O

GAN ENG SENG SCHOOL
Preliminary Examination 2020

CANDIDATE NAME

CLASS | | | **INDEX NUMBER** | | |

PHYSICS
Paper 1 Multiple Choice

6091/01

14 September 2020
1 hour

Sec 4 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

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

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.

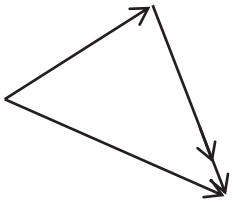
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

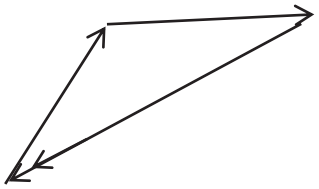
Total Marks
40

1 Which of the following vector addition shows correctly the addition of two forces?

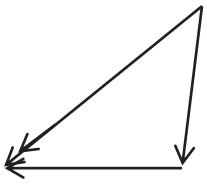
A



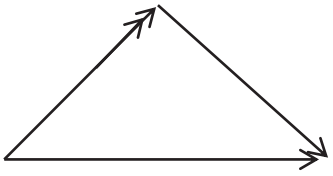
B



C



D



2 Which of the following representing the longest length?

A	400 μm	**B**	0.004 Gm
C	4 000 dm	**D**	40 Mm

3 Object X falls freely from rest for 3 seconds and object Y also falls freely from rest for 6 seconds.

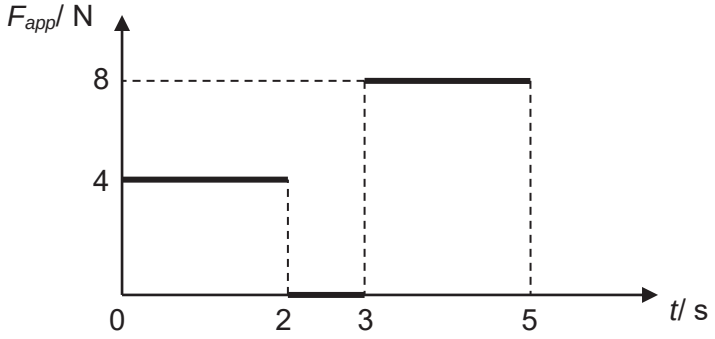
Which of the following statements is **true**?

A Y falls half as far as X.
B Y falls twice as far as X.
C Y falls three times as far as X.
D Y falls four times as far as X.

4 Joash threw a ball vertically upwards at an initial speed of 30 m s^{-1}. What is the distance travelled by the ball 5 s after the throw?

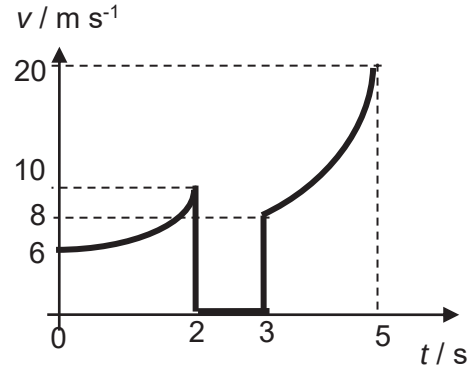
A 75 m **B** 65 m
C 45 m **D** 25 m

5 The graph below shows the force acting on a 1 kg block of wood which is originally moving at 6 m s^{-1} on a table.

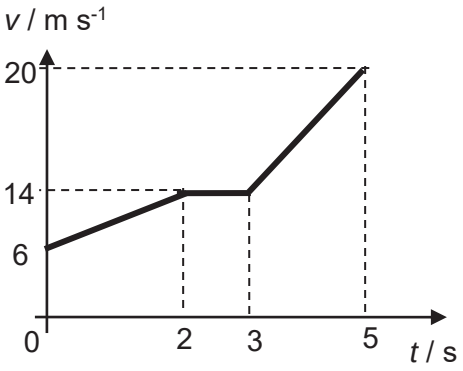


If the table has a friction of 2 N, what is the velocity-time graph of the wood?

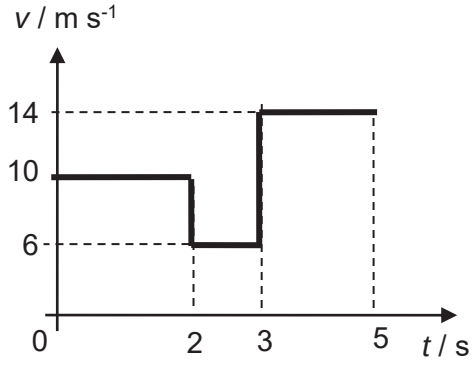
A



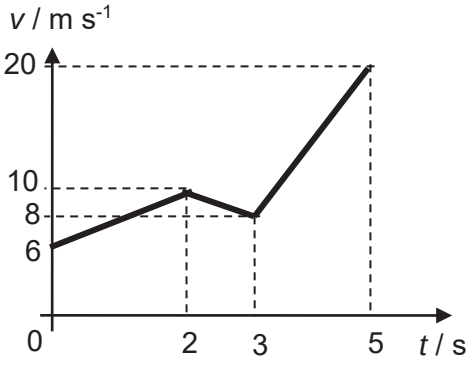
B



C



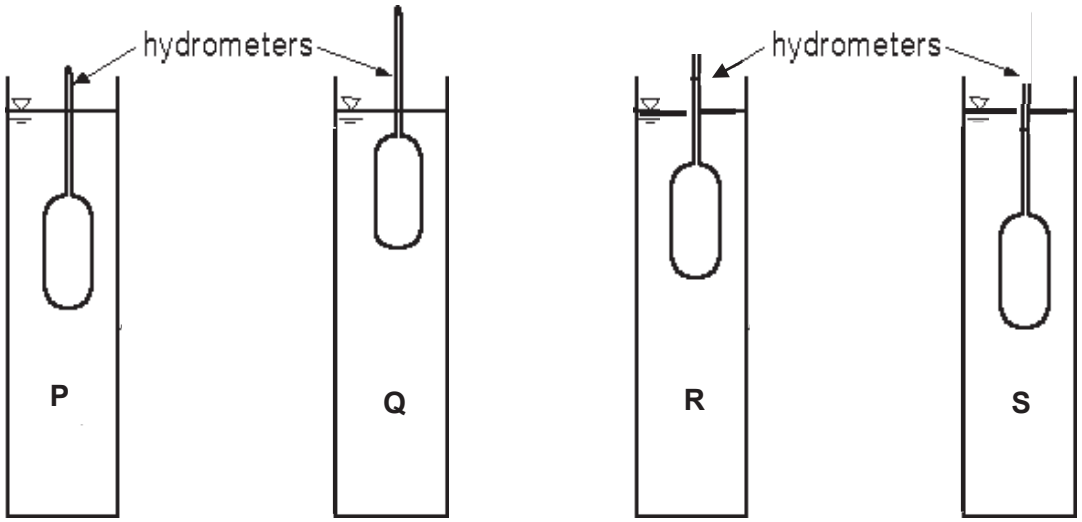
D



6 Which of the following will experience the largest inertia?

A A bowling ball that is rolling at 20 m/s.
B A basketball that is falling at a rate of 10 m/s^2.
C An elephant that is at rest.
D A car that is travelling at 100 km/h.

