O

GAN ENG SENG SCHOOL
Preliminary Examination 2019

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

SCIENCE (PHYSICS, CHEMISTRY) 5076/01
FOUR EXPRESS / FIVE NORMAL ACADEMIC
Paper 1 Multiple Choice

17 September 2019
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the OTAS in the spaces unless this has been done for you.

There are **forty** questions in 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 OTAS.

Read the instructions on the OTAS 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.

A copy of the Data Sheet is printed on page **18**.
A copy of Periodic Table is printed on page **19.**

The use of an approved scientific calculator is expected, where appropriate.

Total Marks
40

1 Which of the following has the most appropriate order of magnitude?

A Diameter of Earth: 1 x 10^{7} m
B Diameter of an atom: 1 x 10^{-5} m
C Length of a bus: 1 x 10^{4} m
D Thickness of a human hair: 1 x 10^{-3} m

2 Amber takes 6.0 s to walk from point **W** to point **X**, and takes 6.0 s to walk from point **X** to point **Y** and finally another 6.0 s to walk from point **Y** to point **Z** as shown below in Fig. 2.

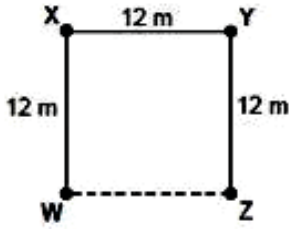


Fig. 2

The points **WXYZ** form a square with side 12 m. What is the magnitude of her average speed and velocity?

	Average Speed (m/s)	Average Velocity (m/s)
A	2.0	0.50
B	2.0	0.67
C	2.0	2.0
D	6.0	0.67

3 Zonglin, an astronaut, held a feather in one hand and a hammer in the other while on the moon. He dropped both objects together from the same height and both arrived at the same time on the ground.

This experiment shows that …….. .

A the gravitational field on the moon is the same as that on Earth
B objects on the moon has no weight
C the same force was acting on each object
D both the feather and the hammer fell with the same acceleration

4 Fig. 4 shows part of a car braking system.

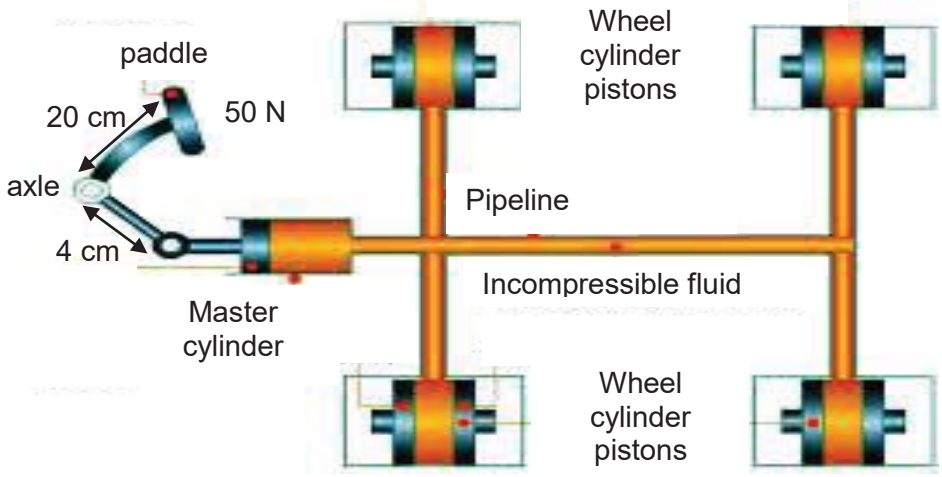
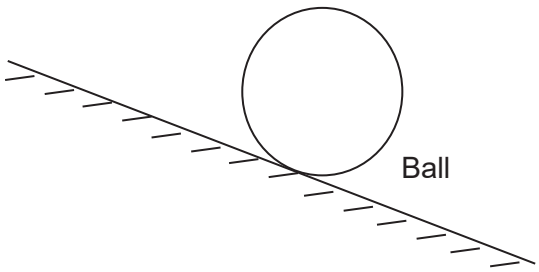


Fig. 4

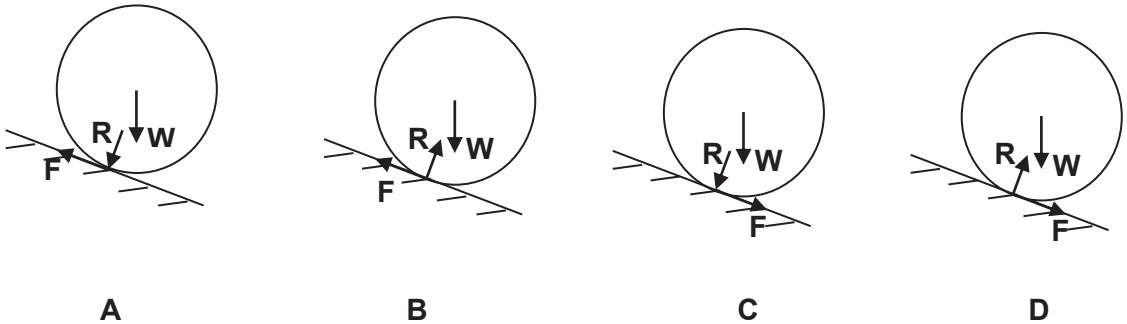
If the driver exerts a force of 50 N on the paddle, what is the pressure transmitted to the fluid in the master cylinder of cross sectional area 5.0 cm^2, $\mathbf{P_m}$, and the pressure transmitted to the 4 small cylinders of the wheels of cross sectional area 1.0 cm^2, $\mathbf{P_w}$?

	$\mathbf{P_m}$ / N $\mathbf{cm^{-2}}$	$\mathbf{P_w}$ / N $\mathbf{cm^{-2}}$
A	250	250
B	250	63
C	50	50
D	50	13

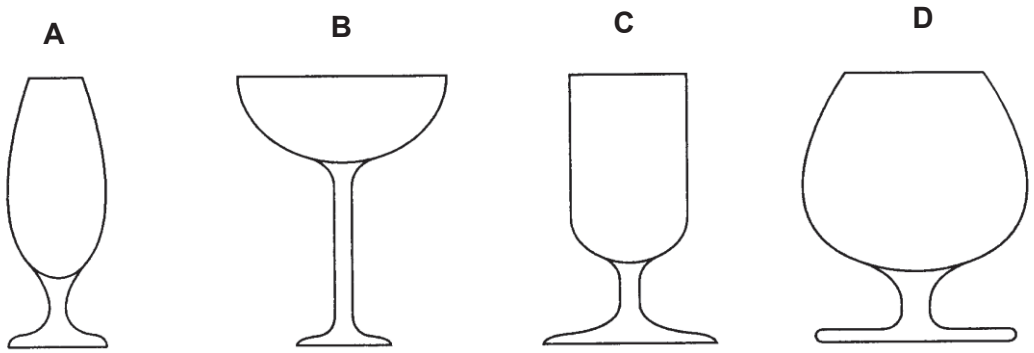
5 The diagram below shows a ball with a weight of **W** that is rolling down a slope at constant velocity. The frictional force **F** is acting on the ball. **R** is the contact force acting on the ball.



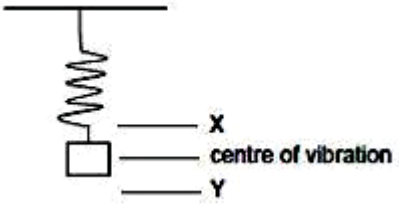
Which of the following shows the correct free-body diagram?



6 The diagrams below show the cross-section of different glasses. Which one is the least stable when they are filled to the brim with water?



7 A mass M is hung from a spring. It is then pulled down slightly and allowed to vibrate vertically between **X** and **Y**.



Which correctly describes the energy at **X** and **Y**?

	Energy at X	Energy at Y
A	Kinetic	Kinetic
B	Kinetic	Potential
C	Potential	Kinetic
D	Potential	Potential

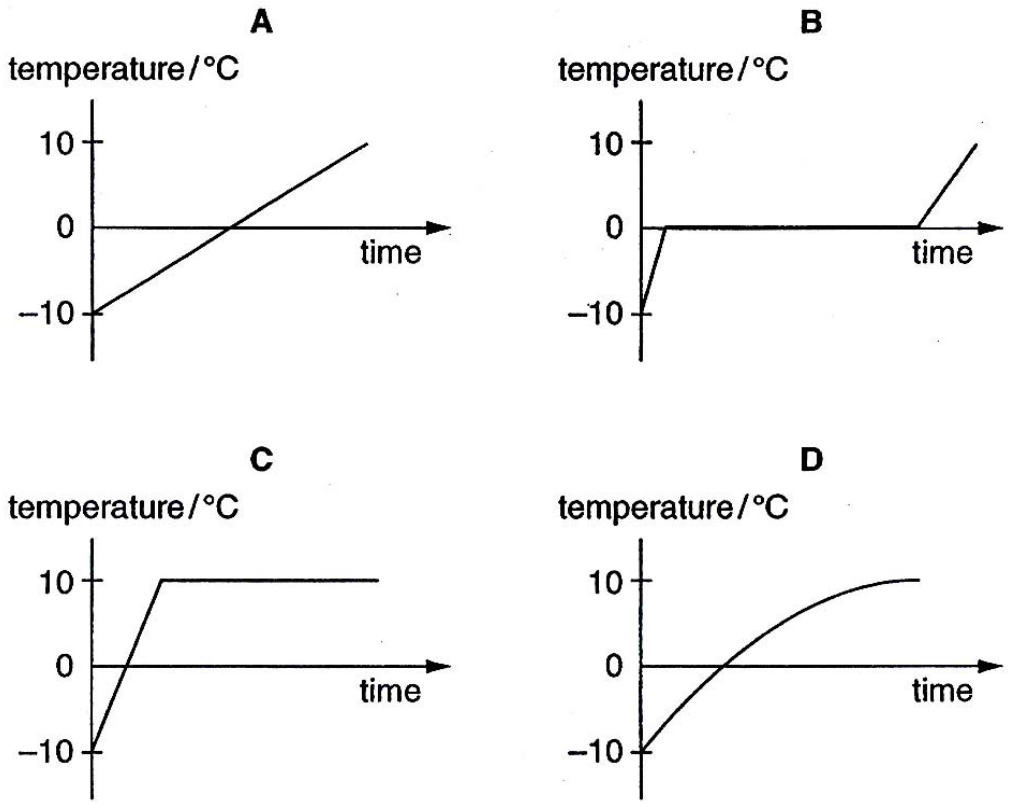
8 A gas is heated in a sealed container. Which of the following does not increase?

