a pencil for any diagrams, graphs or rough working
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions in the spaces provided.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
……	
.....	
Total	

This document consists of **17** printed pages (including cover page).

SECTION A [45 MARKS]
Answer all the questions in the spaces provided.

1 Fig.1.1 below shows the velocity-time graph of a 900 kg car travelling on a straight horizontal road for the first sixty seconds of its journey.

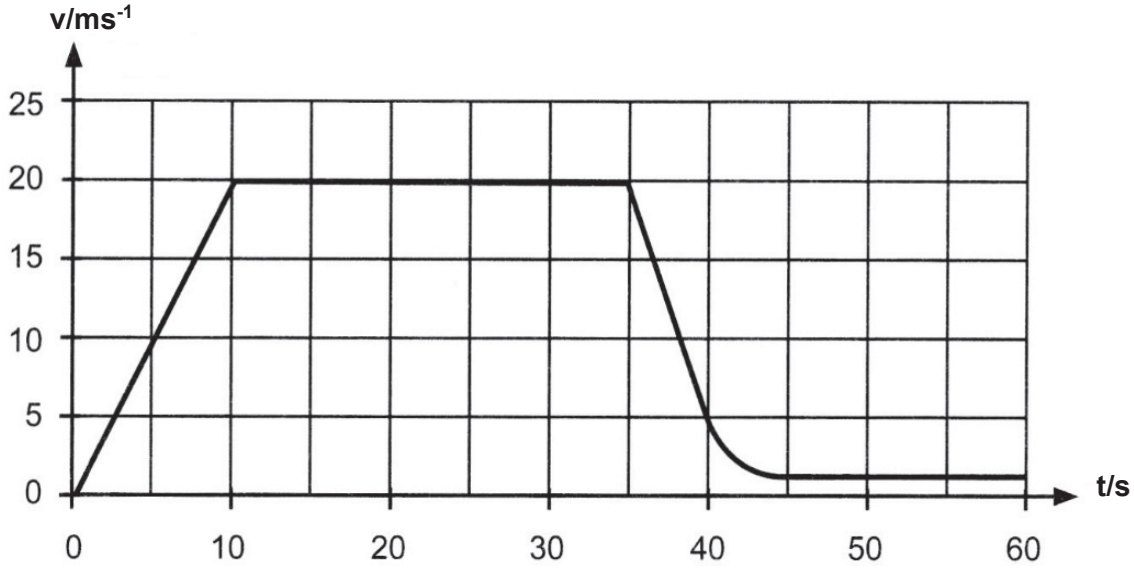


Fig 1.1

(a) Calculate, for the first 10 seconds,

(i) the acceleration of the car,

acceleration = ... m/s^2 [2]

(ii) the resultant force acting on the car.

resultant force = ... N [2]

(b) State how the braking force relates to the forward driving force,

(i) from t = 35 s to t = 45 s and

.....

.....

(ii) between t = 45 s to t = 60 s.

.....

..... [2]

(c) Determine the total distance travelled by the car during the first 30 s of its journey.

total distance = ... m [2]

2 Fig. 2.1 shows a stone supported by two strings that hang from a rod. The tensions in the two strings are 1.3 N and 2.0 N.

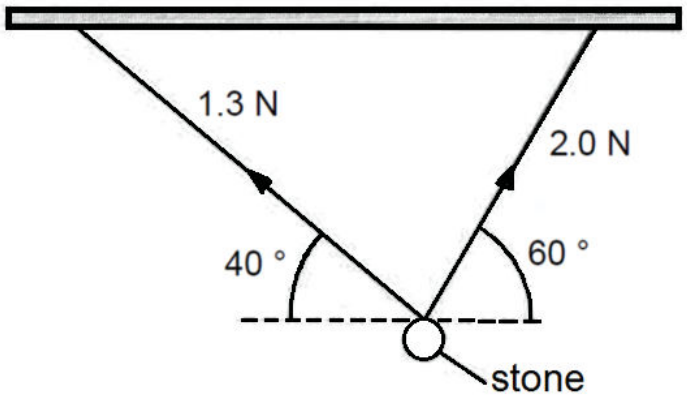


Fig. 2.1 (not drawn to scale)

In the space below, draw a labelled diagram to show the resultant force of the two tensions. Determine the size of the resultant force and the angle between the resultant force and the horizontal.

scale = 1 cm to ..... N

resultant force = ... N

angle = ... [5]

3 Fig 3.1 shows a barrier found in most carparks. The barrier is in equilibrium. The weight of the pole is 450 N and the centre of gravity of the pole is 1.30 m away from the pivot.

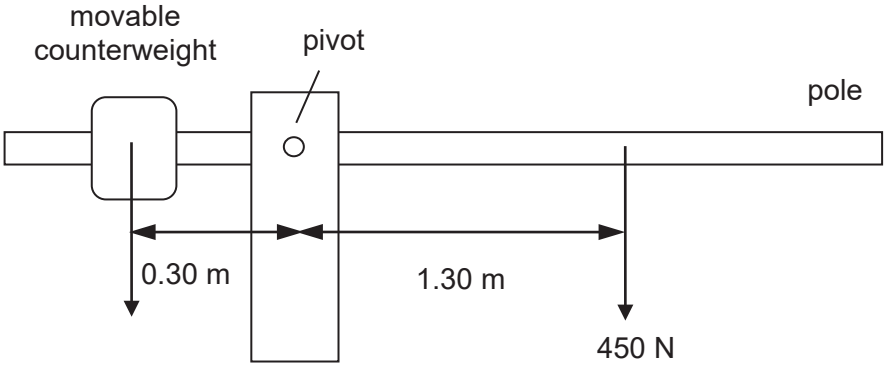


Fig. 3.1

(a) The centre of gravity of the movable counterweight is 0.30 m away from the pivot.

(i) Calculate the weight of the counterweight.

weight of counterweight = ... N [2]

(ii) Hence, calculate the mass of the counterweight.

mass of counterweight = ... kg [1]

(b) Calculate the amount of force acting on the pivot.

force on pivot = ... N [1]

(c) Describe and explain how the gate can be opened.

.....

.....

.....

..... [2]

4 Fig. 4.1 shows a toy car of mass 1.00 kg on a smooth track.
The toy car which is given a slight push starts to move with an initial speed of 2.00 m/s down a smooth track.

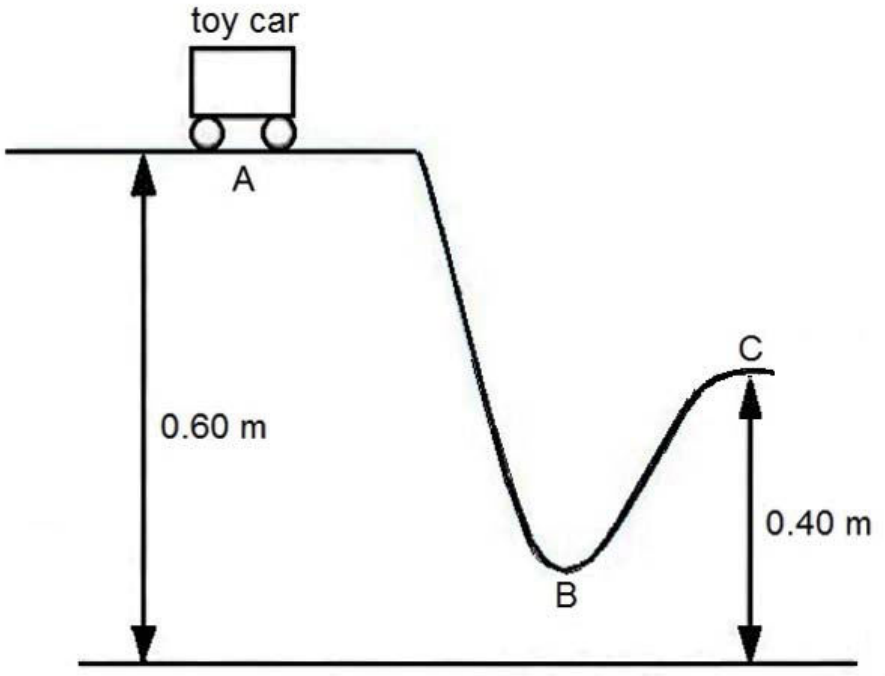


Fig 4.1

(a) State the Principle of Conservation of Energy.

.....

.....

.....

..... [2]

(b) State and explain at which point on the track would the speed of the toy car be at its maximum.

.....

.....

.....

..... [2]

(c) (i) Calculate the gravitational potential energy of the toy car at point **C**.

gravitational potential energy = ... J [1]

(ii) Hence, determine the speed of the toy car at **C**.

speed = ... m/s [2]

5 **(a)** Fig. 5.1 shows how the temperature of an unknown solid substance varies when heated over a Bunsen flame.

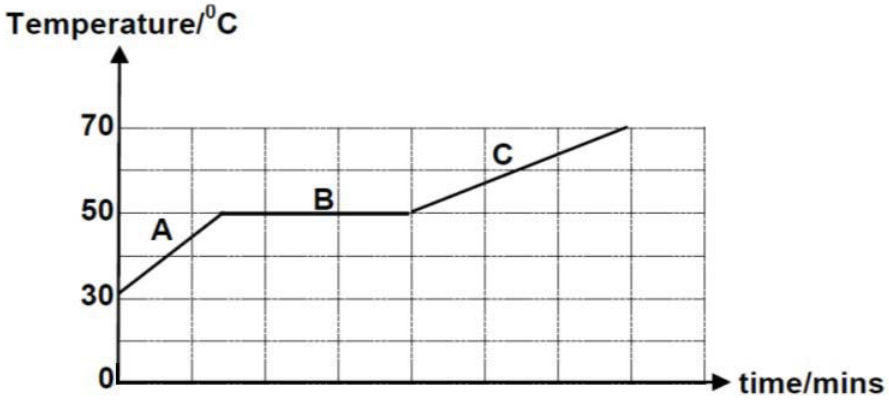


Fig. 5.1

(i) Name the process taking place during stage **B**.

..... [1]

(ii) Describe the movement of the particles at stage **C**.

.....

..... [1]

(iii) Describe the arrangement of the particles at stage **A**.