7 Hydrometers are used to measure the density of four different liquids, **P**, **Q**, **R** and **S** as shown.



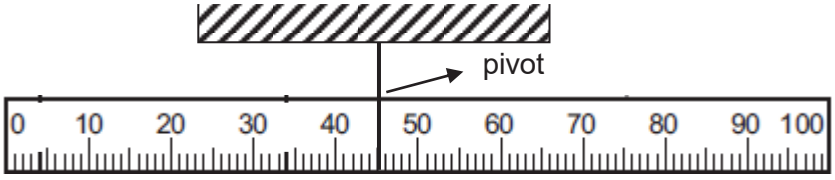
Which arrangement shows correctly the decreasing density of the four liquids?

A **Q**, **R**, **P**, **S**
B **Q**, **R**, **S**, **P**
C **S**, **P**, **Q**, **R**
D **S**, **P**, **R**, **Q**

8 Which of the following statements about gravitational field is correct?

A Gravitational field strength of the earth is independent of location.
B Gravitational field causes forces on objects because they are charged.
C The gravitational field attraction of the Earth acts towards the centre of the Earth.
D The gravitational field strength on the Moon is less than that on Earth because there is no atmosphere on the Moon.

9 A 200 g metre rule is balanced at the 45 cm mark as shown below.

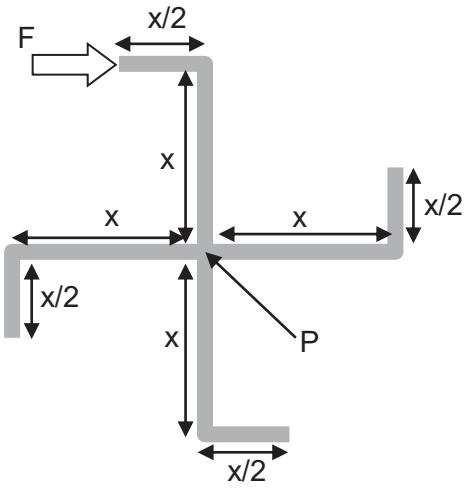


A load of 50 g is now hung at the 15 cm mark.

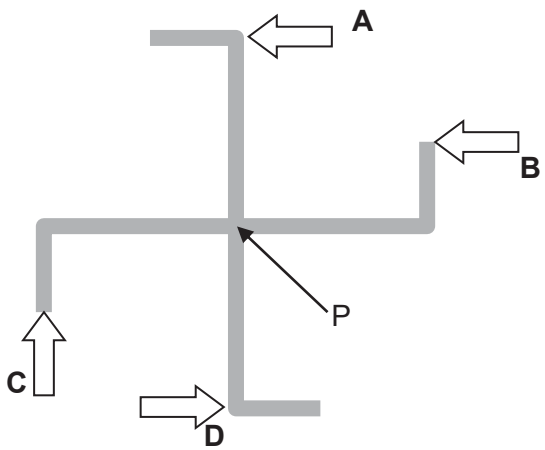
What is the new pivot position that will allow the ruler to be balanced again?

A 39 cm mark
B 37 cm mark
C 35 cm mark
D 30 cm mark

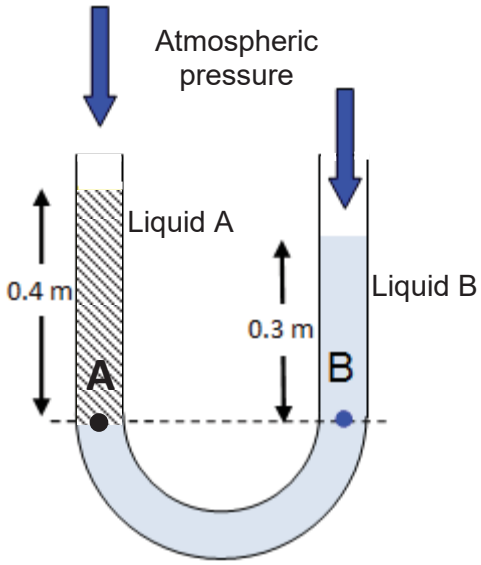
10 An object was spinning about its pivot point, P, due to a force F as shown below.



Which direction should a force, 2F, be applied to stop the spinning?



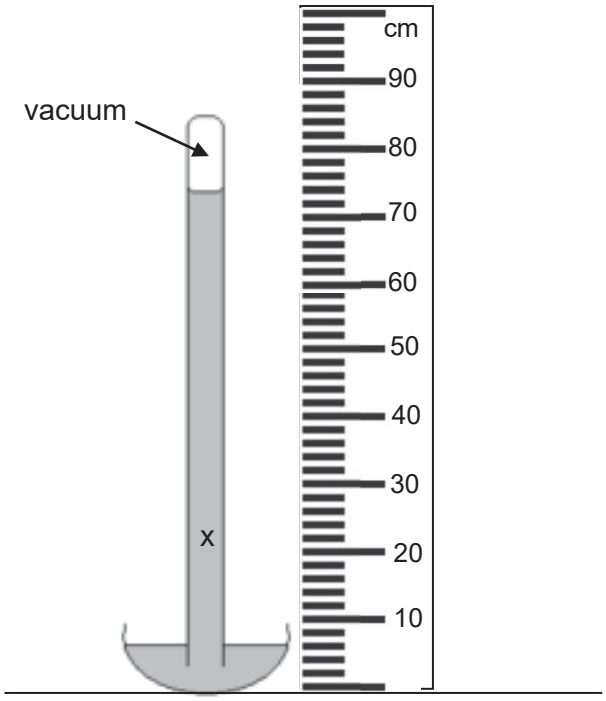
11 In the manometer as shown below, 0.4 m of liquid A was added together with liquid B.



What is the density of liquid B if the density of liquid A is p?

A $4p/3$ **B** $3p/4$
C $4p/7$ **D** $3p/7$

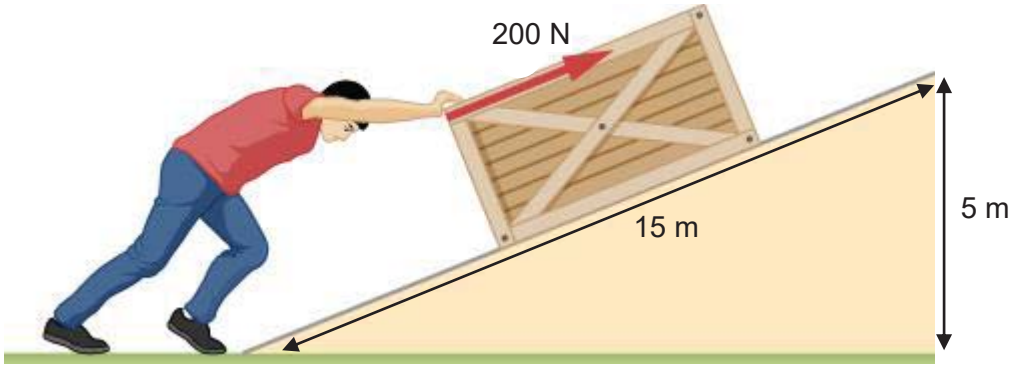
12 The diagram below shows a mercury barometer used to measure the surrounding atmospheric pressure.



What is the pressure measured at X?

A 16 cm Hg **B** 22 cm Hg
C 52 cm Hg **D** 62 cm Hg

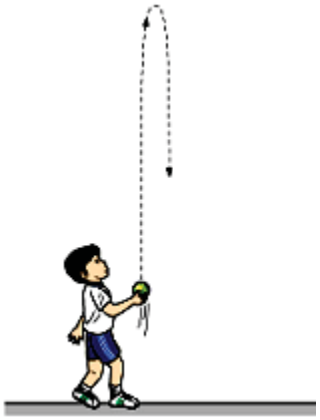
13 Xavier was pushing a mass 50 kg to the top of the ramp. The gravitational field strength is 10 N/kg.