A The average distance between the gas molecules.
B The average kinetic energy of the gas molecules.
C The number of collisions of gas particles on the walls of the container.
D The average force exerted by the gas on the walls of the container.

9 Which of the following statements about the vacuum flask is **incorrect**?

A Loss of thermal energy by radiation is minimized by keeping hot water in a double-walled glass container.
B Loss of thermal energy is minimized by using a cork or plastic stopper to close up the neck of the glass container.
C The vacuum in the double-walled glass container effectively prevents conduction and convection.
D The walls of the glass container are silvered to reduce radiation.

10 Ice at –10°C is heated at a constant rate until it is water at +10°C.
Which graph shows how the temperature changes with time?



11 Fig. 11 shows the top view of the wave-fronts of water waves radiating from a vibrating source in a pool.

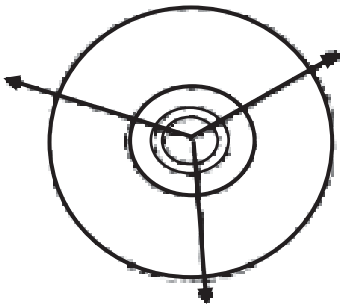
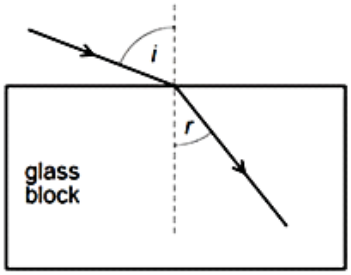


Fig. 11

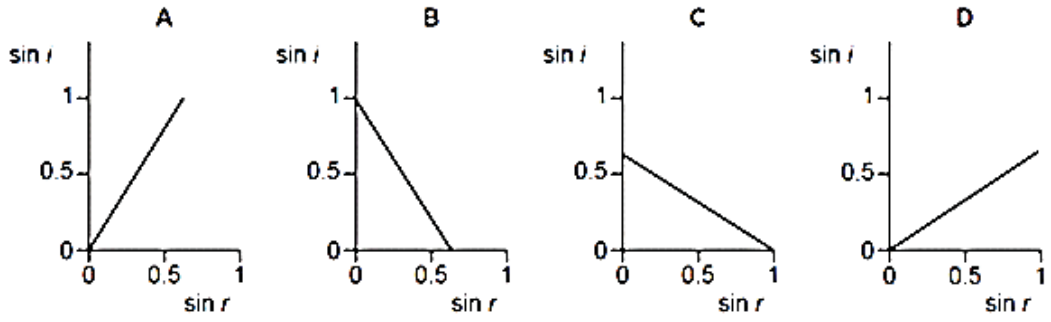
As the wave travels away from the vibrating source, its ……

A speed increases.
B frequency increases.
C wavelength decreases.
D frequency is decreases.

12 A ray of light enters a glass block at an angle of incidence *i*, producing an angle of refraction *r* in the glass.



Several different values of *i* and *r* are measured, and a graph is of sin *i* against sin *r* is drawn. Which graph is correct?



13 Jovan conducts an experiment in which a lens forms a blurred image of an object on a screen as shown in Fig. 13.

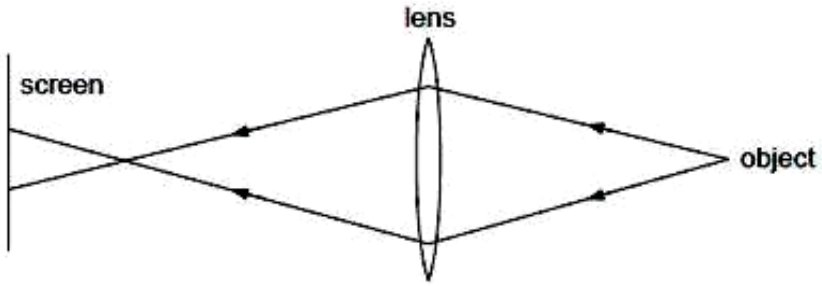


Fig. 13

How can Jovan ensure that the image is focused on the screen?

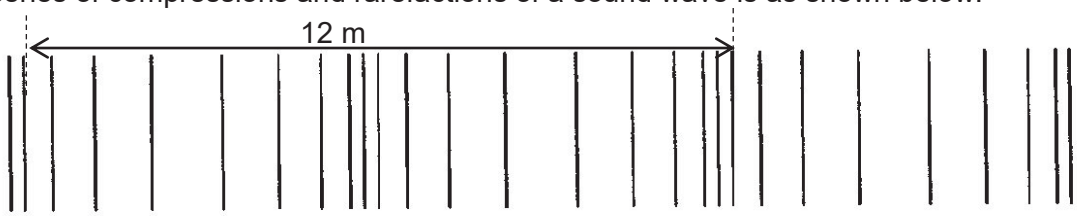
A Use a lens with a shorter focal length at the same position
B Move the screen away from the lens
C Move the object closer to the lens
D Use a brighter object at the same position

14 Which of the following statement is **true** about **R** in the following electromagnetic spectrum?

Radiowave	**P**	**Q**	Visible light	**R**	**S**	Gamma ray

A It comes from radioactive materials.
B It has the shortest wavelength.
C It is given out by a hot object.
D It causes tanning of the skin.

15 A series of compressions and rarefactions of a sound wave is as shown below.



Given that the speed of sound is 300 m/s, what is the frequency of this sound wave?

A 12.5 Hz
B 25.0 Hz
C 50.0 Hz
D 75.0 Hz

16 Fig. 16.1 shows a drum inside a photocopier. After an intense beam of light is shone on the image on the paper, positive charges remain on the drum as shown. Fig. 16.2 shows the drum rolling and toner power is attracted to the drum. Fig. 16.3 shows a piece of paper passing over the drum's surface.

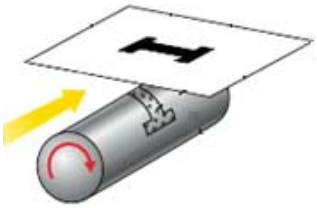


Fig. 16.1

Fig. 16.2

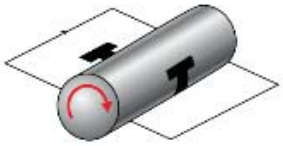
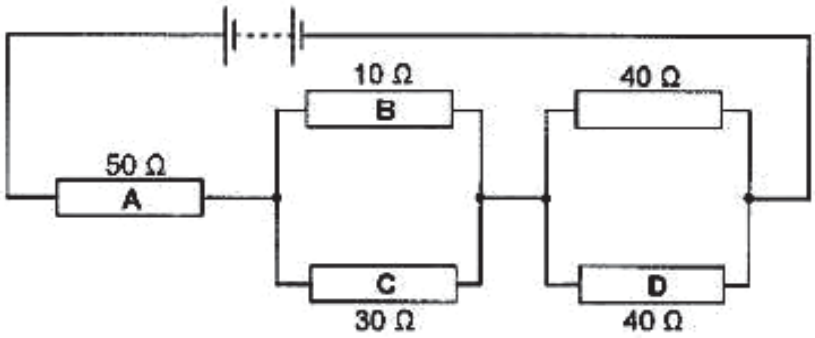


Fig. 16.3

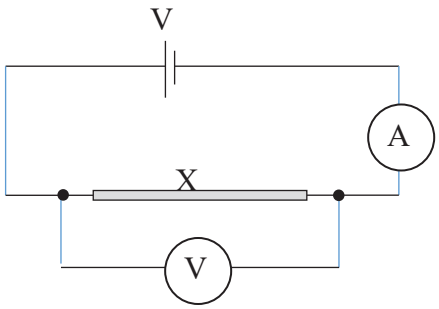
Which row of the table correctly states the charge of the toner and the paper?

	charge of toner	**charge of paper**
A	positive	negative
B	negative	positive
C	positive	positive
D	negative	negative

17 The diagram shows a circuit containing five resistors connected to a battery. In which resistor is the current the smallest?



18 A resistor X is made from a length L of resistance wire with a cross sectional area A. It is connected to a simple electrical circuit and the voltmeter and the ammeter readings are recorded.



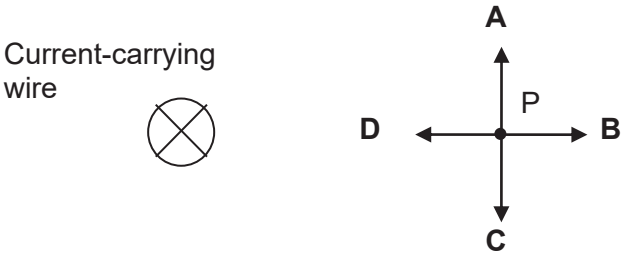
A second resistor Y made from wire of the same material has a length 2L and cross-sectional A. It is then connected in parallel with wire X to the electrical circuit.
Which of the following **correctly** describes the readings observed from the voltmeter and ammeter?