.....

..... [1]

(b) Explain why a pot of water boils faster with a covered lid.

.....

.....

.....

..... [2]

6 Fig. 6.1 shows a rectangular glass block, **PQRS**, with a refractive index of 1.50. A light ray is incident on the side **PS** of the glass block as shown.

(a) What is meant by the phrase *refractive index of 1.50*?

.....

..... [1]

(b) A ray of light is incident on the side **PS** at 75° and is refracted into the glass block at 40°.

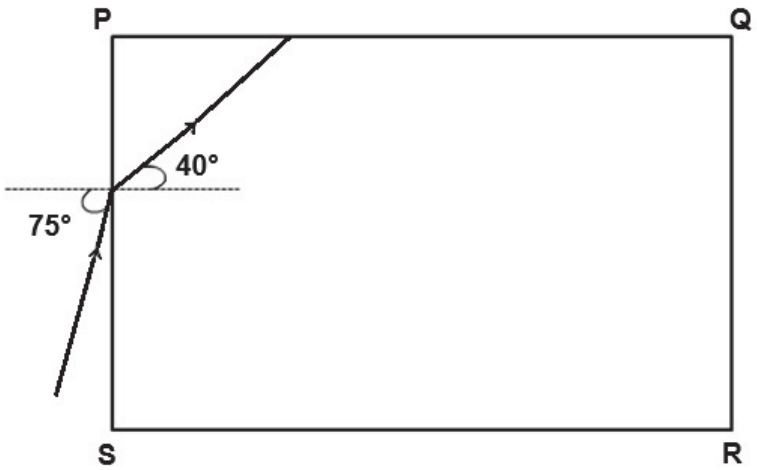


Fig. 5.1

(i) Show that the refractive index of the glass block is 1.50. [1]

(ii) Calculate the critical angle of the glass block.

critical angle = ... ° [2]

(iii) Complete the path of the light ray until it emerges into the air again.
Label all the angles clearly. [2]

7 **(a)** A beam of light is travelling parallel to the axis of a thin lens, as shown in Fig. 7.1. Point **F** is the focal point of the lens.

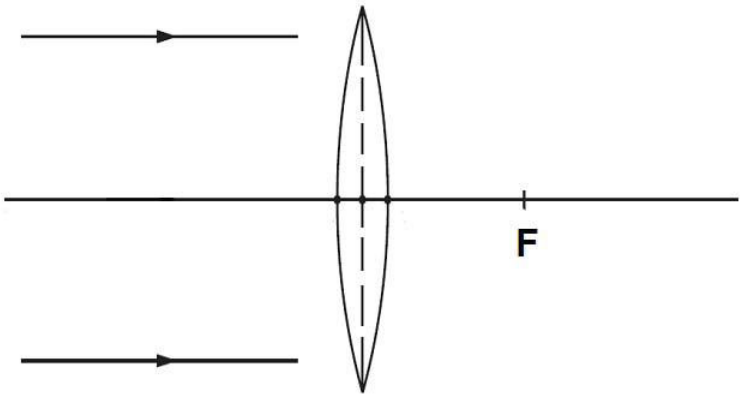


Fig. 7.1

On Fig. 7.1, complete the paths of the two rays after passing through the lens. [2]

(b) In this part of the question, you are required to draw an accurate ray diagram using the grid on Fig. 7.2 for the lens in part **(a)**.

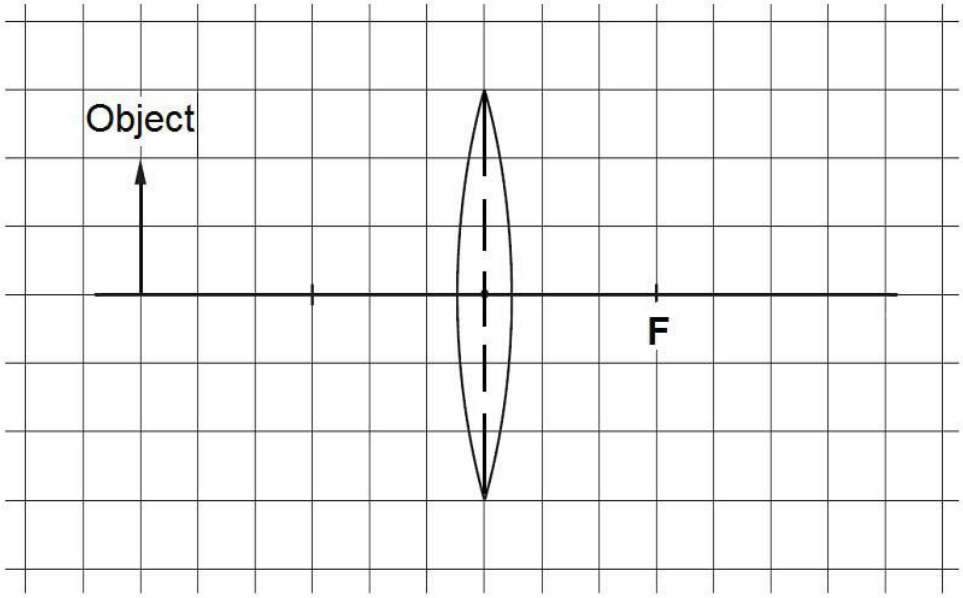


Fig. 7.2

(i) On the diagram, draw two rays from the top of the object through the lens to locate the position of the image. Label the image "**I**" beside it. [2]

(ii) From your diagram, state **one** similarity about the image and the object.

.....

..... [1]

8 Fig. 8.1 shows an arrangement that is used to remove dust particles from the smoke in a factory chimney.

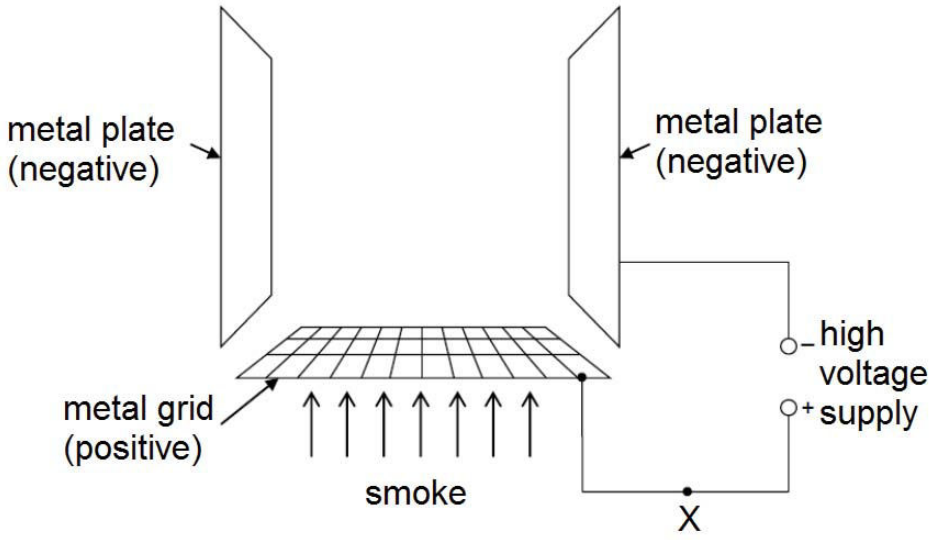


Fig. 8.1

When smoke passes through the metal grid, this results in the dust particles having a net positive charge.

(a) Explain what happened to the dust particles as they pass through the metal grid.

.....

.....

.....

..... [2]

(b) If 6.0 C of charges flow past point **X** in 1.0 minute, calculate the current flowing through **X**.

current = ... A [1]

SECTION B [20 MARKS]

Answer **ANY TWO** questions from this section.

9 Fig. 9.1 shows a metal cylinder which contains 0.000 46 m^3 of oil. The total mass of the cylinder and the oil is 1.2 kg. The mass of the cylinder is 0.800 kg and the space above the oil is air. The gravitational field strength is 10 N/kg.

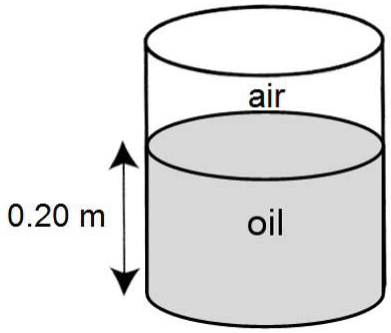


Fig. 9.1

(a) State **two** differences between the mass and the weight of a substance.

Difference 1: .....

.....

Difference 2: .....

.....

[2]

(b) Calculate the weight of the oil.

weight = ... [1]

(c) Calculate the density of the oil in SI unit.

density = ... [2]

(d) Calculate the pressure exerted by the oil on the base of the cylinder in SI unit.

pressure = ... [2]

(e) State and explain how the values of each of the following quantities would change when the cylinder and the oil is brought to the Moon, where the gravitational field strength is reduced.

(i) density of oil.

.....

..... [1]

(ii) pressure exerted by the oil on the base of the cylinder.

.....

.....

..... [2]

10 (a) A boy holds the loose end of a long rope which is fixed to a pole.
He moves it up and down at a rate of 20 complete oscillations in every 50 seconds.
Fig. 10.1 shows a section of the wave moving along the rope.