What is the efficiency of Xavier?

A 83.3 %
B 13.3 %
C 25.0 %
D 8.3 %

14 Donovan was throwing a 500 g basketball upwards with an initial velocity of 20 m/s. The gravitational field strength is 10 N/kg and assuming no air resistance.



What is the gain in potential energy of the basketball after leaving Donovan's hand for 1 s?

A 100 J
B 75 J
C 25 J
D 10 J

15 A gas is heated in a rigid sealed container. Which quantity does not change?

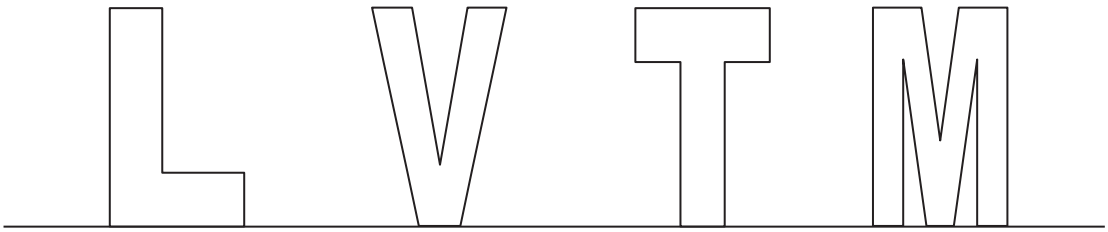
A The average speed of the gas particles
B The average force exerted on the walls of the container by the gas particles
C The average distance between the gas particles
D The frequency of collisions on the walls of the container by the gas particles

16 According to the kinetic theory, matter is made up of very small particles in a constant state of motion.

Which row best describes the particle behaviour in the liquid state?

	forces between particles	motion of particles
A	strong	move randomly at high speed
B	strong	vibrate but are free to move position
C	very strong	vibrate to and fro about a fixed position
D	weak	move randomly at high speed

17 All the objects below are made of the same material and having the same thickness.



A **B** **C** **D**

Which object will cool down the fastest if they were all being heated to the same temperature?

18 Which statement about the transfer of thermal energy is correct?

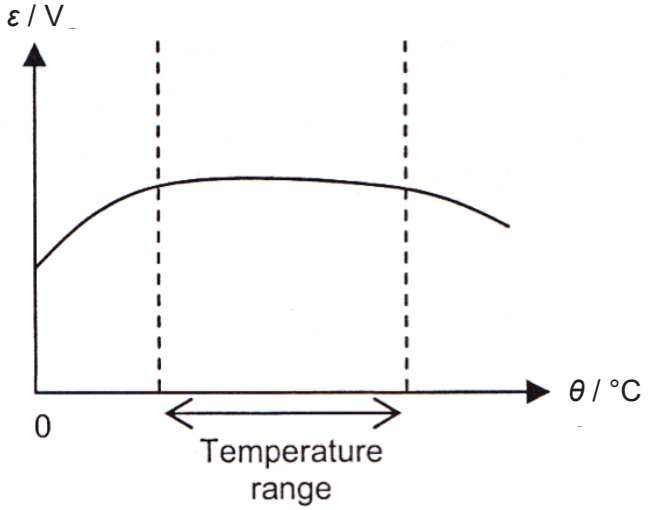
A All metals conduct thermal energy equally well.
B Convection can only occur in solids or liquids.
C Convection occurs in liquids because hot liquid is denser than cold liquid.
D The radiation that transfers thermal energy is a type of electromagnetic radiation.

19 When ice changes into water at 0 °C,

I	work is done in breaking the molecular structure of ice in solid state.
II	internal energy is increased.
III	energy is absorbed to raise the temperature.

A I only
B II only
C I and II only
D I, II and III

20 The diagram shows a graph of how the e.m.f., ε / V, of a thermocouple varies with temperature, θ / °C.



Why is the thermocouple inappropriate for measurement of temperature in the range as shown?

A The thermocouple produces an e.m.f. at 0 °C.
B The relationship between ε *and* θ is non-linear.
C The thermocouple does not always indicate a unique value of e.m.f..
D The e.m.f. has not been measured using temperatures using the Kelvin scale.

21 The diagrams show the scale of a voltmeter connected to a thermocouple thermometer.

thermocouple probe in melting ice

thermocouple probe in steam

thermocouple probe in liquid

What is the temperature of the liquid?

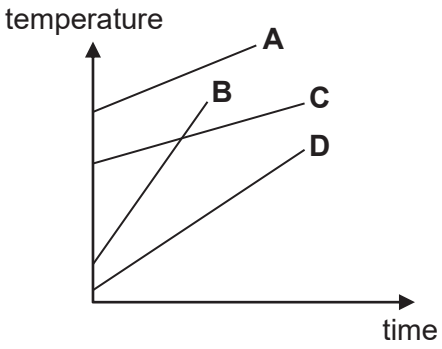
A 75 °C
B 100 °C
C 120 °C
D 125 °C

22 When Satish mixed 30 g of liquids Q and 50 g of liquid R together, he obtained a final temperature of 45 °C.

What is the ratio of heat capacity of liquid Q to heat capacity of liquid R if the initial temperature of liquid Q and R are 20 °C and 90 °C respectively?

A 9/5
B 5/9
C 1/3
D 3/1

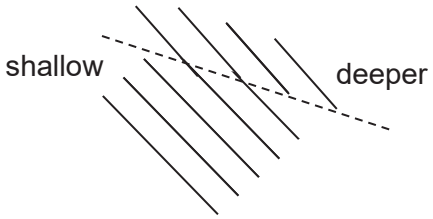
23 Four different materials of equal mass were heated by the same heater. The temperature-time graph of the four different materials were shown below.



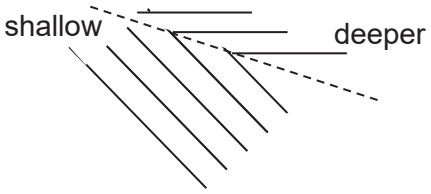
Which material has the lowest specific heat capacity?