	Voltmeter Reading	**Ammeter Reading**
A	Decrease	Decrease
B	Decrease	Increase
C	No Change	Decrease
D	No Change	Increase

19 Five electrical appliances were left switched on for different times. In which appliance is the greatest amount of energy converted?

	Appliance	**Time**
A	3 kW water heater	0.5 h
B	1.5 kW hot-plate	2.0 h
C	750 W pressing iron	3.0 h
D	100 W lamp	15.0 h

20 The diagram shows a wire carrying current into the plane of the page. What is the direction of the magnetic field at point P?



21 The table below contains details of four different particles. The letters are **not** chemical symbols.

	K	**L**	**M**	**N**
nucleon number	3	14	19	23
proton number	2	7	10	11
total number of electrons	2	7	10	11

Which of the particles **K, L, M** and **N** will form an ionic compound with chlorine?

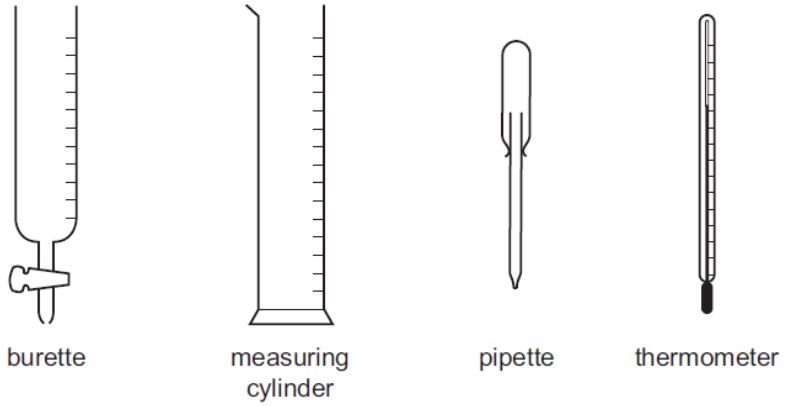
A K

B L

C M

D N

22 The four pieces of apparatus shown below are used in chemical experiments.



Which statement about the apparatus is correct?

A The burette can be used to measure 17.30 cm^3 of solution to a flask.

B The measuring cylinder measures the mass of a substance used in an experiment.

C The pipette can be used to add 250 cm^3 of liquid to a beaker.

D The thermometer collects and measures the temperature of a water-soluble gas.

23 Alcohol and water are completely miscible. This means when mixed together they form only one liquid layer.

Which method is used to separate alcohol from water?

A filtration

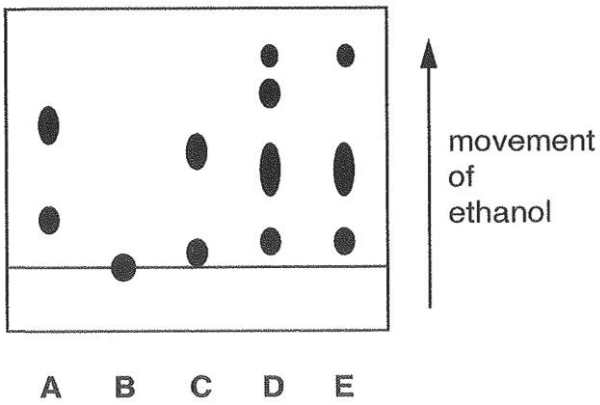
B fractional distillation

C precipitation

D crystallisation

24 Food scientists use paper chromatography to compare the food colourings in food. The colourings labelled **A, B, C, D** and **E** were separated into their components using chromatography with an ethanol solvent.

Their results are shown as a chromatogram.



Which two of **A, B, C, D** and **E** contain similar food colourings?

A A and C

B C and D

C B and C

D D and E

25 The initial temperatures of the silver nitrate and sodium chloride solutions are measured and recorded after a few minutes.

initial temperature of silver nitrate solution = 28.0 °C

initial temperature of sodium chloride solution = 29.0 °C

The sodium chloride solution is then immediately poured into the Styrofoam cup containing the silver nitrate solution. The mixture is stirred and the following temperature is recorded.

highest temperature of the mixture = 37.5 °C

Which of the following statements is true?

A The reactants have a lower energy level as compared to the products.

B Heat is lost by the reactants to the surrounding.

C Heat is gained by the reactants from the surrounding.

D The products gained energy from the surrounding.

26 What is always true for a pure substance?

A It always boils at 100 ºC.

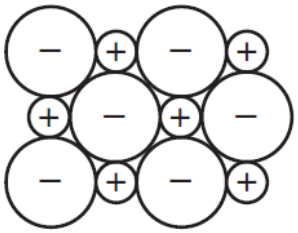
B It contains only one type of atom.

C It has a fixed melting point.

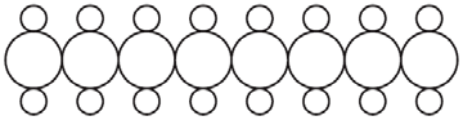
D It is solid at room temperature.

27 Which diagram could represent the structure of an alloy?

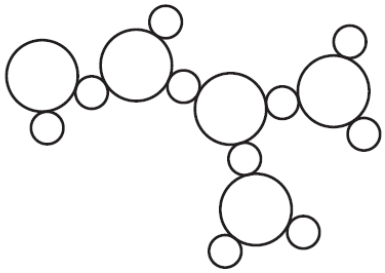
A



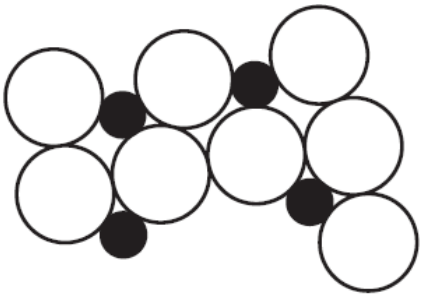
B



C



D



28 Sodium chloride is an ionic solid.

Which statement is **not** correct?

A Ions are formed when atoms lose or gain electrons.

B Ions in sodium chloride are held together by weak intermolecular forces of attraction.

C Ions of opposite charge attract each other.

D Solid sodium chloride cannot conduct electricity.

29 20 cm^3 of methane is reacted with 70 cm^3 of oxygen.

The equation for the reaction is shown.

$$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (l)$$

All volumes are measured at r.t.p.

What is the **total** volume of gas remaining at the end of the reaction?

A 90 cm^3

B 50 cm^3

C 30 cm^3

D 20 cm^3

30 Which of the following reacts with ammonium salt to produce ammonia gas?

A hydrochloric acid

B sulfuric acid

C sodium chloride solution

D sodium hydroxide

31 Aluminium is the most common metal in the Earth's crust.

Which is **not** a property of aluminium?

A ductile

B malleable

C good conductor of electricity

D low melting point

32 The table shows the formula of oxides of different elements.

	sulfur	**potassium**	**aluminium**
formula of oxide	SO_2	K_2O	Al_2O_3

Which row describes the nature of oxide for different elements?

	sulfur	**potassium**	**aluminium**
A	acidic	acidic	amphoteric
B	acidic	basic	amphoteric
C	basic	acidic	basic
D	neutral	basic	basic

33 What is the approximate composition of dry air?

A 78% nitrogen, 21% oxygen and the remainder being noble gases

B 78% nitrogen, 21% oxygen and the remainder being noble gases and carbon dioxide

C 78% nitrogen, 20% oxygen and the remainder being carbon dioxide

D 78% nitrogen, 20% oxygen and the remainder being noble gases and carbon dioxide

34 Which equation shows a reduction reaction?

A $CaCO_3 \rightarrow CaO + CO_2$

B $NaOH + HCl \rightarrow NaCl + H_2O$

C $Cl_2 \rightarrow 2Cl^-$

D $Zn \rightarrow Zn^{2+}$

35 Astatine is an element in Group VII of the Periodic Table.

What are the likely properties of astatine?

	colour	**state**
A	black	solid
B	dark brown	liquid
C	green	gas
D	yellow	solid

36 Which reaction does **not** take place in the dark?

A $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

B $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

C $C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$

D $C_2H_4 + H_2 \rightarrow C_2H_6$

37 The table below describes several changes.

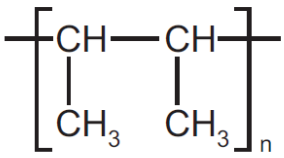
Process I	sugar solution and yeast	⟶	formation of ethanol
Process II	silver nitrate solution and hydrochloric acid	⟶	insoluble silver chloride formed
Process III	carbon	⟶	carbon dioxide formation

What are the suitable descriptions of the following changes?

	process I	**process II**	**process III**
A	fermentation	precipitation	oxidation
B	hydrogenation	neutralisation	oxidation
C	oxidation	neutralisation	polymerisation
D	fermentation	hydrogenation	oxidation

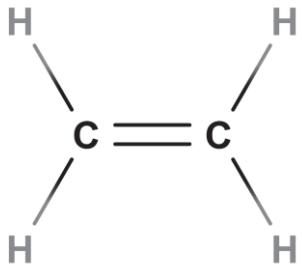
38 Polymers are made by addition polymerisation of simple molecules called monomers.

The structural formula of a polymer is given below.