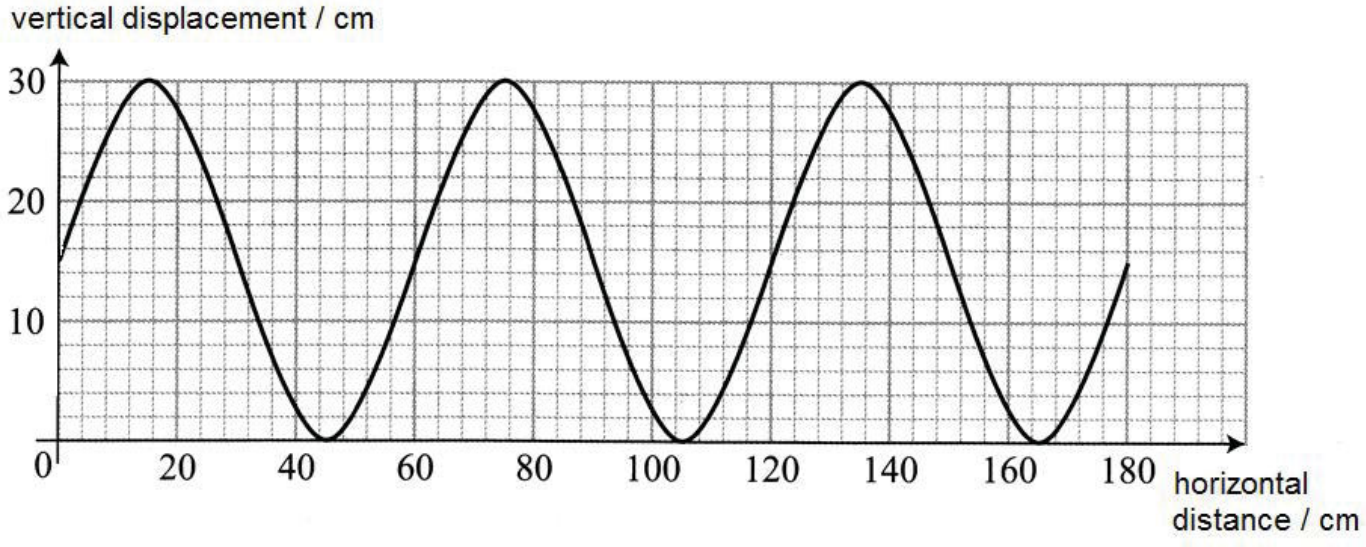


Fig. 10.1

(i) State the value of the amplitude of the wave.

amplitude = ... [1]

(ii) Calculate the frequency of the wave.

frequency = ... [2]

(iii) Calculate the speed of the wave.

speed = ... [2]

(b) Fig. 10.2 shows the cone of a loudspeaker that is producing sound waves in air.
At any given moment, a series of compressions and rarefactions exist along the line **PQ**.

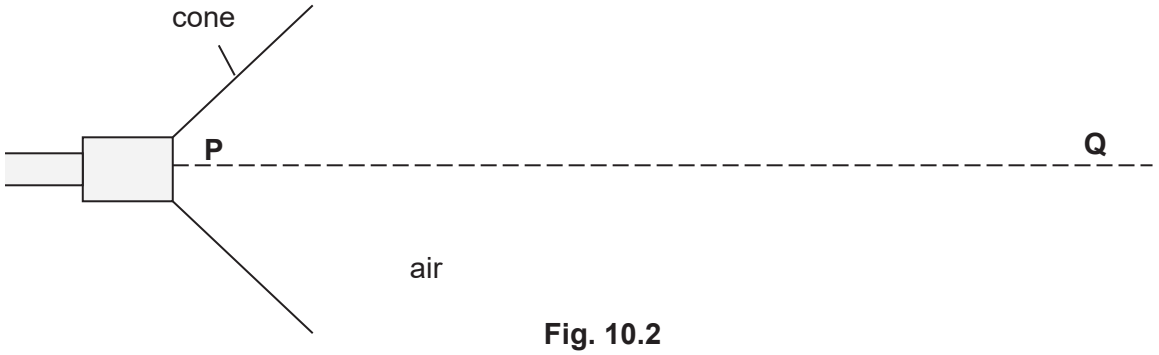


Fig. 10.2

The sound wave experience a rarefaction at **P**.

(i) On Fig 10.2, draw the wave lines to represent **two** wavelengths of compressions and rarefactions between **P** and **Q**.
Use the letter **C** to mark **two** compressions and the letter **R** to mark **two** rarefactions along **PQ**. [2]

(ii) With reference to the sound wave travelling along **PQ** in Fig. 10.2, explain what is meant by a *longitudinal* wave.

.....

..... [1]

(iii) To the right of **Q**, there is a large vertical wall 50 m in front of the loudspeaker.
The speed of sound in air is 340 m/s.
Calculate the time taken for the echo to return to **P**.

time taken = ... [2]

11 (a) Fig. 11.1 below shows an electrical circuit with a lamp and two resistors

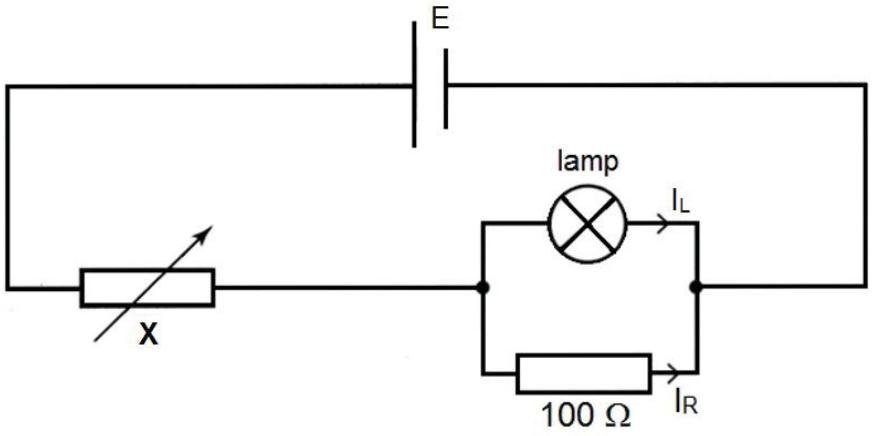


Fig. 11.1

(i) Name the component **X**.

..... [1]

Fig. 11.2 shows the graph of current against potential difference for the lamp **alone**. The potential difference across the lamp is 4.0 V.

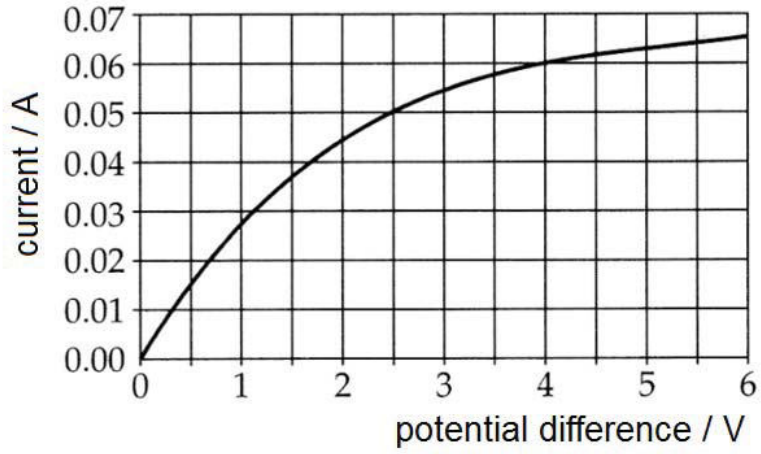


Fig. 11.2

Determine

(ii) the current in the lamp, I_L.

I_L = ... [1]

(iii) the current in the 100 Ω resistor, I_R.

I_R = ... [2]

(iv) the current in component **X**.

current through **X** = ... [1]

(b) Fig. 11.3 shows a type of electromagnetic lock in a door.

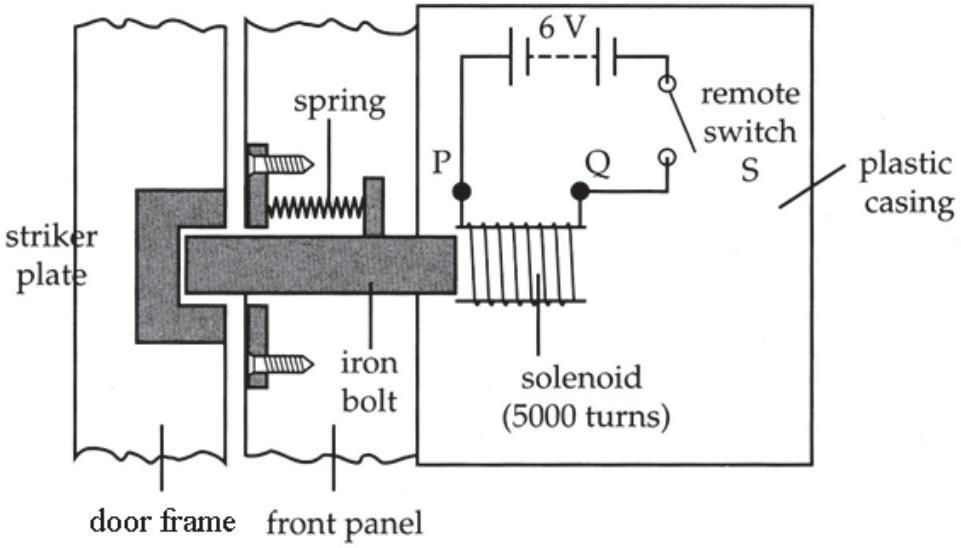


Fig. 11.3

When switch S is closed, the iron bolt moves to the right and out of the striker plate, allowing the door to be opened.

(i) Explain why the iron bolt moves to the right and into the solenoid when the switch is closed.

.....

.....

.....

.....

.....

..... [3]

(ii) After using the electric lock for a year, the 6 V battery goes "flat" and its e.m.f. drops to 4 V.
Why the electromagnetic lock does **not** work now?

.....

.....

.....