24 Which of the following shows correctly the wavefront as it enters into a deeper region?

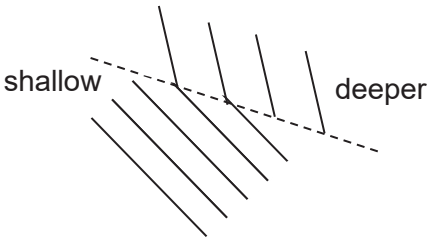
A



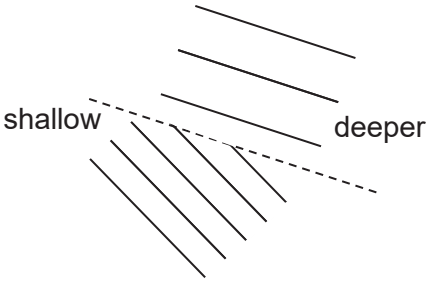
B



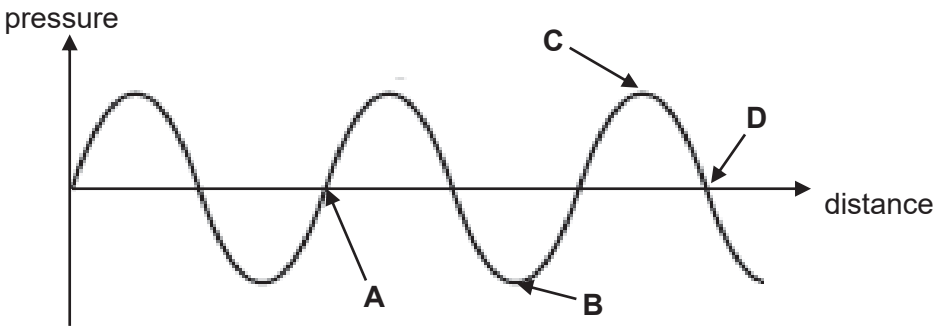
C



D

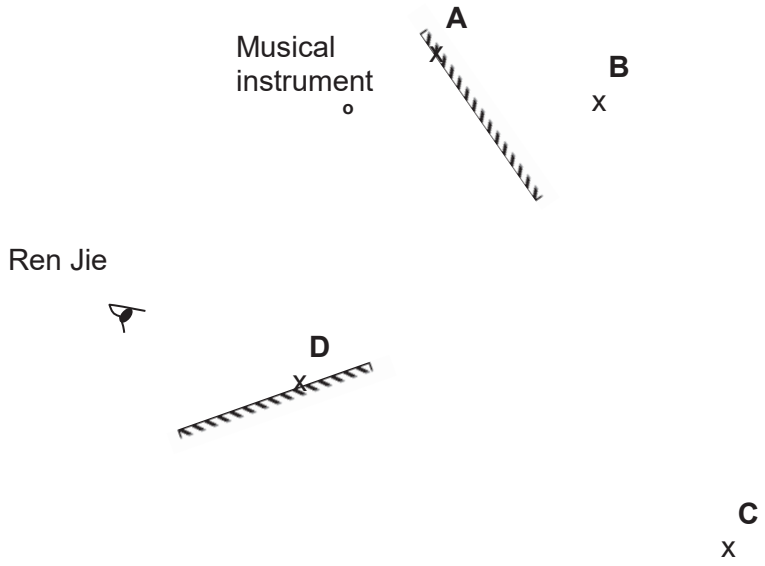


25 The diagram below shows a pressure-distance graph of a longitudinal wave.



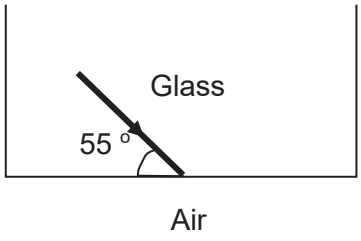
Which point indicates that it is the centre of rarefaction?

26 Ren Jie was looking through the mirror at his musical instrument.



Where is the position of the image of musical instrument?

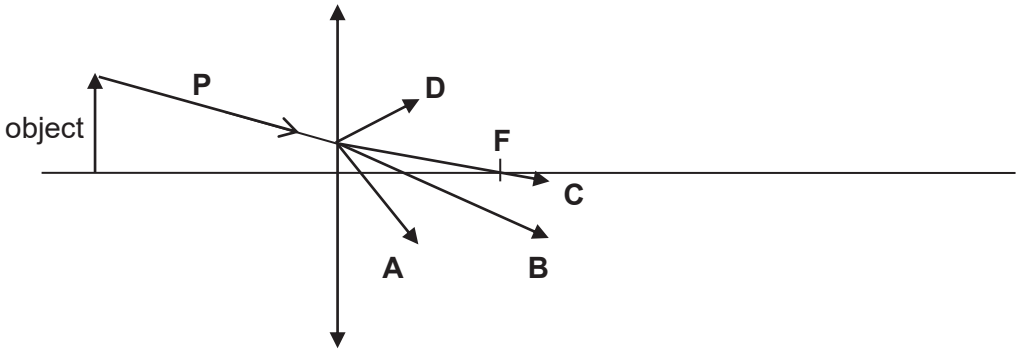
27 A beam of light shone at an angle of 55 ° in the glass is shown below.



What is the change in the direction of the light path if the refractive index of glass is 1.45?

A 56.3 °
B 31.7 °
C 23.3 °
D 21.3 °

28 An object is placed in front of a thin converging lens as shown below.



Which direction shows correctly the path ray P will take after it passes through the lens?

29 Which list shows electromagnetic waves in order of increasing frequency?

A visible light, X-rays, Gamma rays
B visible light, Gamma rays, X-rays
C X-rays, Gamma rays, visible light
D Gamma rays, X-rays, visible light

30 What is the wavelength of an electromagnetic wave that has a frequency of 6.0×10^5 GHz?

A 5.0×10^{-13} m **B** 5.0×10^{-10} m
C 5.0×10^{-7} m **D** 5.0×10^{-4} m

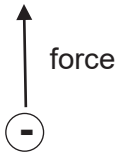
31 How will the amplitude and wavelength change as sound increases in loudness and pitch?

	Amplitude	Wavelength
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

32 Which object will not attract tiny pieces of paper?

A a metal knife sharpened with a knife sharpener
B a ceramic spoon wiped with a kitchen cloth
C a plastic comb combed through dry hair
D a wooden pencil rubbed with an eraser

33 A stationary negative charge in an electric field experiences an electric force in the direction shown.



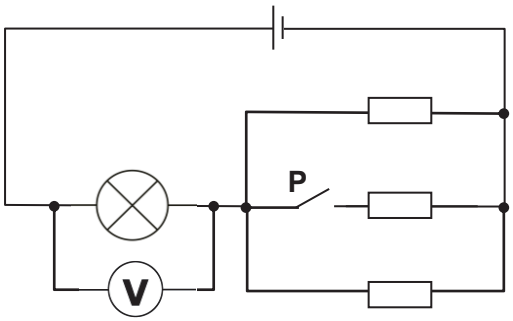
What is the direction of the electric field?

A horizontally to the left
B horizontally to the right
C vertically downwards
D vertically upwards

34 An electron carries 1.6×10^{-19} C. What is the potential difference across a 5 Ω resistor if there are 1×10^{10} electrons flowing through it in 4 μs?

A 0.002 V
B 2.00 V
C 3.2×10^{-14} V
D 1.28×10^{-15} V

35 A circuit was set up with a lamp connected as shown below.



What happens to the voltmeter reading as switch **P** is closed?

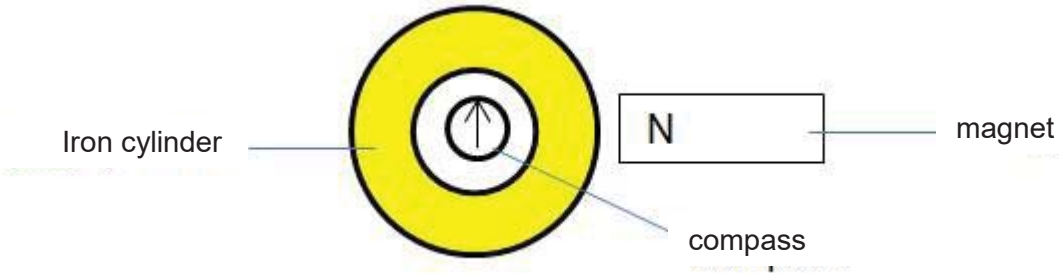
A The voltmeter reading remains unchanged.
B The voltmeter reading decreases.
C The voltmeter reading increases.
D The voltmeter reading shows zero reading.

36 Yida was spending 6 hours each night revising for his upcoming Physics examination. He had two 100 W light bulbs in his room. The weekly bill for his room was $3.00

How much saving would he have in a week if a unit of electricity cost 24 cents?