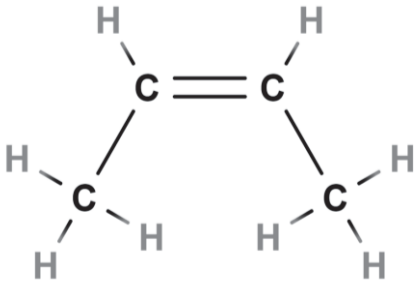


Which is the structural formula of its monomer?

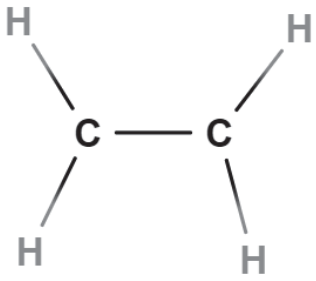
A



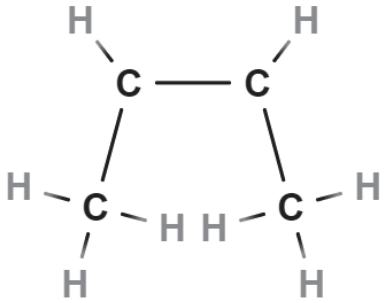
B



C

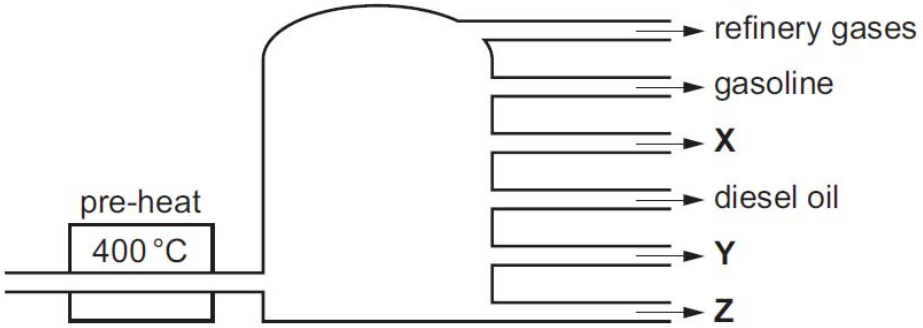


D



39 Petroleum is a mixture of hydrocarbons. In an oil refinery, it is separated into useful fractions.

The diagram shows some of these fractions.



What are fractions **X, Y** and **Z**?

	X	Y	Z
A	paraffin (kerosene)	naphtha	bitumen
B	naphtha	paraffin (kerosene)	bitumen
C	paraffin (kerosene)	bitumen	lubricating oil
D	paraffin (kerosene)	lubricating oil	bitumen

40 When left exposed to air, butanol is slowly oxidised to form a product.

Which statements about the product are correct?

1. It is a compound with a $-CO_2H$ group.
2. It burns in air and can be used as a fuel.
3. It has the general formula of C_nH_{2n}.

A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

END OF PAPER

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

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		**Key** proton (atomic) number atomic symbol name relative atomic mass									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 –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	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.).

O

GAN ENG SENG SCHOOL
Preliminary Examination 2019

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

SCIENCE (PHYSICS)
FOUR EXPRESS / FIVE NORMAL ACADEMIC

5076/02
3 September 2019
1 hour 15 minutes

Paper 2

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
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.
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 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	45
Section B	20
…….....	
……...	
Total	65

For Examiner's Use

Section A [45 marks]

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

1 Delton uses a pair of vernier calipers to measure the internal and external diameter of a hollow pipe. The readings are shown in Fig. 1.

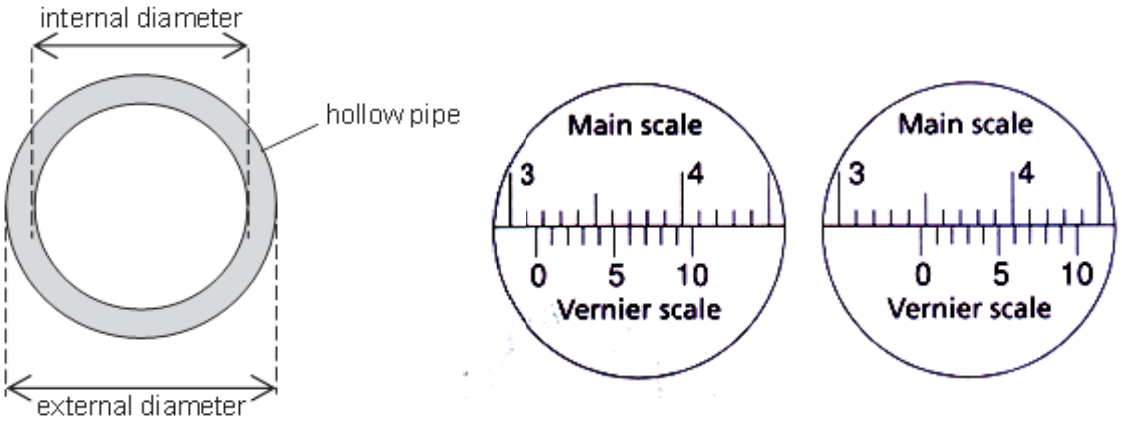


Fig. 1

(a) If the vernier caliper has a negative zero error of 0.08 cm, calculate the thickness of the pipe.

Thickness = ……[2]

(b) Suggest a method to increase the accuracy of the readings.

……

……[1]

2 Dave pushes a block of mass 500 g up a rough inclined plane with an initial velocity of 9.0 m/s. The block returns to its starting point 4 seconds later with a velocity of 3.0 m/s. Fig. 2 shows the set-up and the corresponding graph.

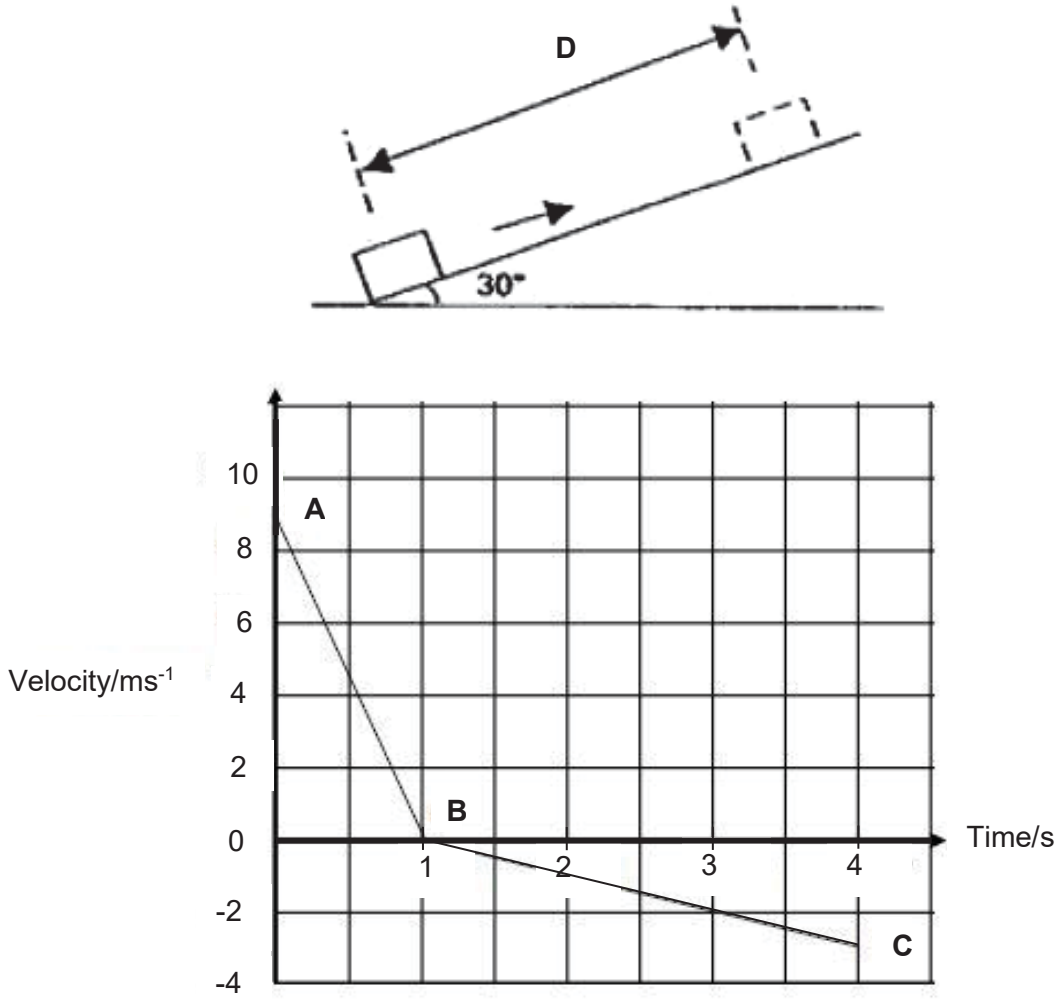


Fig. 2

(a) Using values that can be taken from the graph, describe the motion of the object:

(i) between **A** and **B**, and

……..

……..

……[1]

(ii) at **B**.

……..

……[1]

For Examiner's Use

2 **(b)** Calculate the maximum distance **D** that the object has travelled up on the inclined plane.

Maximum distance **D** = ……[2]

3 During the National Day Parade, a 70 kg sky diver jumped off from a height of 1000 m carrying a parachute of 10 kg. The diver falls freely before opening his parachute. Fig. 3 shows a table indicating the upward air resistance acting on the diver for the first 7 seconds of his fall.

Air Resistance / N	0	100	240	450	800	800	800	2400
Time / s	0	1	2	3	4	5	6	7

Fig. 3

State and explain during the period of time during which the diver falls at constant speed.