..... [2]

****** END OF PAPER 2 ******

2018 Preliminary Examination Marking Scheme
[Sec. 4 Express / 5 Normal (Academic) 5076 Science Physics Paper 2]

SECTION A [45 MARKS]

1 (a) (i) acceleration, $a = \frac{v-u}{t} = \frac{20-0}{10}$ [1 for working]

$= \underline{\textbf{2.0 m/s}^2}$ [1 for ans]

(ii) resultant force, $F_R = ma = (900)(2.0)$ [1 for working]

$= \underline{\textbf{1 800 N}}$ [1 for ans]

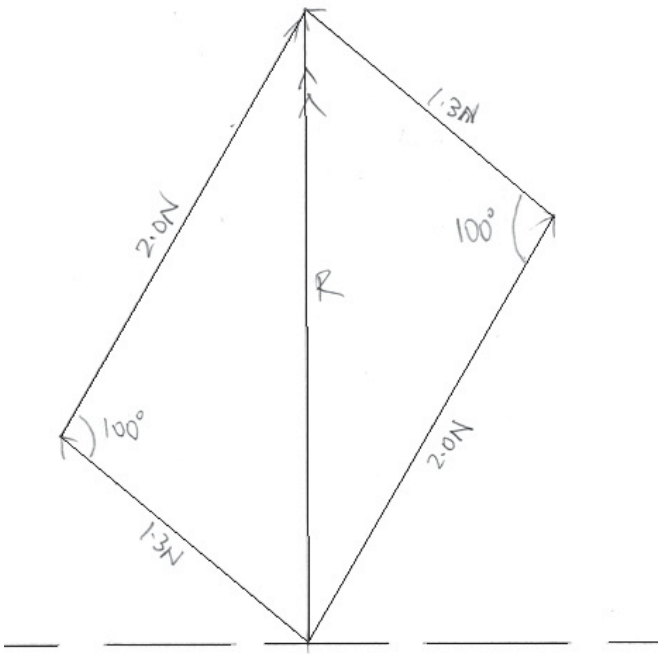
(b) (i) From t = 35 s to t = 45 s, the **braking force is greater than the forward driving force**. [1]

(ii) Between t = 45 s to t = 60 s, **the braking force is equal to the forward driving force**. [1]

(c) Total distance = ½ (10)(20) + (20)(20)
= 100 + 400 [1 for working]
= **500 m** [1 for ans]

2 [**Maximum = 2** for correct length of arrows]
[To deduct 1 mark for lack of arrows or wrong arrow]
[To deduct 1 mark for lack of angles or wrong angle between arrows]

Suitable scale = **1 cm to 0.2 N** [1]
resultant force = **2.56 ± 0.02 N** [1 for value within range]
angle of resultant with horizontal = **90° ± 1°** [1 for angle within range]



3 **(a)** Using Principle of Moments,

(i) W x 0.30 m = 450 N x 1.30 m [1 for working]

$$W = \frac{450 \times 1{,}30}{0.30}$$

= **<u>1950 N</u>** [1 for ans]

(ii) Using W = mg

$$m = \frac{W}{g}$$

$$= \frac{1950}{10}$$

= **<u>195 kg</u>** [1 for working & ans]

(b) Force on pivot = 1950 N + 450 N

= **<u>2400 N</u>** [1 for working & ans]

(c) The gate can be opened by **<u>shifting the counterweight further away from the pivot</u>**. **<u>(OR shift to the left)</u>**. [1]

so the **<u>counterclockwise moment</u>** produced by the force of the counterweight is **<u>larger than</u>** the **<u>clockwise moment</u>** produced by the weight of the pole. [1]

4 **(a)** Energy cannot be created or destroyed.
It can only be converted from one form to another; [1]
the total energy of an isolated system is constant. [1]

(b) At **<u>point B</u>**. [1]
At this point the **<u>change in height of the toy car is the greatest</u>** and the largest amount of GPE would have been converted to KE and thus the car would be at the greatest speed. [1]

(c) **(i)** GPE at point **C** = mgh
= (1.00)(10)(0.40) = **<u>4.0 J</u>** [1 for working & ans]

(ii) Total energy at point **A** = KE at point **A** + GPE at point **A**
= ½ mv^2 + mgh
= ½ (1.00) $(2.00)^2$ + (1.00)(10)(0.60)
= 2.0 + 6.0 = **<u>8.0 J</u>** [1 for working & ans]

Total energy at point **A** = GPE at point **C** + KE at point **C**
8.0 = mgh + ½ mv^2
8.0 = (1.00)(10)(0.40) + ½ mv^2
8.0 – 4.0 = ½ (1.00) v^2
v = $\left(\sqrt{8.0}\right)$
= **<u>2.83 m/s</u>** [1 for ans & unit]

[allow ecf from **(c)(i)**]

5 (a) (i) melting [1]

(ii) During stage **C,** the molecules are **sliding past one another**. [1]

(iii) The molecules at stage **A** are **closely packed together**. [1]

(b) With a covered lid, it reduces heat loss to the surroundings by:

- **prevents convection current from forming**.
- reducing **evaporation from the water surface**,
- **reducing conduction through the layer of trapped air** between the water and the lid.

[any TWO answers, 1 mark each, max = 2]

6 (a) "*refractive index of 1.50*" shows that
the **ratio** of the **sine of the incident angle** to the **sine of the refracted angle is 1.50** OR
Ratio of the **speed of light in vacuum** to the **speed on light in the medium is 1.50**. [1]

(b) (i) Refractive index, $n = \frac{\sin i}{\sin r} = \frac{\sin 75°}{\sin 40°}$

= 1.50 (shown) [1 for working]

(ii) $n = \frac{1}{\sin c}$

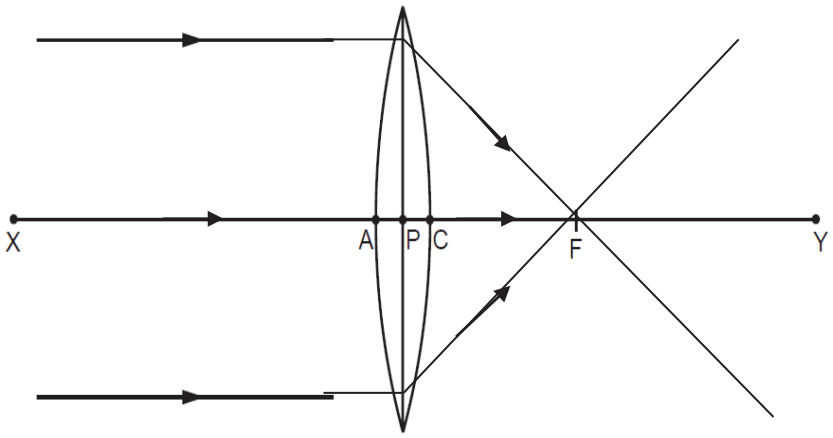
$1.50 = \frac{1}{\sin c}$ [1 for working]

$c = \sin^{-1}\left(\frac{1}{1.50}\right)$

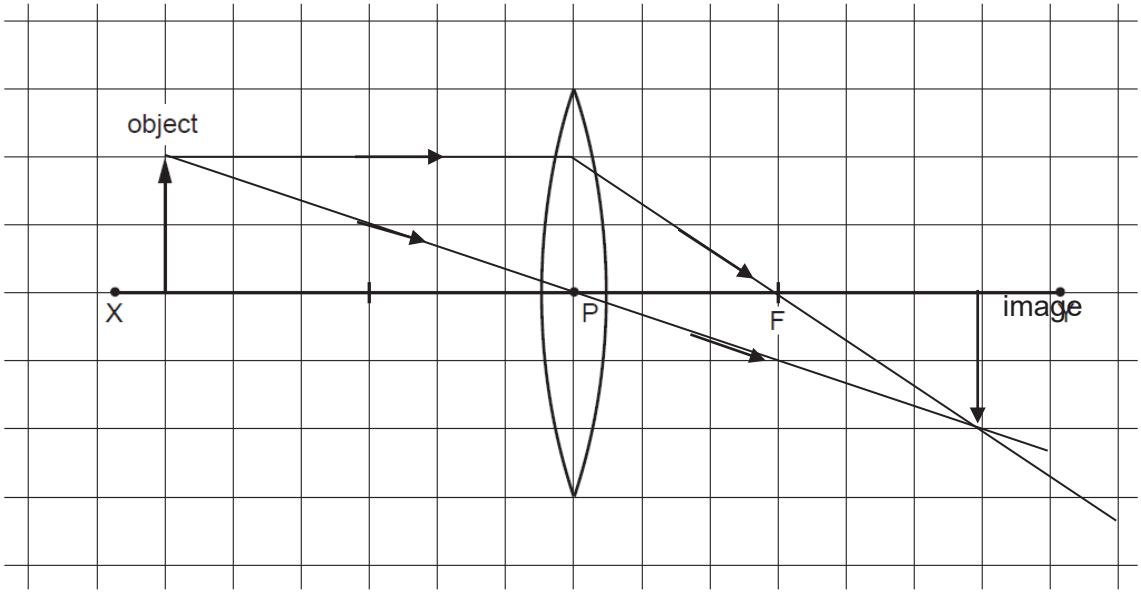
= **41.8 °** [1 for ans]

(b) (iii) [1 for Total Internally Reflected ray, angle 50°, at side **PQ**]
[1 for emergent ray at side **QR**, angle = 75°]

7 (a) [1 mark for each ray converging onto F on the right after passing through the lens]
[**max = 2 marks**]



(b) (i) [1 mark for each ray, **max = 2 marks**]



(ii) The **object distance is the same as the image distance**. OR
The **size of the image is the same as the size of the object**. [1]

8 (a) When the dust particles come into contact with the grid, they **lose electrons to the grid** [1]. Thus the particles will have less negative charges than positive charges and end up with a net positive charge and this cause it to be **attracted to the metal plate**. [1]

(b) Using I = Q / t
= 6.0 / (1 x 60) = **0.10 A** [1 for working & ans]

SECTION B [2 X 10 = 20 MARKS]

9 (a) [**Any TWO** answers. 1 mark each. **Maximum = 2**]

Mass	Weight
A measure of the amount of matter in an object.	The force of gravitational attraction on an object.
SI unit: kilogram (kg)	SI unit: newton (N)
Measured with a beam balance.	Measured with a spring balance.
Mass remains unchanged when it is moved to another place with different gravitational attraction.	Weight changes when it is moved to another place with different gravitational attraction.