A 270 cents
B 201 cents
C 199 cents
D 98 cents

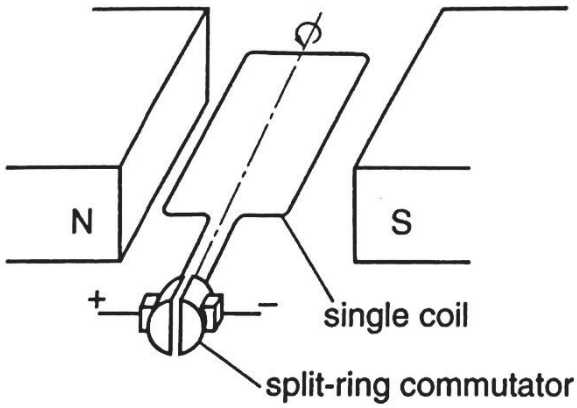
37 A compass is placed inside a closed iron cylinder on the table. The north pole of a permanent magnet is brought near the cylinder as shown in diagram.



In which direction does the needle of the compass point?

A away from the permanent magnet
B opposite direction
C original direction
D towards the permanent magnet

38 The diagram shows a two-pole single-coil electric motor.

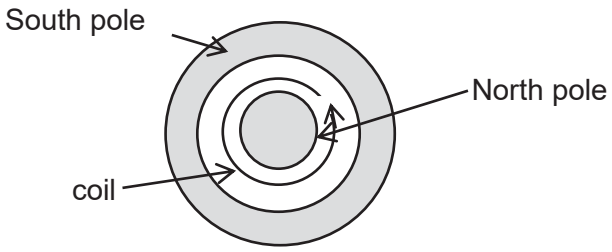


The split-ring commutator reverses the current in the coil as it rotates.

How many times did the current reversed as the coil completes one full revolution?

A 1
B 2
C 3
D 4

39 The diagram shows the front view of a loudspeaker, which consists of magnets and a coil amongst other items.



If the current is flowing in the speaker's coil in an anticlockwise direction as shown, what is the direction the coil that it will move?

A To the right.
B Out of the page.
C To the left.
D Into the page.

40 Two long, parallel conductors carrying current lie in a horizontal plane.
The two conductors attract one another.

Which statement is true?

A The two currents are in the same direction.
B The two currents are in opposite direction.
C The two currents are parallel to the Earth's magnetic field.
D The two currents are at 90° to the Earth's magnetic field.

END OF PAPER

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GAN ENG SENG SCHOOL
Preliminary Examination 2020

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PHYSICS
Paper 2

6091/02

01 September 2020
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 11** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

For Examiner's Use

Section A [50 marks]

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

1 (a) The size of a virus is approximately the size of ultraviolet wavelength.

State the wavelength of the ultraviolet in metres.

……[1]

(b) (i) Given that the thickness of a hair is about 10^3 times more than size of a virus, state a suitable apparatus to measure the thickness of hair.

……[1]

(ii) State two necessary steps needed to ensure that accurate readings are obtained when reading the thickness of hair.

……

……

……

……[2]

2 Alex was running for the inter-school 5 km cross country competition. He ran a total displacement of 5 km round a reservoir. He completed the whole competition with a time of 20 minutes. Alex's friend, Clement shared that his velocity is 15 km/h.

(a) State what is meant by displacement of 5 km.

……

……[1]

(b) In the paragraph above, state and explain the two errors found.

……

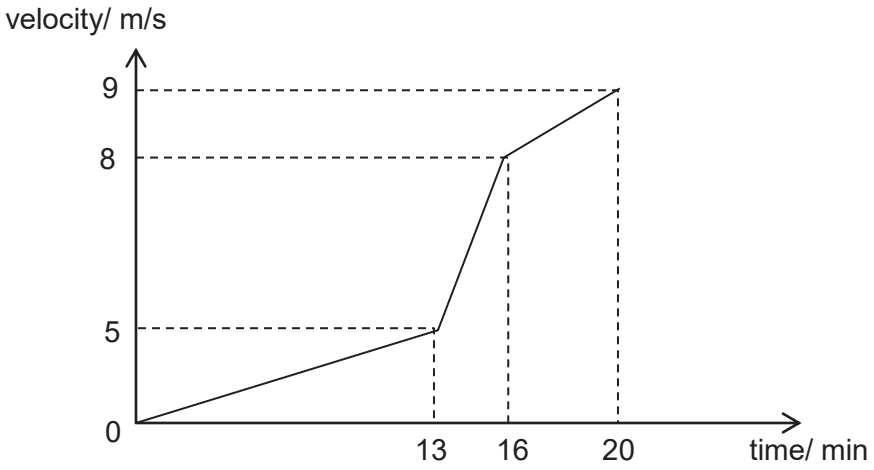
……

……

……[2]

For Examiner's Use

2 (c) The velocity time graph of Alex during the run was shown below.



(i) State and explain the period at which Alex was running with the greatest acceleration.

……

……

……

……[2]

(ii) Calculate the greatest resultant force that Alex is experiencing. Take Alex's mass as 50 kg.

Greatest resultant force = ……[2]

3 An object of mass 0.80 kg is suspended and equally supported by two identical strings as shown in Fig. 3. (not drawn to scale).

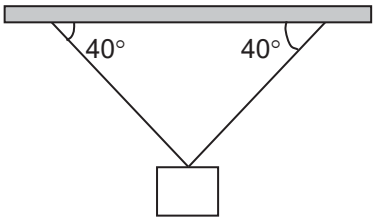


Fig. 3

(a) State two differences between mass and weight.

……

……

……

……[2]

(b) Calculate the weight of the object. (Gravitational field strength = 10 N/kg)

weight = …… [2]

(c) By drawing a scale diagram, determine the magnitude of the tension in one string.

Tension = …… [4]

For Examiner's Use

4 Andres was trying to open a door at the AVA room as shown in Fig. 4.

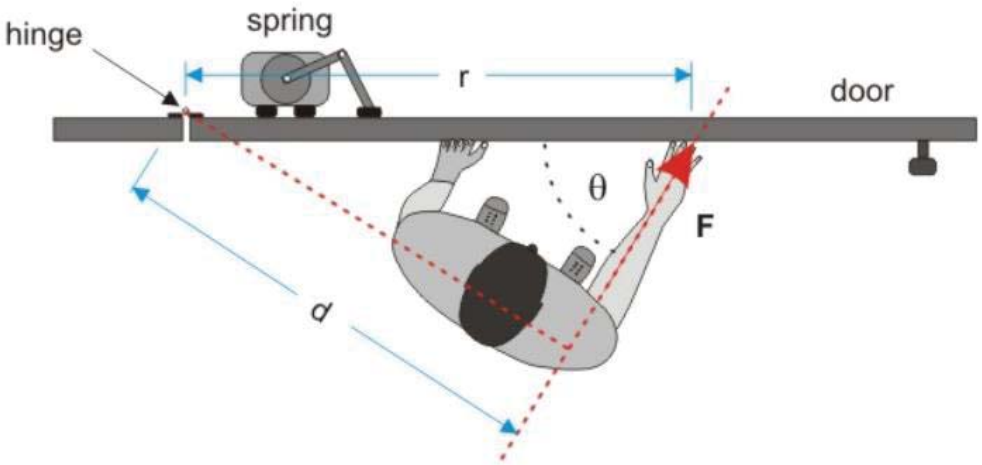


Fig. 4

(a) State and explain two ways how Andres could open the door more efficiently.

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……[2]

(b) State what is moment and its formula.

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……[2]

(c) State two reasons why moment is not measured in Joule.