.....

……..

……..

……

……[2]

For Examiner's Use

4 Fig. 4.1 shows a rectangular barge of dimensions 2.0 m x 1.2 m x 0.4 m.

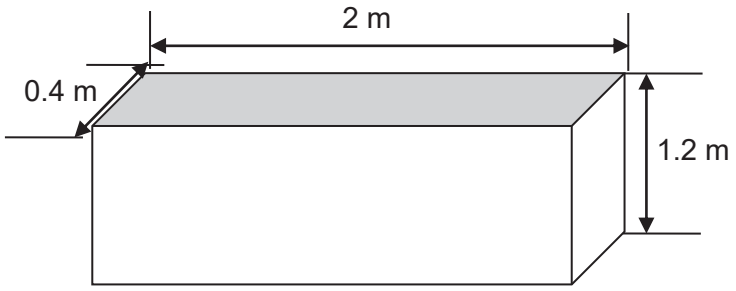


Fig. 4.1

(a) Given that the density of the block is 7800 kg/m^3, calculate the mass of the block.

Mass = ……[2]

(b) Calculate the maximum pressure that can be exerted by the barge on the ground.

Maximum pressure = ……[2]

For Examiner's Use

4 (c) The barge is submerged in seawater and tethered by a taut rope as shown in Fig. 4.2. The current in the seawater is pushing the barge with a force of 50 kN to the right, causing the rope to have an angle of 30 º to the vertical.

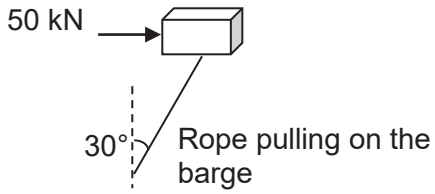


Fig. 4.2

Draw a scaled vector diagram to determine the tension in the rope. Indicate the scale that you are using.

Scale = ……

Tension = ……[4]

For Examiner's Use

5 Fig. 5.1 shows a section of a vertical door with a horizontal hinge along its lower edge. C_1 is the position of the centre of gravity of the door. Fig 5.2 shows the door with a piece of wood attached so that the door is less likely to open by itself. The new position of the centre of gravity of the door and the wood is C_2. The thickness of the door is 8.0 cm.

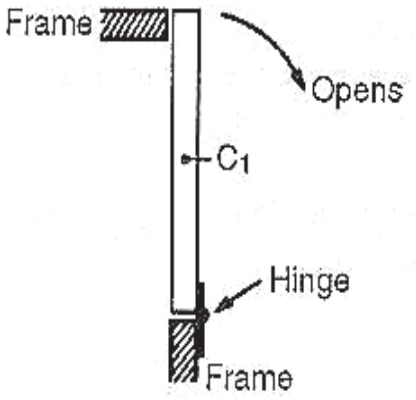


Fig. 5.1

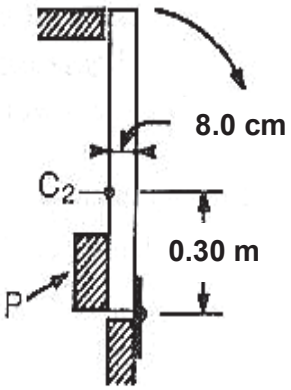


Fig. 5.2

(a) Explain why the door is less likely to fall open with wood P attached to it.

……..

……..

…….[2]

(b) The combined weight of the door and wood P is 35 N. Calculate the moment required to hold the door closed when it is in the vertical position, as shown in Fig. 5.2.

Moment = …… [2]

For Examiner's Use

6 Fig. 6 shows a section of a solar heating system which helps to provide hot water for a house.

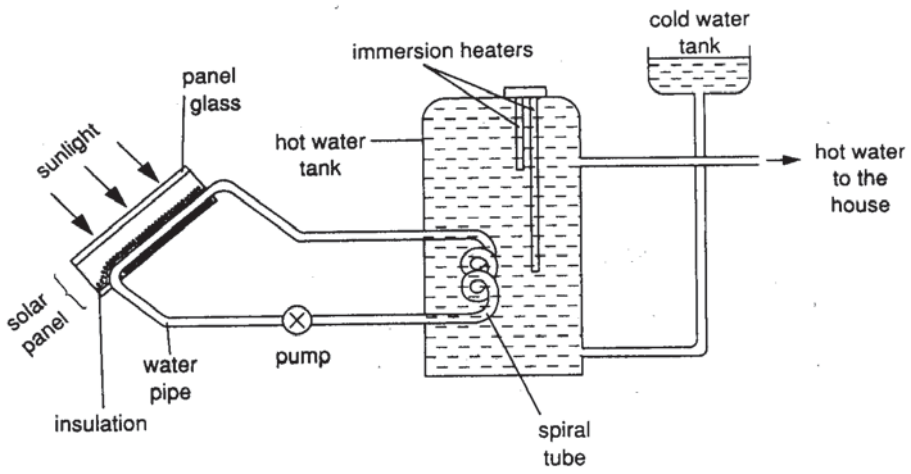


Fig. 6

It consists of a solar panel placed outdoor on a roof. Connected to this panel are water pipes. Heat from the Sun warms the water in these pipes which is then pumped to a hot water tank inside the house. Inside the hot water tank, the hot water transfers its heat, becomes cooled and circulates back to the solar panel.

Explain the purpose of the following features.

(a) The solar panel is covered with a sheet of glass.

……..

……..[1]

(b) The insulation for the water pipe in the solar panel.

……..

……..[1]

(c) The water pipe in the hot water tank is spiral in structure, painted black and made from copper.

……..

……..

……..

……..

……

……..[3]

For Examiner's Use

7 **(a)** Fig. 7.1 shows the displacement-distance graph of a vibrating string at time t = 0 s.

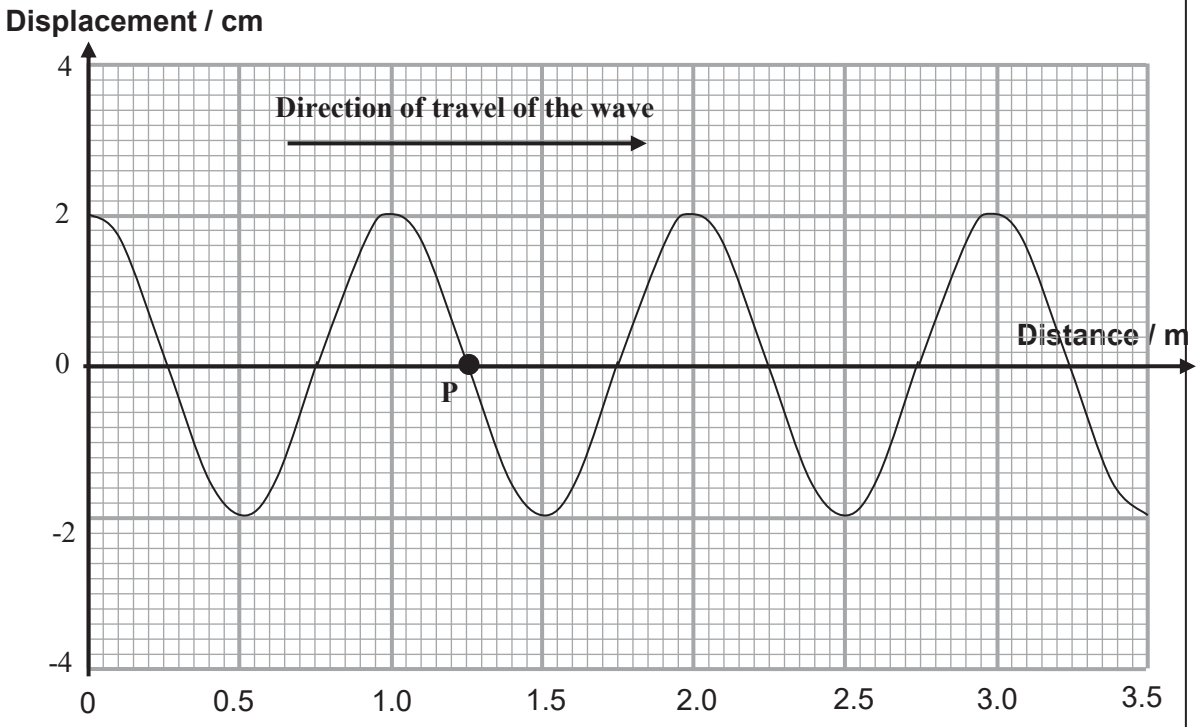


Fig. 7.1

(i) Describe the direction of movement of P for one complete cycle starting from time t = 0 s.

……...

……

……[2]

(ii) It takes 0.6 s for point P to move two cycles. Calculate the speed of the wave.

Speed = ……[2]

For Examiner's Use

7 **(b)** Fig. 7.2 shows a very large plane mirror, inclined at 45° to the horizontal, beneath a pattern on the high ceiling of a hall.