(b) Using W = mg
= (1.2 – 0.800)(10)
= **4.0 N** [1 for working, ans & unit]

(c) Using density $= \frac{m}{V} = \frac{0.400}{0.00046}$ [1 for working]
= **870 kg/m^3** [1 for ans & unit]

(d) Using $P = \frac{F}{A} = \frac{4.0}{\left(\frac{0.00046}{0.20}\right)}$ [1 for working]
= **1740 Pa** [1 for ans & unit]

(e) (i) Density **does not change**. Since **Density = Mass / Volume**, both the **mass and volume of the liquid does not change**. [1]

(ii) Pressure will be **reduced**. [1]
According to **P = F/A**, **weight W (= F) of the liquid is smaller on Moon with base area remains constant**. [1]

10 (a) (i) amplitude = **15.0 cm** [1]

(ii) frequency, f = no of oscillations / time
= 20 / 50 [1 for working]
= **0.40 Hz** [1 for ans & unit]

(iii) Using $v = f\lambda$
v = 0.40 x 60 [1 for working]
= **24 cm /s or 0.24 m/s** [1 for ans & unit]
[allow ecf from **(a)(ii)** for value of frequency]

(b) (i) lines = 1 mark
Labelling of **C** and **R** = 1 mark

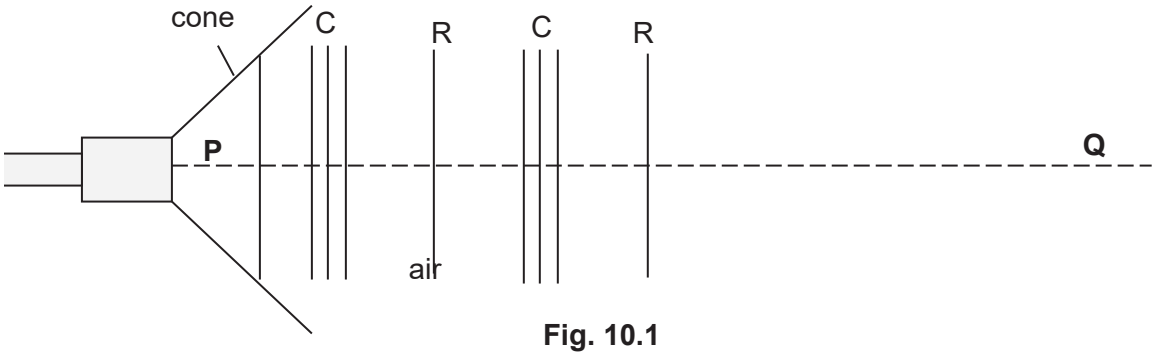


Fig. 10.1

(ii) The sound wave **travels in the direction** (along PQ)
parallel to the direction of the vibration of the air molecules. (along PQ). [1]

(iv) Time = $\frac{2 \times \text{distance}}{\text{speed}} = \left(\frac{2 \times 50}{340}\right)$ [1 for working]

= **0.29 s (accept 0.294 s)** [1 for ans & unit]

11 (a) (i) Rheostat or variable resistor [1]

(ii) (From the graph) current I_L = **0.060 A** [1 for ans & unit]

(iii) Using V = IR

current $I_R = \frac{V}{R} = \frac{4.0}{100}$ [1 for working]

= **0.040 A** [1 for ans & unit]

(iv) current I_X = 0.06 + 0.04

= **0.10 A** [1 for ans & unit]

(b) (i) When the switch is closed, the **solenoid becomes an electromagnet**. [1]
The iron bolt is then **attracted to the solenoid due to magnetic induction**. [1]
This **strong attractive force will overcome the force of the spring** and cause the lock to be unlocked. [1]

(ii) At 4 V, there is **little current flowing through the solenoid**. [1]
Therefore **the magnetic field strength of the solenoid is too weak to attract the iron bolt**. [1]

Name: …… Index No. …… Class: ……

BUKIT BATOK SECONDARY SCHOOL

GCE O LEVEL PRELIMINARY EXAMINATION

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

SCIENCE **5076/03**

Paper 3 Chemistry

15 August 2018

1030 – 1145 h

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use a pencil for any diagrams, graphs or rough working
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions in the spaces provided.
Write your answers in the spaces provided on the Question Paper.

Section B

Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

Electronic calculators may be used.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is given at the end of the paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **19** printed pages

Section A [45 marks]
Answer **all** the questions.
Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the composition of unpolluted, dry air.

(a) Write in the missing name of the gas which occupies 78% of air. [1]

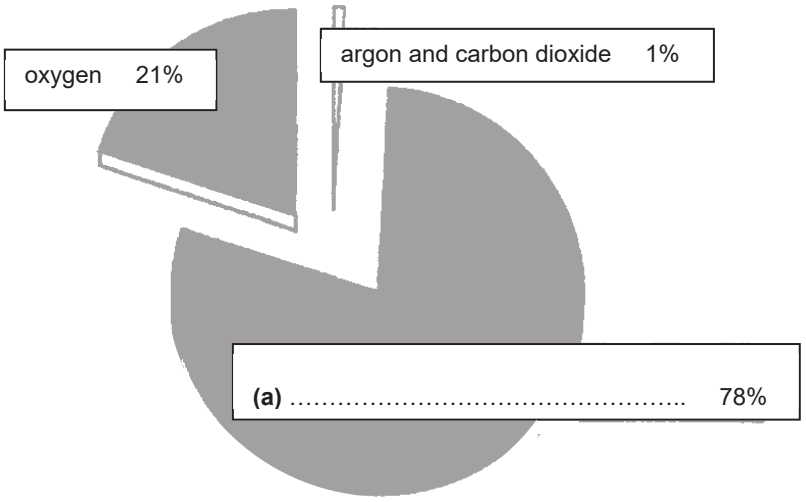


Fig. 1.1

(b) Name two gases that pollute the atmosphere and name the chemical source of each.

Gas 1 .....

Source .....

.....

Gas 2 .....

Source .....

..... [4]

2 A student collected some water from a polluted river.
The water contains some soluble solids and insoluble clay.

(a) State a method that can separate the clay from the rest of the water.

…… [1]

(b) The student then boiled the river water to obtain the soluble solids.
Fig. 2.1 shows how she heated the water.

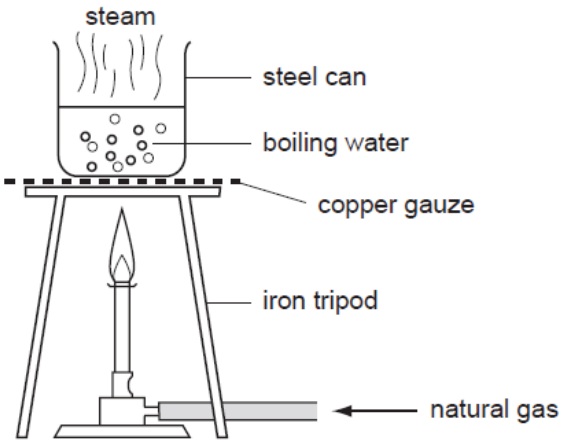


Fig. 2.1

The student wrote in her practical sheet that "*the boiled river water is pure because the universal indicator remains green when it is added to the boiled river water.*"

Do you agree with her statement? Explain.

……..

…….. [1]

(c) On cooling, steam will condense. Describe what happens to the spacing and movement of the particles of steam during condensation.

changes to spacing

……..

changes to movement

…….. [2]

3 Cold packs are used to reduce swelling, inflammation and pain by removing the heat. A list of chemicals from a science laboratory is shown below:

ammonium nitrate, dilute hydrochloric acid, water, anhydrous sodium carbonate, sodium hydroxide

(a) From the list of chemicals provided above, select a **pair** of chemicals that can be used for making a cold pack in a science laboratory.

…….. [1]

(b) Explain your answer in **(a)** and state the type of energy change.

……...

…….. [2]

4 A solution of nitric acid, HNO_3, has a concentration of 126 g/dm^3.

(a) **(i)** Calculate the relative molecular mass of nitric acid.
[Relative atomic masses, A_r : H, 1; N, 14; O, 16]

relative molecular mass = …….. [1]

(ii) Calculate the concentration of the solution in mol/dm^3.

concentration = …….. [1]

(b) Magnesium carbonate reacts with this solution of nitric acid as follows:

$$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$$

(i) What mass of magnesium carbonate react with 500 cm^3 of nitric acid?

Mass of magnesium carbonate = …….. [2]

(ii) Find the volume of carbon dioxide gas produced in this reaction.

Volume of carbon dioxide = …….. [1]

(c) Another nitric acid solution is made by diluting 1.0 mol to make 2.0 dm^3 of solution. What is the concentration of this solution in mol/dm^3?

concentration …….. [1]

5 Fig. 5.1 shows the properties of some elements in Group VII.

Properties	X	Y	Iodine
melting point / °C	- 7.2	- 101.0	114.0
boiling point / °C	58.8	- 35.0	184.0
reaction with aqueous potassium iodide	colourless solution turns brown	colourless solution turns brown	
reaction with cold aqueous sodium hydroxide	reacts quickly and less vigorously to form a colourless solution	reacts rapidly and vigorously to form a colourless solution	reacts slowly to form a colourless solution

Fig. 5.1

(a) State the physical state and colour of **Y** at room temperature and pressure.

…… [1]

(b) Using evidence from Figure 5.1, explain and deduce the identity of **X**.

……

……

……

……

……

…… [3]

(c) Iodine reacts with cold aqueous sodium hydroxide according to the equation:

$$2NaOH + I_2 \rightarrow NaI + NaOI + H_2O$$

(i) Explain why both element **X** and **Y** undergoes similar reaction with cold aqueous sodium hydroxide.

……

…… [1]

(ii) Hence, construct a chemical equation for the reaction between element **X** and cold aqueous sodium hydroxide.

…… [1]

6 Equal masses of lumps of lead (II) carbonate were reacted with three different acids of the same concentration in three separate experiments I, II and III. The acids were in excess and all other conditions were kept the same.

Experiment	Reagents	
I	Lead (II) carbonate	Nitric acid
II	Lead (II) carbonate	Sulfuric acid
III	Lead (II) carbonate	Ethanoic acid

The mass of the lead (II) carbonate was measured and calculated at regular time intervals and the results for experiments I and II are shown in Figure 6.1.

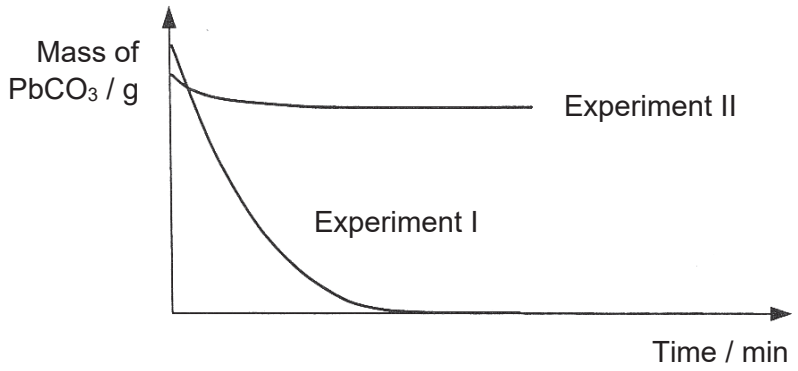


Fig. 6.1

(a) Using Fig. 6.1, determine if lead (II) carbonate react completely with sulfuric acid. Explain your answer.