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……[2]

5 A manometer was used to measure the pressure difference between the atmospheric pressure and the gas pressure in a chamber as shown in Fig. 5.1. The atmospheric pressure is 76 cm Hg and the density of mercury is 13 600 kg/m^3.

For Examiner's Use

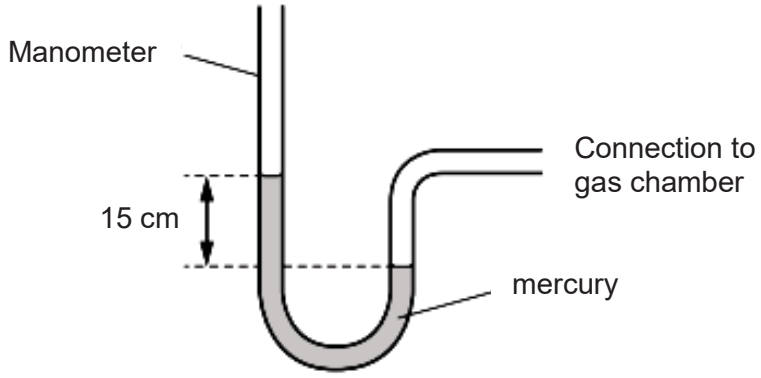

Fig. 5.1

(a) State the pressure found in the gas chamber in Pa.

pressure = ... [2]

(b) The liquid used in the manometer is now changed to liquid X. Liquid X has a density of 6 800 kg/m^3 and the manometer increases in its diameter. State the new height difference found in the manometer. Support your explanation with numerical calculation.

height difference = ...[2]

For Examiner's Use

5 **(c)** Fig. 5.2 shows a hydraulic system works by exerting a force on the piston A which in turn pushes the piston B upwards with a larger force. Explain how the principle of conservation of energy is applicable in the hydraulic system.

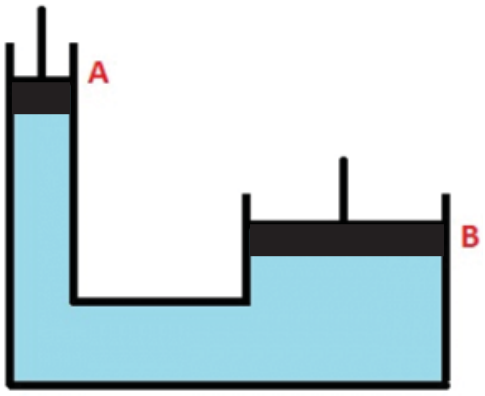

Fig. 5.2

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……[4]

6 A simple pendulum of length 1.00 m has a bob of mass 0.20 kg. The bob is pulled aside by a horizontal distance of 0.3 m and is then released as shown in Fig. 6.

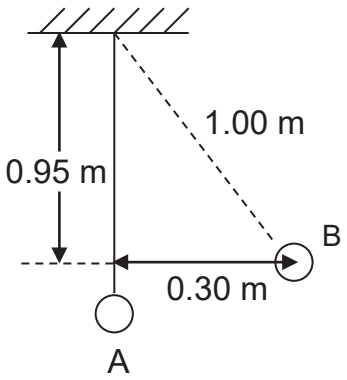

Fig. 6

(a) Calculate the gravitational potential energy at position B.

gravitational potential energy = …….. [2]

(b) Calculate the velocity at which the bob will pass through A.

velocity at A = ……. [2]

(c) State the assumption made in **(b)**.

…….

…….[1]

For Examiner's Use

7 A light uncharged metal ball, X, is freely suspended and is in contact with an uncharged metal sphere, Y, as shown in Fig 7.1. A positive charged metal rod, Z, is moved towards Y as shown in Fig. 7.2

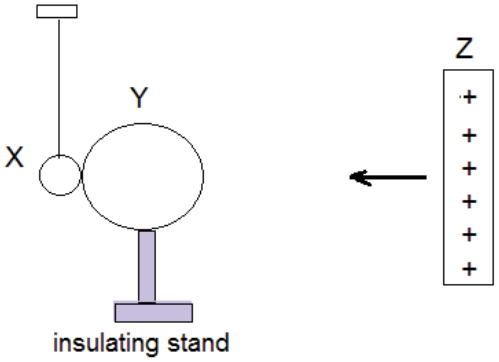

Fig. 7.1

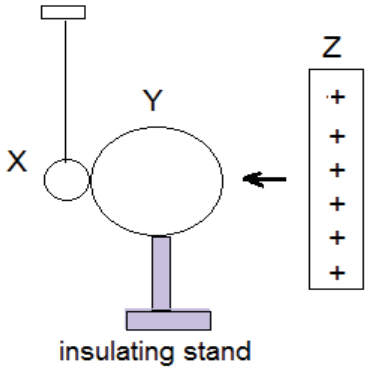

Fig. 7.2

(a) Explain what is meant by *electric field*.

……

…… [1]

(b) State the charges induced on spheres X and Y in Fig. 7.2

X : …….. **Y** : …….. [1]

(c) Sketch in Fig 7.1 the electric field pattern between Y and Z. [1]

(d) When Z is brought to touch Y and then removed, suggest what will happen.

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…… [3]

For Examiner's Use

8 In the circuit shown in Fig. 8.1, E is a battery of e.m.f. 20.0 V and negligible internal resistance. R_1 is a variable resistor of maximum resistance 400 Ω, R_2 is a fixed resistor of resistance 200 Ω, V_1 is a voltmeter and A is an ammeter.

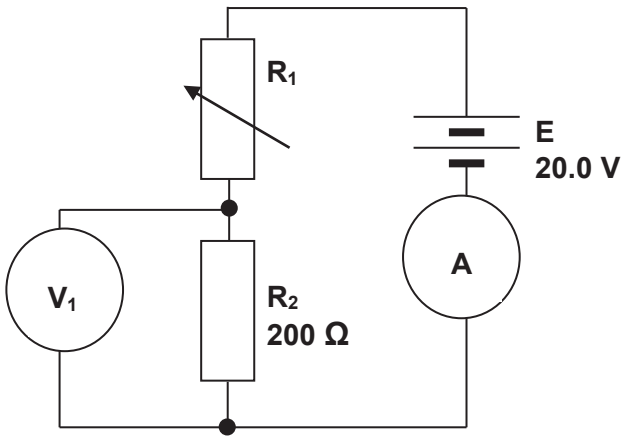

Fig. 8.1

(a) Determine the maximum and minimum readings of V_1.

maximum reading = ……..[1]

minimum reading = ……..[1]

(b) Calculate the current through the ammeter when R_1 is set at 250 Ω.

current = ……[2]

For Examiner's Use

8 **(c)** A thermistor connected in series with a 1 200 Ω resistor is added to the circuit as shown in Fig. 8.2. V_2 is the second voltmeter. When temperature is at 0 °C, the resistance of the thermistor is 3 600 Ω. When the temperature is at 100 °C, its resistance is 400 Ω.