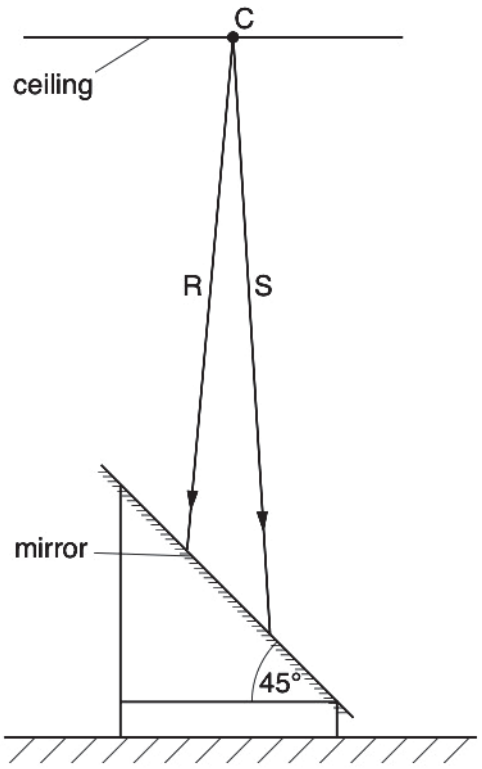


Fig. 7.2

The mirror is set on a stand at head-height immediately below the centre C of the pattern. R and S are two rays of light from C that strike the mirror.

(i) On Fig 7.2, draw the rays R and S after they strike the mirror. [1]

(ii) Show how these rays can be used to locate the image of C. Mark and label the position of this image with the letter **I**. [2]

For Examiner's Use

8 Fig. 8 shows a circuit with three switches S_1, S_2 and a lamp L_1.

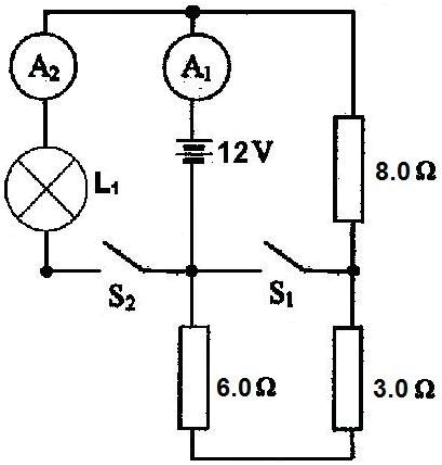


Fig. 8

(a) Calculate A_1 when S_1 is closed.

A_1 = ……..[2]

(b) When both S_1 and S_2 are closed, A_2 shows 0.8 A. What is the resistance of L_1?

Resistance = ……[2]

(c) Explain how the brightness of the lamp is affected when S_1 is opened while S_2 is closed.

…….

…….

…….[2]

For Examiner's Use

9 **(a)** Fig. 9.1 shows the electrical wiring of a house.

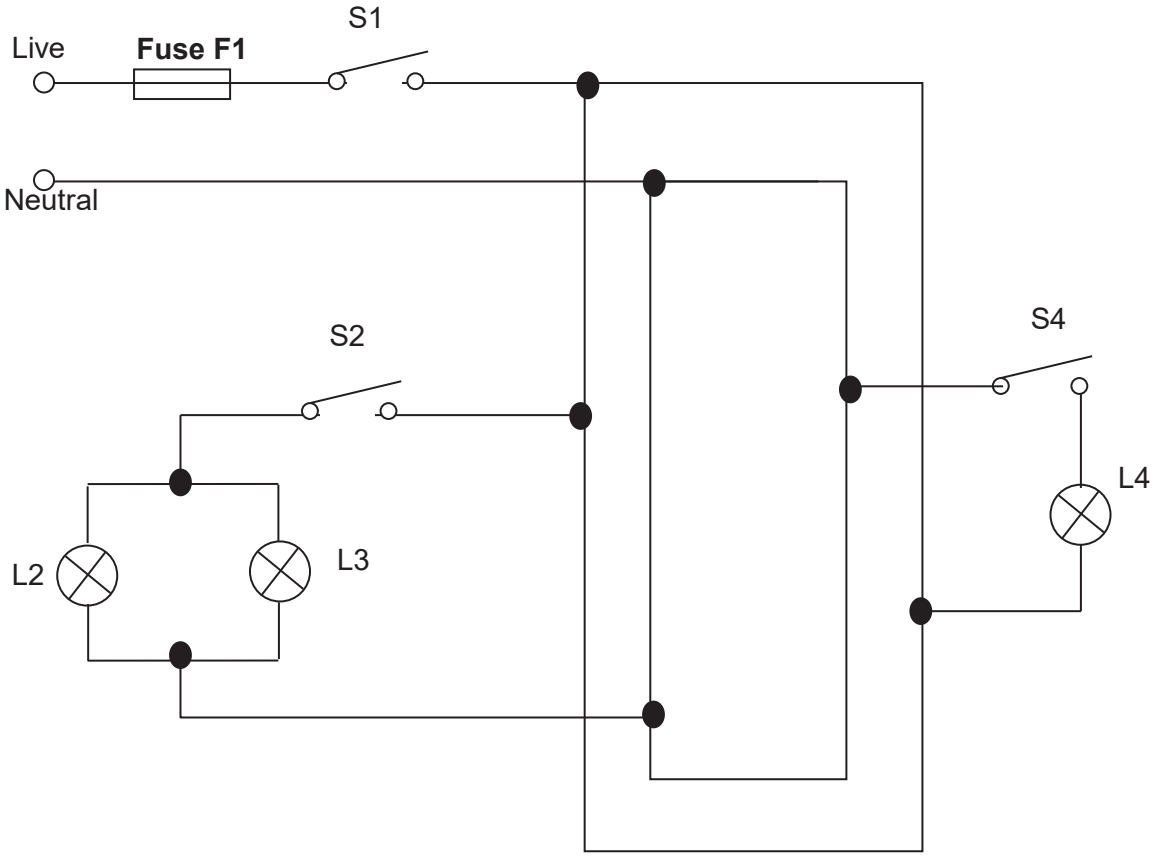


Fig. 9.1

(i) State why lamp L4 is wrongly connected.

……

……[1]

(ii) State the purpose of the fuse.

……

……[1]

(iii) Explain why the switch and fuse should be placed on the live wire.

……

……[1]

9 **(b)** Fig. 9.2 shows an iron rod AB resting in a magnetic field and connected to a circuit. The rod can move freely in the magnetic field.

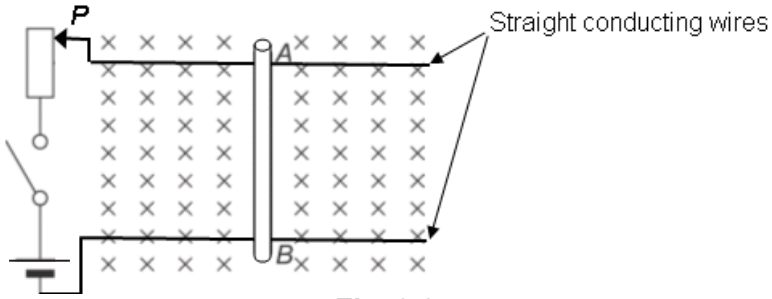


Fig. 9.2

(i) State and explain what happens to the rod when the switch is closed.

……

……

……[2]

(ii) State what happens to the rod when P is moved closer to the switch.

……..

……..[1]

Section B [20 marks]

For Examiner's Use

Answer any **two** questions in this section.

Write your answers in the spaces provided.

10 (a) Singapore experiences many thunderstorms every year. Tall buildings and trees have a higher likelihood of being hit by lightning in these storms. Fig 10.1 shows a thunder cloud with a flat, positively charged base. It passes over a cluster of trees growing on a flat, open land.

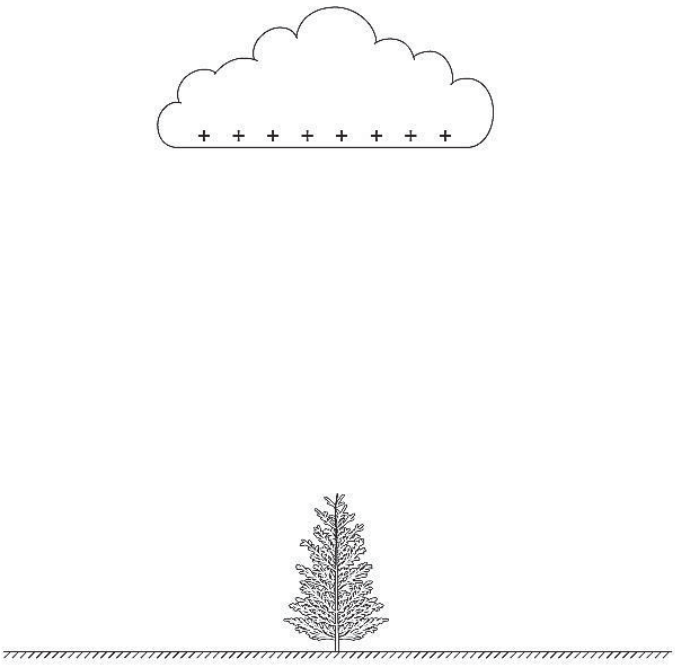


Fig. 10.1

(i) On Fig. 10.1, mark the charges on the tree. [1]

(ii) Explain how the tree may be struck with lightning.

……

……

……

……[2]

(iii) In the lightning strike, a charge of 620 C passes from the cloud to the tree. Given that the strike took place in 2.5 x 10^{-4} s, calculate the average current in the lightning strike.

Current = ……..[2]

For Examiner's Use

10 (b) Zhetai set up the apparatus as in Fig. 10.2 in a lab. Two flat metal plates are positioned horizontally with one above the other. He connected the positive terminal of a high voltage power supply to the bottom plate and the negative terminal to the top plate.