…… [1]

(b) **(i)** In experiments I and III, would ethanoic acid react faster than nitric acid? Explain your answer in terms of hydrogen ions in the acids.

……..

……..

……..

…… [2]

(ii) Lead (II) ethanoate is a white, crystalline substance with a sweetish taste and is soluble in water.

Sketch on the same axes above, the result for experiment III. [1]

(c) Briefly outline how a pure and dry sample of lead (II) nitrate can be made from lead (II) carbonate.

……

……

……

……

……

……

…… [4]

7 Propane and propene are both organic compounds.

(a) Compare how they react, if at all, with
(i) oxygen,
(ii) hydrogen.

……

……

……

……

……

……

……

……

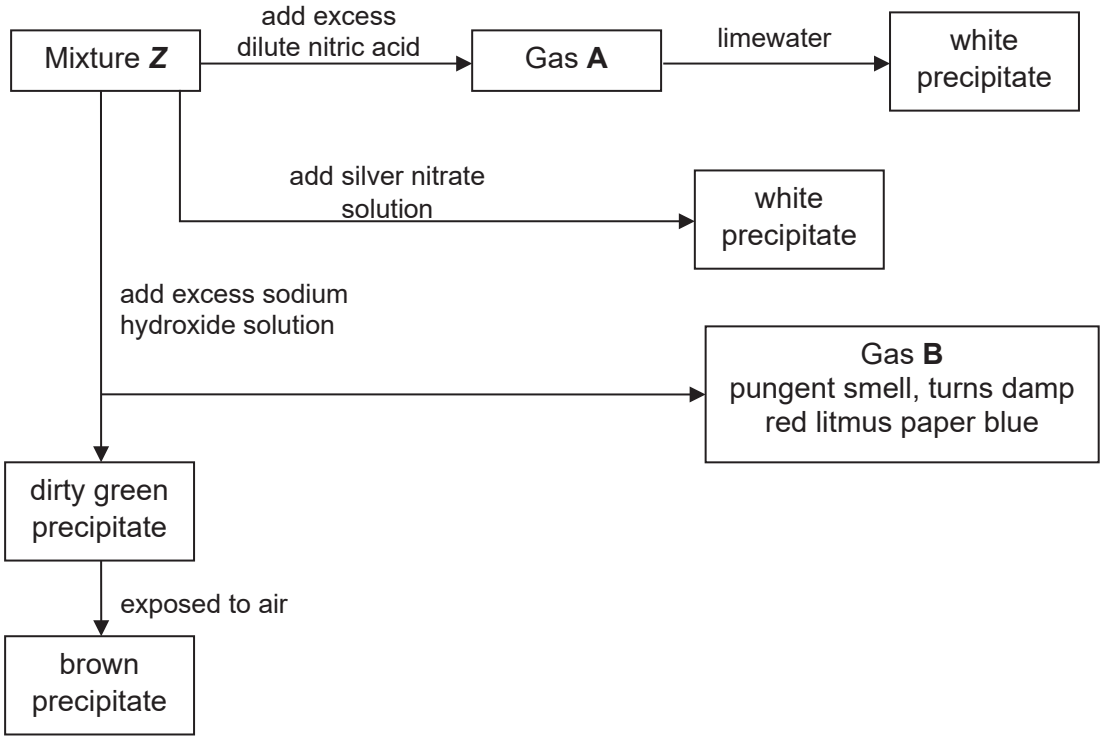
……

……... [5]

(b) Write a chemical equation for any one of these reactions.

……... [1]

8 A mixture ***Z*** was made by dissolving two salts, ***X*** and ***Y***, in water. A series of reactions was carried out on mixture ***Z*** as shown below.



(a) Identify the **four** ions that are present in mixture ***Z***. Justify your answers. [4]

Ions	Formula	Reasons
1		
2		
3		
4		

(b) Predict what would be observed if excess ammonia solution was added to a sample of mixture ***Z***.

……

……... [1]

(c) No reaction was observed when ammonia solution was added to aqueous solution of salt ***Y***.

Give the names of salts ***X*** and ***Y***.

X : ……...

Y : …… [2]

- End of Section A -

Section B [20 marks]
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

9 Fig. 9.1 shows the structures of calcium chloride and chlorine gas.

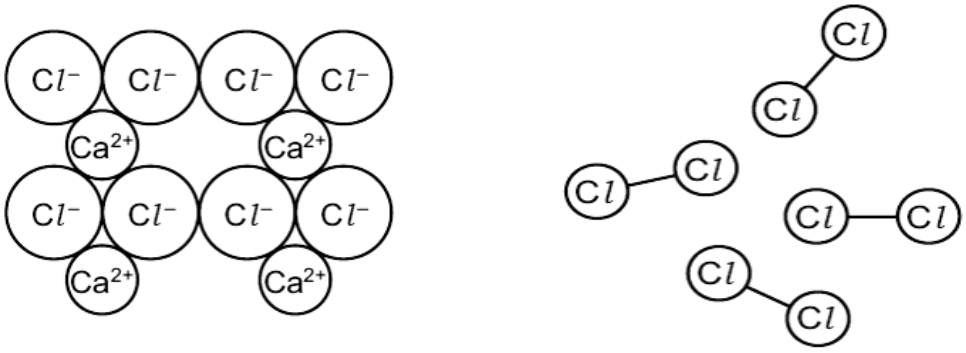


Fig. 9.1

(a) Chlorine exists as two isotopes, ^{35}Cl and ^{37}Cl.
Describe the similarities and differences between these two isotopes.

……

……

…….. [3]

(b) Calcium reacts with chlorine atoms to form calcium chloride.
Fig. 9.2 shows the physical properties of calcium chloride and chlorine.

	conductivity	boiling point/ ^{O}C
calcium chloride	conducts in molten state but not in solid state	1935
chlorine gas	does not conduct electricity	-34

Fig. 9.2

(i) Predict and explain the electrical conductivity of strontium chloride.

……

……

…….... [2]

(ii) Explain how a calcium atom combines with chlorine atoms to form calcium chloride. Your answer should include:

- electronic structures of atoms
- force of attraction in the compound

……

……

……

…….... [3]

(iii) Give a reason why chlorine gas has such a low boiling point.

……

……

…….... [2]

[Total : 10 marks]

10 (a) Duralumin is an alloy made up mainly of aluminium and copper atoms.

Fig. 10.1 shows how the strength of duralumin changes with the different percentage of copper added.

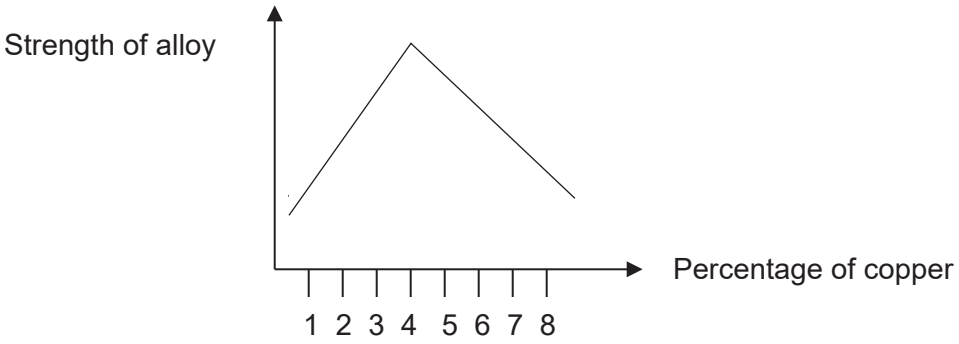


Fig. 10.1

(i) Using the information from Figure 10.1, estimate the percentage of copper that will produce the strongest duralumin mixture.

…… [1]

(ii) Explain, with the aid of a well-labelled diagram of duralumin, why it is stronger than pure aluminium.

……

……

…… [2]

(b) Fig. 10.2 shows the results of an experiment in which four metals are placed in solutions of other metal nitrates.

Solution		Metals added			
Metal nitrate	**Colour**	**Calcium**	**Chromium**	**Cobalt**	**Copper**
Calcium nitrate	Colourless	No reaction	No reaction	No reaction	No reaction
Chromium (III) nitrate	Green	Colourless solution and grey solid	No reaction	No reaction	No reaction
Cobalt (II) nitrate	Pink	Colourless solution and grey solid	Green solution and grey solid	No reaction	No reaction
Copper(II) nitrate	blue	Colourless solution and reddish-brown solid		Pink solution and reddish-brown solid	No reaction

Fig. 10.2

(i) Arrange the four metals in order of their reactivity starting with the most reactive.

…… [1]

(ii) Predict two observations when chromium is added to copper(II) nitrate solution.

……

……

…… [2]

(c) One possible chemical reaction between metal **Y** and the solution of salt **X** is as follows:

$$\mathbf{Y} + \mathbf{X}(NO_3)_2 \rightarrow \mathbf{X} + \mathbf{Y}(NO_3)_2$$

(i) Complete the table below with the missing information.

formula	oxidation state of Y
Y	
$\mathbf{Y}(NO_3)_2$	

[2]

(ii) Using the data above, explain whether **Y** is an oxidizing or a reducing agent.

……

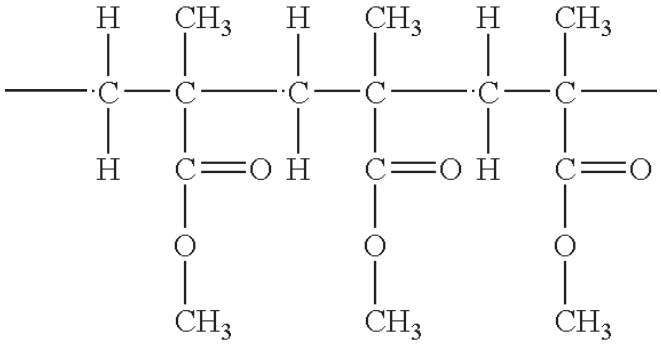
……

……

…… [2]

[Total : 10 marks]

11 Poly(methyl methacrylate) is formed by addition polymerisation.
Its structure is shown below.



(a) **(i)** Draw the structure of the monomer of poly(methyl methacrylate).