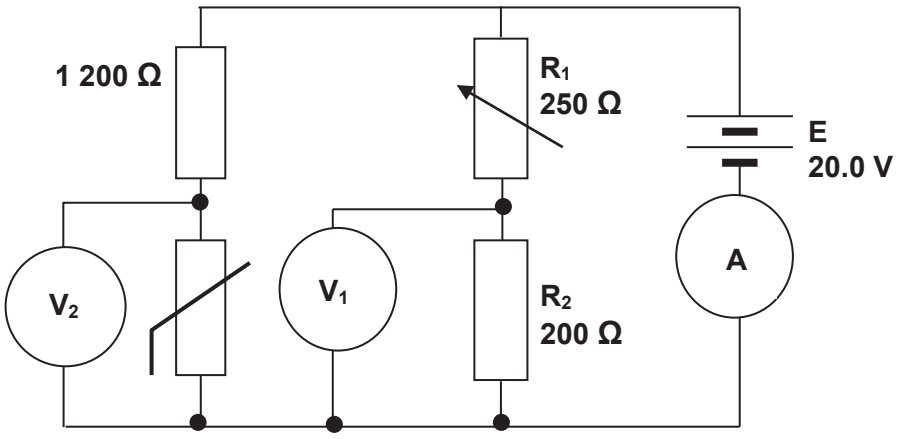

Fig. 8.2

Calculate the readings of the ammeter A and voltmeter V_2 when R_1 is set to 250 Ω and the thermistor is placed in steam from pure water boiling at standard atmospheric pressure.

ammeter reading = ……[1]

voltmeter reading = ……[1]

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's Use

9 Fig. 9.1 shows the circuit diagram of a hairdryer. A motor-driven fan and a heating element are used to generate warm air. The hairdryer is connected to a 230 V a.c. supply. Switch S can be connected to either contact J or K.

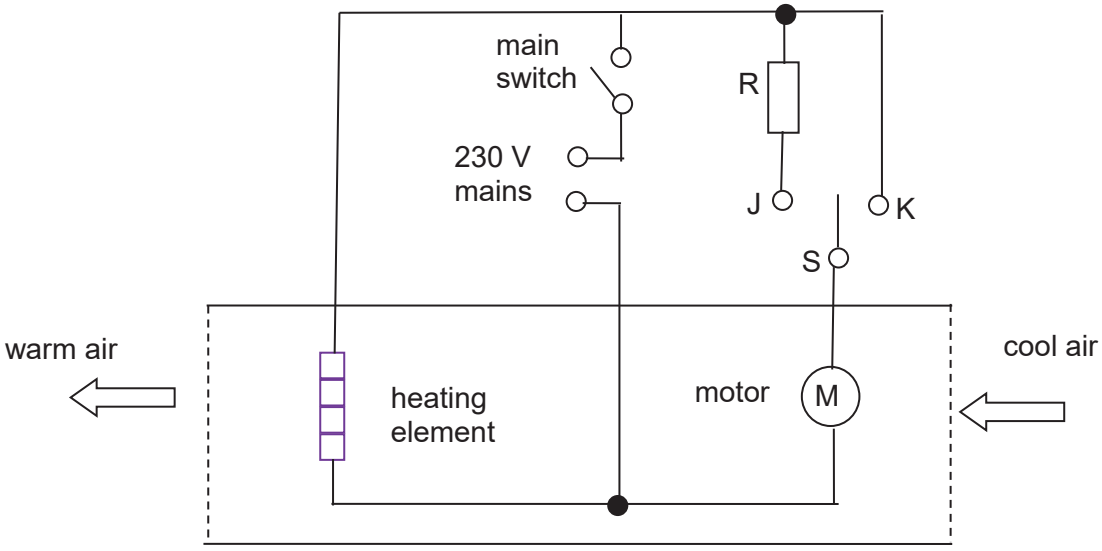

Fig. 9.1

(a) The hairdryer is used to dry wet hair.

Explain, using kinetic theory of matter, how the hairdryer can increase the rate of evaporation of water from the wet hair.

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.....[3]

For Examiner's Use

9 **(b)** During quality control tests of the hairdryer in the factory, switch S is first connected to contact J. Some measurements are made to obtain the data shown in Fig. 9.2.

resistance of the heating element	25 Ω
resistance of resistor R	40 Ω
temperature of air entering the hairdryer	28 °C
temperature of air flowing out of the hairdryer	33 °C
rate of air flow through the hairdryer	46 g/s

Fig. 9.2

Calculate the specific heat capacity of air.

Specific heat capacity of air = ……[2]

(c) Switch S is then connected to contact K. State and explain the change in the rate of air flowing through the hairdryer and the temperature of the air flowing out of the hairdryer, as compared to when switch S is connected to contact J.

……

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……[3]

9 **(d)** The cost of using the hair dryer for 25 minutes when the hair dryer is set to the higher air flow rate is 28 cents. Calculate the unit cost of the electricity used.

For Examiner's Use

Unit cost = …….. [2]

10 **(a)** Fig. 10.1 shows an object, O placed at 10 cm away from the lens.

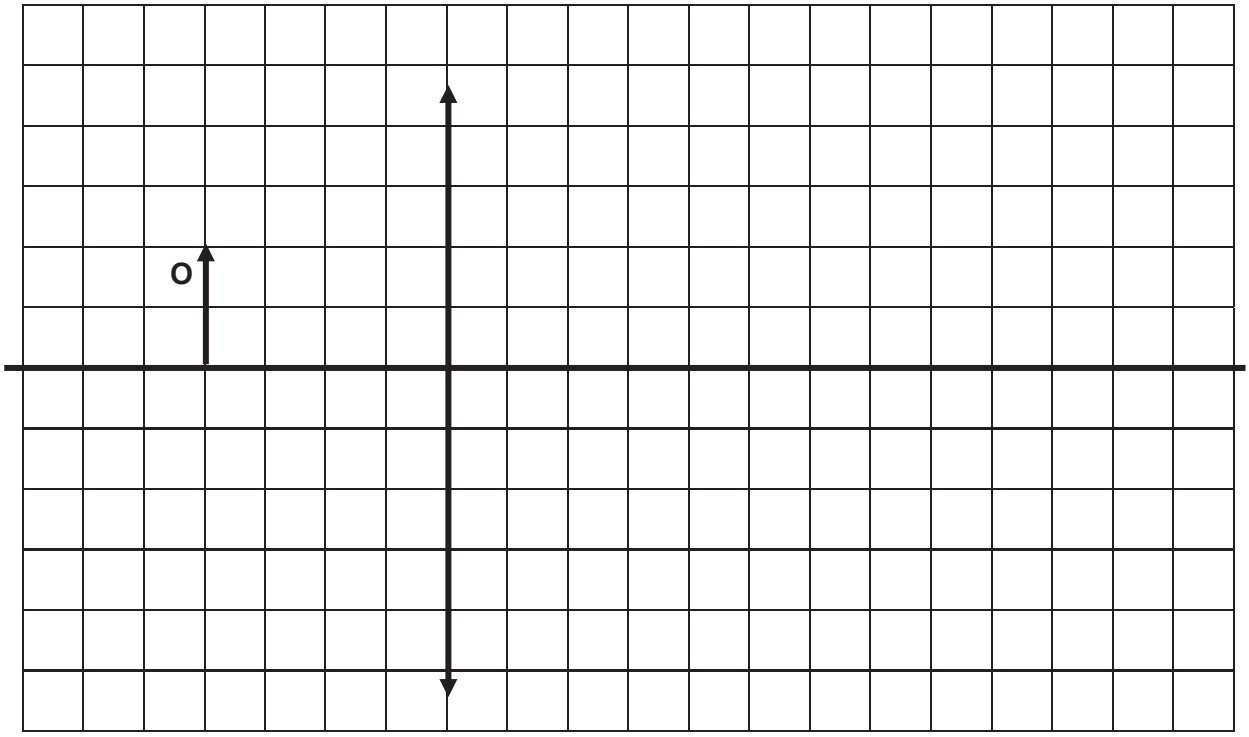

Fig. 10.1

(i) A virtual image of 1.5 times the size of object is formed. Draw 2 rays in Fig. 10.1 to locate the position of the image and label it as I. [3]

(ii) State the distance of the image from the lens.

distance of image from lens = …….. [1]

For Examiner's Use

10 **(b)** Fig. 10.2a represent the positions of equally spaced 'dots' of air molecule before a sound wave passes through air. The dots in Fig. 10.2b represents the positions of the same 'rows' at one particular instant as the sound wave passes.