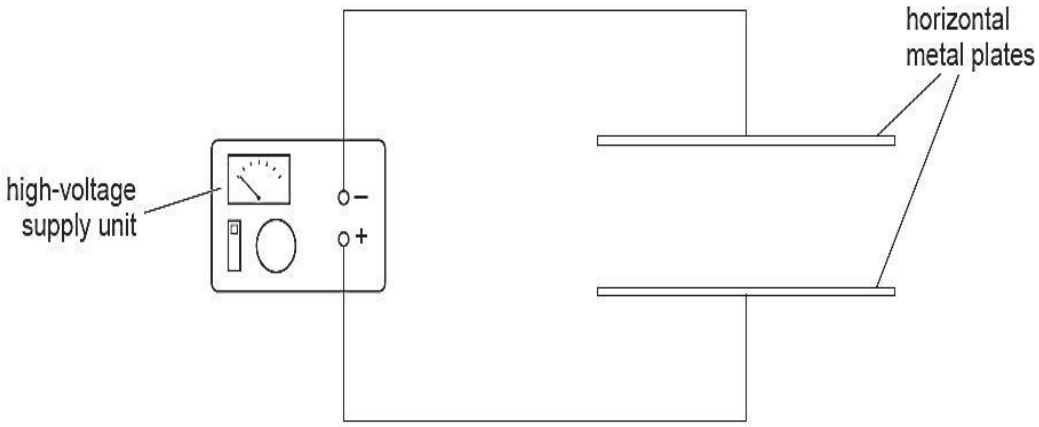


Fig. 10.2

(i) On Fig 10.2, draw the shape and direction of the electric field produced. [2]

(ii) State what is meant by an *electric field*.

……

……[1]

(iii) Zhetai observed that when a small, charged oil droplet was placed between the metal plates, it accelerated downwards. State the charge of the oil droplet and explain the observed movement.

……

……

……

……[2]

For Examiner's Use

11 Ships can make use of ultrasound waves to determine the depth of the sea. An ultrasound pulse is emitted from a ship and the echo is received by a receiver on the ship. The receiver then records the time, t, at which the echo returns to the ship.

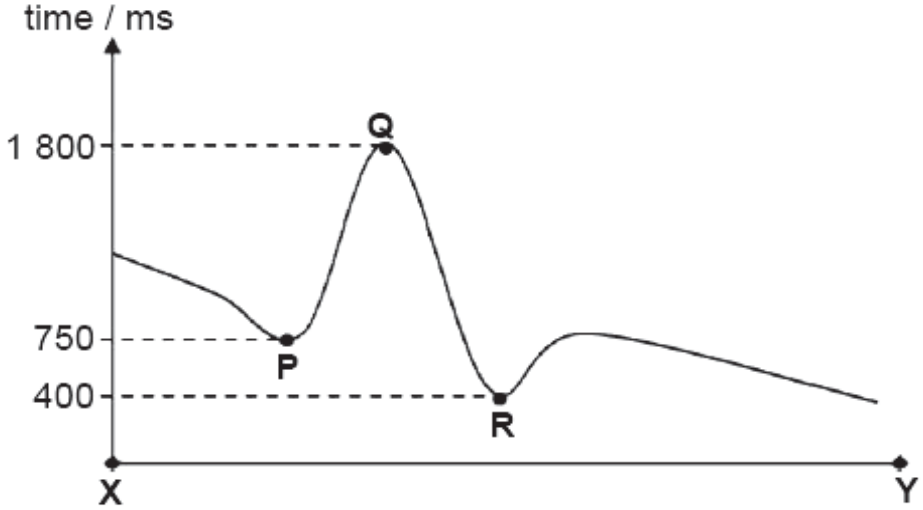


Fig. 11.1

Fig. 11.1 shows the graph recorded by the receiver indicating the duration taken for the ultrasound pulse to return to the receiver as the ship moves from point X to point Y.

(a) State what is meant by *ultrasound waves*.

……

……[1]

(b) Describe how the ultrasound waves travel from the ship to the seabed.

……

……

……

……[2]

(c) Determine which point, **P**, **Q**, or **R**, is deepest. Explain your answer.

……

……

……

……[2]

(d) Calculate the depth of the seabed at point **P**. The speed of sound in water is 1500 m/s.

Depth of seabed = ……[2]

11 **(e)** Given that the frequency of the ultrasonic waves is 45 kHz, determine the wavelength of the ultrasound waves in water.

Wavelength = ……[2]

(f) As the ship approaches more shallow regions of the sea, the receiver produces a sound wave as shown in Fig. 11.2.

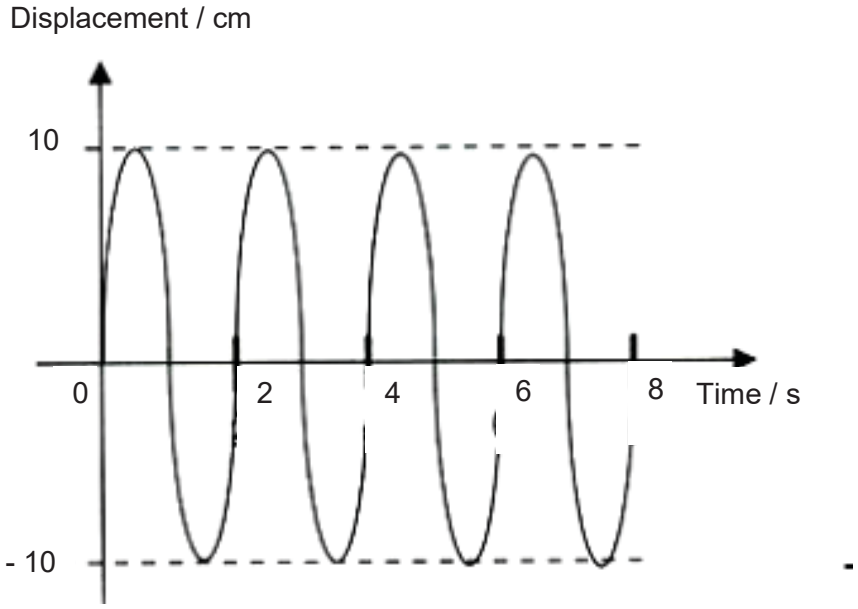


Fig. 11.2

The transmitter is tuned to produce a new sound wave that has double the frequency and half the loudness of the sound wave in Fig. 11.2. Sketch on Fig.11.2, a well-labelled displacement-time graph for the new sound as it passes through the same location.

[1]

For Examiner's Use

12 Pole vaulting is an Olympic track and field event in which an athlete uses a long and flexible pole to jump over a bar. To do so, the athlete sprints towards the bar before planting the pole into a vault box to initiate the jump.

Fig. 12.1 shows a sprinting athlete holding a straight pole just before he plants the pole into the vault box. Fig. 12.2 shows the athlete during the jumping phase of the vault as he launches himself in an attempt to clear the bar.

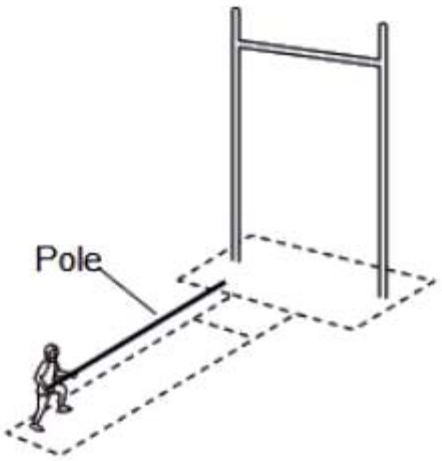


Fig. 12.1

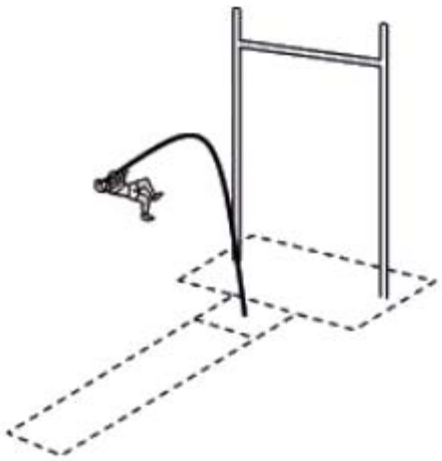


Fig. 12.2

(a) State and explain the energy changes that have taken place for the athlete and the pole between the events in Fig. 12.1 and Fig. 12.2.

(i) Athlete: …….

……[1]

(ii) Pole: ……..

……[1]

(b) The athlete releases the pole and reaches a height of 6.1 m, clearing the bar. He has a mass of 70 kg.

(i) Calculate the average speed at which he was running, such that he could clear the bar.

Average speed = ……[2]

For Examiner's Use

12 (b) (ii) Calculate the output power of the athlete if he can run up to the vault in 5.4 s.

Power = ……[2]

(iii) Calculate the force exerted by the athlete on a 1.5 m landing foam if it deforms by 0.50 m when he lands on it.

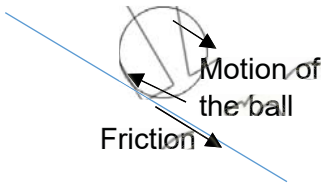
Force = ……[2]

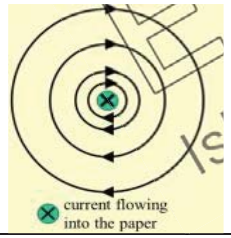
(iv) State and explain if the answer you calculated in **(b)(i)** is higher, same or lower than the actual average speed of the athlete.