[1]

(ii) Explain why and how the monomer drawn in **(a)(i)** can undergo addition polymerisation to form poly(methyl methacrylate).

……

……

……

…… [2]

(b) Ethanol can be obtained from glucose through the process of fermentation. One of the conditions of this process is having an anaerobic environment. Otherwise, substance **X** will be produced instead.

(i) Write the chemical equation for fermentation of glucose.

…… [1]

(ii) Draw the structural formula of substance **X**.

[1]

(iii) Describe a laboratory experiment to differentiate ethanol and substance **X**.

……

……

……

……

…… [3]

(iv) A student carries out fermentation in a laboratory. To speed up the process, he heats up the mixture to 100 ºC. Explain why he will **not** obtain ethanol.

……

…… [1]

(v) State one use of ethanol.

…… [1]

[Total : 10 marks]

- End of Paper –

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

DATA SHEET

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										2 He Helium 4
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 Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulfur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
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 –		

Key

proton (atomic) number

atomic symbol

lanthanoids	57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
actinoids	89 Ac Actinium –	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium –	94 Pu Plutonium –	95 Am Americium –	96 Cm Curium –	97 Bk Berkelium –	98 Cf Californium –	99 Es Einsteinium –	100 Fm Fermium –	101 Md Mendelevium –	102 No Nobelium –	103 Lr Lawrencium –

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

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 1 : Multiple Choice Questions (20 marks)

21	**D**	Sugar = $C_6H_{12}O_6$ where carbon, hydrogen and oxygen atoms are chemically bonded together
22	**C**	Conc sulfuric acid H_2SO_4 dries acidic gases (so they don't react). Upward delivery is used to collect gases which are less dense than air. NH_3 will react with conc H_2SO_4 though it can be collected via upward delivery. CO_2, H_2 and O_2 will not react with conc H_2SO_4 thus can be dried & collected. Only H_2 is less dense than air to be collected via upward delivery method.
23	**C**	Melting point of substance is to be <-150°C and boiling point <-100°C.
24	**C**	Different substances have different solubility in different solvents.
25	**D**	Y – from Group VI because it has 6 valence electrons Z – from Group VII because it gas 7 valence electrons
26	**B**	Hydroxide ion = OH^- There are 8 protons in oxygen and 1 proton in hydrogen atoms = 9 protons F- ion has 9 protons (each fluorine atom has 9 protons, it takes in 1 electron to form a fluoride ion, proton number is not affected thus remains the same).
27	**B**	Rubidium chloride is made up of Rb^+ and Cl^- ions thus RbCl. Group I metals have low melting point and are soluble in water.
28	**D**	Acidic oxide (CO_2) and amphoteric oxides (Al_2O_3 and ZnO) can react with NaOH which is a base.
29	**A**	R is a solid which can react with solution S in a neutralisation reaction. Thus R = insoluble metal oxide (ie a solid) and S = acid (solution)
30	**D**	$BaCl_2$ gives white precipitate = SO_4^{2-} present White precipitate soluble in excess aq NH_3 = Zn^{2+} ion present
31	**B**	No of moles of Mg = mass ÷ molar mass = 6g ÷ 24 = 0.250 mol 1mol Mg produces 1mol H_2 Volume of H_2 = no of moles x molar volume = 0.250 mol x 24 dm^3 = ***6 dm^3***
32	**D**	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ Answer is **NOT** (B) because **LIME** is used to remove acidic impurities, not **limestone**. **LIME** is produced of heat limestone. $CaCO_3 \rightarrow CaO + CO_2$ $CaO + SiO_2 \rightarrow CaSiO_3$
33	**D**	30% of O_2 will be used up, 70% of air left.
34	**C**	(A) formation of bond = exothermic (B) rusting = exothermic (C) melting (ice absorb heat) = endothermic (D) H_2 combust in O_2 to form H_2O = exothermic
35	**D**	Na atom (2.8.1) loses 1 electron to form Na^+ ion (2.8). Loss of electrons = oxidation
36	**B**	½ volume of CO_2 produced , thus ½ mass of limiting reactant ($MgCO_3$) used.

37	**A**	Smallest molecules = lowest boiling point range
38	**C**	Complete combustion produce carbon dioxide and water.
39	**C**	Oxidation of ethanol to ethanoic acid produces water.
40	**B**	It has C=C and carboxyl group (COOH).

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature gas 1m
when fuel is burned/combusted in vehicle engines source 1m

2a. filtration 1m

2b. No. no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure. either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. 1m

3a. Ammonium nitrate and water 1m

3b. Endothermic. 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 1m

4aii. Concentration of HNO_3 = concentration in g/mol ÷ molar mass
= 126 g/mol ÷ 63
= ***2.00 mol/dm^3*** 1m

4bi. No of moles of HNO_3 = concentration x volume
= 2.00 mol/dm^3 x (500/1000) dm^3
= 1.00 mol 1m

2 mol of HNO_3 reacts with 1 mol of $MgCO_3$
1.00 mol of HNO_3 reacts with 0.500 mol of $MgCO_3$

Mass of $MgCO_3$ = no of moles x molar mass 1m
= 0.500 mol x [24 + 12 + 3(16)] *ecf if 1st 1m*
= ***42 g*** *wrong*
overall -1 if any answer not in 3sf

4bii. 2 mol of HNO_3 produces 1 mol of CO_2
1.00 mol of HNO_3 produces 0.500 mol of CO_2

Volume of CO_2 = no of moles x molar volume
= 0.500 mol x 24 dm^3
= ***12 dm^3*** 1m

4c. Concentration = no of moles ÷ volume
= 1.0 mol ÷ 2 dm^3
= ***0.500 mol/dm^3*** 1m

5a. Pale yellow / yellowish-green gas 1m

5b. X could be bromine since it is a liquid. 1m

It is more reactive than iodine since it is able to displace iodine. 1m

But it is less reactive than Y since it reacts less vigorously with sodium hydroxide. 1m

5ci. All of them have seven valence electrons. 1m

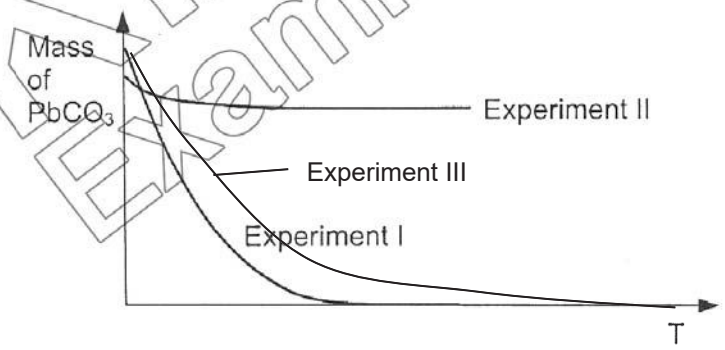
5cii. $2NaOH + X_2 \rightarrow NaX + NaOX + H_2O$ (or use Br for X) 1m

6a. No. Lead (II) sulfate produced is an insoluble salt / there is mass of lead (II) sulfate left. 1m

6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid. 1m

It has / produces lesser H+ ions per unit volume compared to nitric acid. 1m
(Frequency of collisions is lesser thus reaction is slower)

6bii.



1m

6c. (1) Add excess lead (II) carbonate to nitric acid. 1m
(2) Filter to remove excess lead (II) carbonate.
Obtain the filtrate, lead (II) nitrate. (not necessary) 1m
(3) Heat lead (II) nitrate solution till saturation.
Leave to cool for crystals to form. 1m
(4) Filter out the crystals.
Pat dry between filter papers 1m

7a. Both propane and propene reacts with excess oxygen to produce carbon dioxide and water. 1m

Both undergoes incomplete combustion to produce carbon monoxide and water. 1m

Propane does not react with hydrogen. 1m

Propene reacts with hydrogen at (200 °C with nickel catalyst) to produce propane. 1m
have ( ) 1m

7b. $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
$2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$
$2C_3H_6 + 6O_2 \rightarrow 6CO + 6H_2O$
$2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$
$C_3H_6 + H_2 \rightarrow C_3H_8$ either eqn 1m

8a.

Ions	Formula	Reasons
1	Fe^{2+}	*green precipitate formed after adding sodium hydroxide which turned brown over time*
2	NH_4^+	*ammonia gas produced when sodium hydroxide is added*
3	CO_3^{2-}	*carbon dioxide produced after adding nitric acid*
4	Cl^-	*white precipitate formed after adding silver nitrate*

each formula + reason 1m
total 4m

8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

8c. X = iron (II) chloride 1m
Y = ammonium carbonate 1m

Explanation:
Possible answers are
(a) iron (II) chloride and ammonium carbonate
(b) iron (II) carbonate and ammonium chloride
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).
Also, no reaction when aq NH_3 added to Y so Y is an ammonium salt.

Paper 3 Section B : 3 Questions choose 2 (20 marks)

9a. Both have 17 protons. 1m

They have different number of neutron / atomic mass. 1m

^{35}Cl has 18 neutrons/ mass number of 35.
^{37}Cl has 20 neutrons/mass number of 37. 1m

9bi. Strontium chloride conducts in molten state but not in solid state. no marks
The ions (Sr^{2+} and Cl^{-}) are mobile in molten state. 1m
But they cannot move (and are fixed in positions) when in solid state. 1m

9bii. Calcium atom has an electronic configuration of 2.8.8.2.
Chlorine has an electronic configuration of 2.8.7. 1m

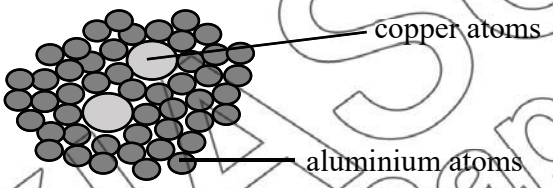
Each calcium atom transfers two valence electrons to 2 chlorine atoms. 1m

Ca^{2+} and Cl^{-} ions are formed which are attracted by electrostatic forces of attraction. 1m

9biii. Weak intermolecular force between chlorine molecules required 1m
little amount of energy to overcome. 1m

10ai. 4% 1m

10aii.