……

……[2]

END OF PAPER

No	Answer	Remark
1	A	Diameter of the Earth : 1.2×10^{7} m Diameter of atom : 1×10^{-10} m Length of bus: 1×10^{1} m Thickness of hair: 1×10^{-4} m
2	B	Average speed = total distance / total time = 36 / 18 = 2 m/s Average velocity = total displacement / total time = 12 / 18 = 0.67 m/s
3	D	Without the effect of air resistance, objects that are dropped from a height will experience free-fall, meaning that the only force acting on it is its weight. Hence, both objects will experience the same acceleration due to gravity.
4	C	Sum of moments about axle are equal: 50 N x 0.20 = Force on master cylinder x 0.04 Force on master cylinder = 250 N Pressure on master cylinder, P_m = F/A = 250 / 5 = 50 N cm^{-2} $P_w = P_m$ = 50 N cm^{-2}
5	D	Since the ball rolls down the slope, the motion of the ball at the point of contact between the ball and slope is upwards. Hence, friction is downwards. 
6	B	As all the glasses are filled with water, the CG of glass B will be higher. The CG of glasses A, C, D will be lower than that of B.
7	D	Both X and Y are turning points in the motion of the mass M. Hence, the speed of the mass at these points is minimum, leading it to have maximum gravitational potential energy at X and maximum elastic potential energy at Y.
8	A	As a gas in a sealed container is heated, the average kinetic energy of the molecules increases as the temperature increases too. Thus, the number of collisions of the gas on the walls of the container increases and the average force exerted by the molecules on the walls increases as well. However, the gas does not expand as it is in the a sealed container and thus, the average distance does not increase.
9	A	Radiation is minimised through changes in surface area, colour and texture. Hence, using a double walled glass container does not minimize radiation but instead conduction (since glass is a thermal insulator).
10	B	Ice melts at 0 ^{o}C.

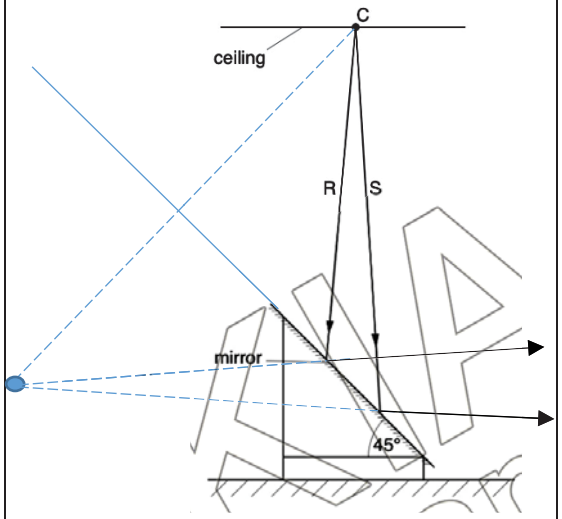
11	A	As the wave moves away, the distance between the wavefronts is increasing. This indicates an increase in wavelength. Since v = fλ, the speed is increasing.
12	A	Given that the light ray enters a glass block, the incident angle, i, is always larger than refracted angle, r (light ray will bend towards the normal). Hence, we know that the value of sin i should be larger than the value of sin r. Additionally, we know that the gradient of sin i – sin r graph should be positive due to our knowledge of refractive index: n = sin i / sin r .
13	C	The image is formed at the intersection of the two rays. To ensure the image on the screen is focused, the intersection of the rays should occur at the screen. Using a shorter focal length would make the rays bend more and the image will be formed closer to the lens. Moving screen away will make the image more blurry. Moving object closer to the lens will cause the intersection of the rays to occur further away from the lens. Changing the brightness of the object will not improve the focus of the image.
14	D	R – ultraviolet rays. S – Xrays.
15	C	Wavelength (distance between successive compressions/rarefactions) = 12/2 = 6 m v = fλ 300 = f (6) f = 50.0 Hz
16	B	The question states that the drum is positive. If the toner is attracted to the drum, it is negatively charged as unlike charges attract. Similarly, for the toner to be attracted to paper, it must be positively charges as unlike charges attract.
17	C	Current in A is the largest as it is the only resistor in series. In the parallel branch of B and C, more current flows through B as it has a lower resistance than C. As for the parallel branch of D, both resistors will have the same current (half of current in A) as they have the same resistance. Hence, C has the least current.
18	D	Resistance wire with length 2L has twice the resistance of X. However, since in parallel with X, total resistance in the circuit will drop. Hence, the current in the circuit will increase. Since X is parallel with the new resistor, the p.d. across both wires are still the same.
19	B	Water heater: 3 kW x 0.5 h = 1.5 kWh Hot plate: 1.5 kW x 2.0 h = 3.0 kWh Iron: 0.75 kW x 3.0 h = 2.25 kWh Lamp: 0.1 kW x 15.0 h = 1.5 kWh
20	C	The direction of the current is into the paper. To find the magnetic field, use the right hand grip to find that the direction of the magnetic field: 

Paper 2

No	Answer	Mark	Remarks
1a	External diameter = 3.47 cm Internal diameter = 3.16 cm Thickness = (3.47 – 3.16) / 2 = 0.155 cm	1 1	
1b	More measurements can be taken from different locations on the pipe to find an average thickness.	1	

2ai	The object slows from 9 m/s to 0 m/s at a uniform rate of 9 m/s^2 as it goes up the ramp.	1	
aii	The object stops momentarily before it increases its velocity from rest to 3 m/s in the opposite direction at a constant rate of 1 m/s^2.	1	
b	Distance travelled = area under the graph = ½ x 9 x 1 = 4.5 m	1 1	
3	The diver falls at constant speed between 4 s to 6 s. This is because the force from the air resistance is the same as the total combined weight of the diver and his load. Since the forces are balanced, the resultant force is zero.	1 1	
4a	Mass = density x volume = 7800 x (0.4x 2 x 1.2) = 7488 kg = 7490 kg	 1 1	
4b	Pressure = F / A = 74880 / (1.2 x 0.4) = 156000 Pa	 1 1	
4c	1 cm : 10 kN (or appropriate scale)	1	

	Labelled forces, arrows Correct Diagram Tension = 10 cm x 10kN = 100 kN (95 kN – 105 kN)	1 1 1	
5a	Adding wood P has lowered and changed the location of the centre of gravity of the door such that it is on the left of the hinge. The line of action of the weight through the new cg causes an anticlockwise moment about the hinge, which prevents the door from opening.	1 1	
5b	Moment = F x d = 35 x 0.08 = 2.8 Nm	 1 1	
6ai	Glass traps the heat from the sunlight much like a greenhouse effect.	1	
6aii	The water pipe is insulated to prevent heat loss.	1	
6aiii	Spiral features are to increase the surface area of the pipe.	1	

	Black is a good emitter of heat Copper is a good conductor of heat.	1 1	
7ai	At t = 0 s, P is at a distance of 1.25 m. It then is displacement in the positive direction until a maximum of 2 m before displacement in the negative displacement until a maximum of – 2 m. It then returns to the original position.	1 1	
7aii	Period = 0.6/2 = 0.3 s Speed = 1.0/0.3 = 3.33 m/s	 1 1	
7b	 Rays R and S (with arrow, correct angle) Position of image perpendicular to mirror extension, labelled.	 1 1 1	

8a	When S1 closed: V = IR 12 = I (8) I = 1.5 A	 1 1	
8b	When both are closed: V = IR 12 = (0.8) R R = 15 Ω	 1 1	
8c	No change to brightness. Since S2 is parallel, the PD across the light bulb does not change regardless whether the switch S2 is open or closed.	1 1	
9ai	The switch should be on the live instead of the neutral wire.	1	
9aii	The fuse will melt and break the circuit to protect the circuitry from damage when excessive current that exceeds the fuse rating flows through it.	1	
9aiii	The switch and fuse should be placed on the live wire so that the appliances will be disconnected from high potential when the switch is off or when the fuse is blown.	1	
9bi	AB will move to the right. There will be a resultant force that acts on AB as it is a current carrying conductor in a magnetic field.	1 1	
9bii	AB moves to the right with greater force/speed	1	
10 ai	Negative charges clustered on the top of the tree, positive charges at the bottom half.	1	
aii	The positive charges at the bottom of the cloud induces a negative charge at the top of the tree as unlike charges attract. The charges build up until there is a discharge from the tree to the cloud.	1 1	

aiii	Current = Charge / Time = 620 / (2.5 x 10^{-4}) = 2.48 x 10^{6} A	1 1	
bi	Field direction from + to – Parallel lines	1 1	
bii	Electric field is a region in which a charge experiences a force.	1	
biii	Negatively charge It moves downward towards the positively charged plate as unlike charges attract.	1 1	
11a	Ultrasound waves are waves that have a high frequency beyond the normal hearing range of 20kHz.	1	
11b	The pulse from the ship causes adjacent water molecules to vibrate. This allows the sound energy to travel through the water in a series of compressions and rarefactions as a longitudinal wave.	1 1	
11c	Q is the deepest The time taken for the echo to return from Q is the longest.	1 1	
11d	Speed = 2d/t 1500 = 2d / (750 x 10^{-3}) D = 562.5 m	1 1	
11e	v = f λ 1500 = 45000 x λ λ = 0.0333 m	1 1	
11f	Amplitude labelled at 5 m Period labelled at 1 s	1	
12ai	When running, kinetic energy to gravitational potential energy and kinetic energy	1	

aii	Kinetic energy to elastic potential energy and gravitational potential energy	1	
bi	Change in GPE = Change in KE $Mgh = ½ mv^2$ $v^2 = 2gh$ $= 2 \times 10 \times 6.1$ $= 122$ $v = 11.0$ m/s	1 1	
bii	Output power = total energy/time = mgh/time = 70 x 10 x 6.1 / 5.4 = 790.7 W = 791	1 1	
biii	KE of athlete = 70 x 10 x (6.1 – 1.5) = 3220 J Work done to stop athlete = 3220 F x d = 3220 F = 6440 N	1 1	
biv	Higher. Work is also done to overcome air resistance.	1 1	