1m

Copper atoms is bigger than aluminium atoms thus they disrupt the orderly arrangement of aluminium atoms and prevent them from sliding. 1m

10bi. Calcium > chromium > cobalt > copper 1m

10bii. Blue solution turns green. 1m
Brown solids formed. 1m

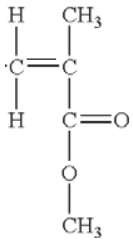
10ci. Y: 0 1m
$Y(NO_3)_2$: +2 1m

10cii. It is a reducing agent. no marks

Y is oxidised as the oxidation state of Y increases from 0 in Y to +2 in $Y(NO_3)_2$. 1m

Y reduces $X(NO_3)_2$ by decreasing the oxidation state of X from +2 to 0 in X. 1m

11ai.



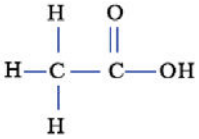
1m

11aii. At **high temperature and pressure (**and in the presence of a catalyst), the **carbon-carbon double bonds** of the monomer **break** / the monomer has C=C bonds which break. 1m

Each monomer forms single bonds and joins with two other monomers. form the polymer, poly(methyl methacrylate). 1m

11bi. $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2CO_2$ 1m

11bii.



1m

11biii. Add potassium manganate(VII) to both substances. 1m
If it turns from purple to colourless, it is substance is ethanol. 1m
If it remains purple, it is substance X. 1m

Also accept –
Use of blue litmus paper
X turns blue litmus paper red
Blue litmus paper remains blue if its ethanol.

Add suitable metal / metal carbonate
If susbstance X, effervescence seen.
H_2 produced with caused lighted splint to extinguish with pop sound (if use metal)
CO_2 produced which formed white precipitate in limewater (if use metal carbonate)

11biv. When the mixture is heated, the yeast denatures and stops the reaction. 1m

11bv. Solvent in paints and varnishes
Manufacture of perfumes, detergent, deodorants etc.
Found in alcoholic drinks like beer, wines and spirits
Used in preparation of ethanoic acid
(Any one) 1m

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature gas 1m
when fuel is burned/combusted in vehicle engines source 1m

2a. filtration 1m

2b. No. no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure, either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. 1m

3a. Ammonium nitrate and water 1m

3b. Endothermic. 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 1m

4aii. Concentration of HNO_3 = concentration in g/mol ÷ molar mass
= 126 g/mol ÷ 63
= ***2.00 mol/dm^3*** 1m

4bi. No of moles of HNO_3 = concentration x volume
= 2.00 mol/dm^3 x (500/1000) dm^3
= 1.00 mol 1m

2 mol of HNO_3 reacts with 1 mol of $MgCO_3$
1.00 mol of HNO_3 reacts with 0.500 mol of $MgCO_3$

Mass of $MgCO_3$ = no of moles x molar mass — 1m
= 0.500 mol x [24 + 12 + 3(16)] — *ecf if 1st 1m wrong*
= ***42 g*** — *overall -1 if any answer not in 3sf*

4bii. 2 mol of HNO_3 produces 1 mol of CO_2
1.00 mol of HNO_3 produces 0.500 mol of CO_2

Volume of CO_2 = no of moles x molar volume
= 0.500 mol x 24 dm^3
= ***12 dm^3*** — 1m

4c. Concentration = no of moles ÷ volume
= 1.0 mol ÷ 2 dm^3
= ***0.500 mol/dm^3*** — 1m

5a. Pale yellow / yellowish-green gas — 1m

5b. X could be bromine since it is a liquid. — 1m

It is more reactive than iodine since it is able to displace iodine. — 1m

But it is less reactive than Y since it reacts less vigorously with sodium hydroxide. — 1m

5ci. All of them have seven valence electrons. — 1m

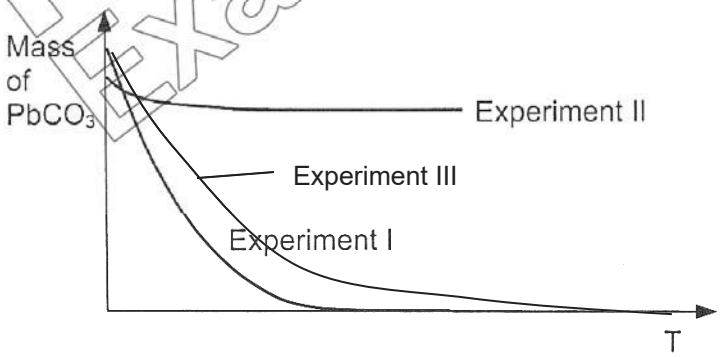
5cii. $2NaOH + X_2 \rightarrow NaX + NaOX + H_2O$ (or use Br for X) — 1m

6a. No. Lead (II) sulfate produced is an insoluble salt / there is mass of lead (II) sulfate left. — 1m

6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid. — 1m

It has / produces lesser H+ ions per unit volume compared to nitric acid. — 1m
(Frequency of collisions is lesser thus reaction is slower)

6bii.



1m

6c. (1) Add excess lead (II) carbonate to nitric acid. — 1m
(2) Filter to remove excess lead (II) carbonate.
Obtain the filtrate, lead (II) nitrate. (not necessary) — 1m
(3) Heat lead (II) nitrate solution till saturation.
Leave to cool for crystals to form. — 1m
(4) Filter out the crystals.
Pat dry between filter papers — 1m

7a. Both propane and propene reacts with excess oxygen to produce carbon dioxide and water. 1m

Both undergoes incomplete combustion to produce carbon monoxide and water. 1m

Propane does not react with hydrogen. 1m

Propene reacts with hydrogen at (200 ^{o}C with nickel catalyst) to produce propane. 1m
have ( ) 1m

7b. $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
$2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$
$2C_3H_6 + 6O_2 \rightarrow 6CO + 6H_2O$
$2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$
$C_3H_6 + H_2 \rightarrow C_3H_8$ either eqn 1m

8a.

Ions	Formula	Reasons
1	Fe^{2+}	*green precipitate formed after adding sodium hydroxide which turned brown over time*
2	NH_4^+	*ammonia gas produced when sodium hydroxide is added*
3	CO_3^{2-}	*carbon dioxide produced after adding nitric acid*
4	Cl^-	*white precipitate formed after adding silver nitrate*

each formula + reason 1m

total 4m

8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

8c. X = iron (II) chloride 1m
Y = ammonium carbonate 1m

Explanation:
Possible answers are
(a) iron (II) chloride and ammonium carbonate
(b) iron (II) carbonate and ammonium chloride
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).
Also, no reaction when aq NH_3 added to Y so Y is an ammonium salt.

Paper 3 Section B : 3 Questions choose 2 (20 marks)

9a. Both have 17 protons. 1m

They have different number of neutron / atomic mass. 1m

^{35}Cl has 18 neutrons/ mass number of 35.
^{37}Cl has 20 neutrons/mass number of 37. 1m

9bi. Strontium chloride conducts in molten state but not in solid state. no marks
The ions (Sr^{2+} and Cl^-) are mobile in molten state. 1m
But they cannot move (and are fixed in positions) when in solid state. 1m

9bii. Calcium atom has an electronic configuration of 2.8.8.2.
Chlorine has an electronic configuration of 2.8.7. 1m

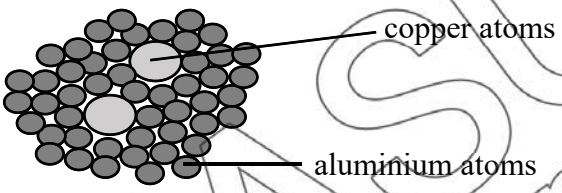
Each calcium atom transfers two valence electrons to 2 chlorine atoms. 1m

Ca^{2+} and Cl^- ions are formed which are attracted by electrostatic forces of attraction. 1m

9biii. Weak intermolecular force between chlorine molecules required 1m
little amount of energy to overcome. 1m

10ai. 4% 1m

10aii.



1m

Copper atoms is bigger than aluminium atoms thus they disrupt the orderly arrangement of aluminium atoms and prevent them from sliding. 1m

10bi. Calcium > chromium > cobalt > copper 1m

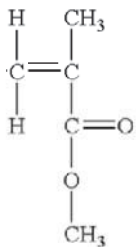
10bii. Blue solution turns green. 1m
Brown solids formed. 1m

10ci. Y: 0 1m
$Y(NO_3)_2$: +2 1m

10cii. It is a reducing agent. no marks

Y is oxidised as the oxidation state of Y increases from 0 in Y to +2 in $Y(NO_3)_2$. 1m

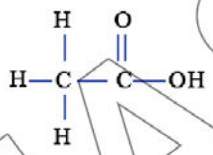
Y reduces $X(NO_3)_2$ by decreasing the oxidation state of X from +2 to 0 in X. 1m

11ai.  1m

11aii. At **high temperature and pressure (**and in the presence of a catalyst), the **carbon-carbon double bonds** of the monomer **break** / the monomer has C=C bonds which break. 1m

Each monomer forms single bonds and joins with two other monomers. form the polymer, poly(methyl methacrylate). 1m

11bi. $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2CO_2$ 1m

11bii.  1m

11biii. Add potassium manganate(VII) to both substances. 1m
If it turns from purple to colourless, it is substance is ethanol. 1m
If it remains purple, it is substance X. 1m

Also accept –
Use of blue litmus paper
X turns blue litmus paper red
Blue litmus paper remains blue if its ethanol.

Add suitable metal / metal carbonate
If susbstance X, effervescence seen.
H_2 produced with caused lighted splint to extinguish with pop sound (if use metal)
CO_2 produced which formed white precipitate in limewater (if use metal carbonate)

11biv. When the mixture is heated, the yeast denatures and stops the reaction. 1m

11bv. Solvent in paints and varnishes
Manufacture of perfumes, detergent, deodorants etc.
Found in alcoholic drinks like beer, wines and spirits
Used in preparation of ethanoic acid
(Any one) 1m