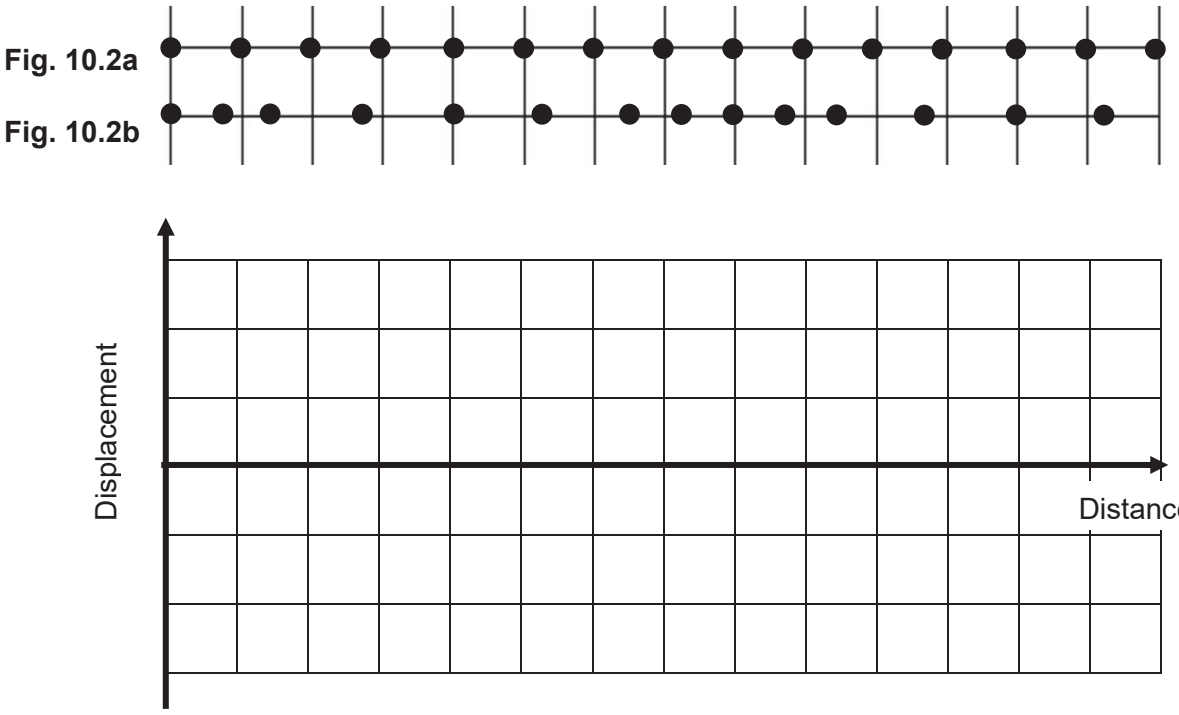

Fig. 10.3

(i) In Fig. 10.2b, mark out accurately the amplitude and the wavelength of the sound wave and labelled it as ***a*** and λ respectively. [2]

(ii) In Fig. 10.3, sketch accurately the displacement distance graph of the sound wave. Positive displacement is to the right.

[2]

(iii) State how will the displacement distance graph in Fig. 10.3 change when the sound created is now louder and of a higher pitch.

……

……

……..[2]

For Examiner's Use

11 EITHER

(a) Fig. 11.1 shows a drop tower found in an amusement park. A 5 kW motor was used to lift up a gondola carrying riders to the top of the vertical structure. It then released to free fall down the tower. Magnetic brakes were activated to slow down the gondola as it approached the bottom of the ride. Take acceleration due to free fall as 10 m/s^2.

Fig. 11.1

(i) Calculate the height of the tower in Fig. 11.1 if the gondola has a mass of 200 kg and it takes 30 s to reach to the top of the tower.

height of tower = ... [2]

(ii) Calculate the time taken for the gondola to reach the bottom of the tower when released.

time taken = ... [2]

For Examiner's Use

11 (b) Daryl did a mockup of the drop tower using two electromagnets, A and B as shown in Fig. 11.2. The electromagnet A is used to hold the mass, a magnetic material, in place while the electromagnet B is used to create a braking force.

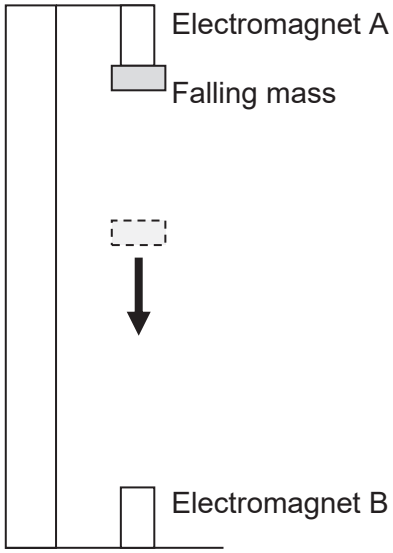

Fig. 11.2

(i) If the falling mass has a mass of 20 g, suggest with reason the magnetic force that the electromagnet B has in order to allow the falling mass to come to rest instantly.

……

……

……

……[2]

(ii) Suggest two ways the electromagnet can increase its strength if a larger falling mass is used.

……

……

……

……[2]

(iii) Daryl intended to increase the height of the fall of the falling mass. State, with reason, if the strength of electromagnet B need to change to break the fall.

……

……

……

……[2]

OR

11 (a) Fig. 11.3 shows a type of motor. PQ and RS are solenoids. The solenoids and the coil ABCD are connected in parallel to a battery.

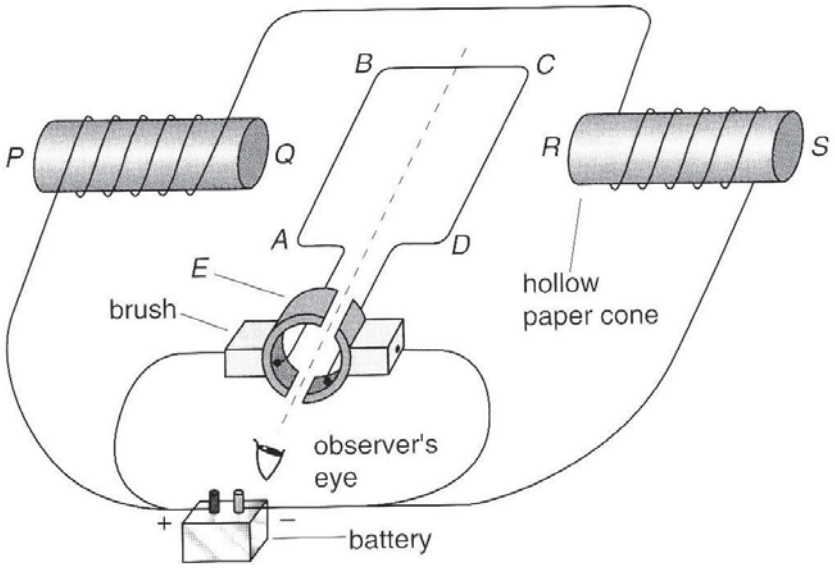

Fig. 11.3

(i) State the polarity at end Q.

……[1]

(ii) State the direction of rotation of the coil as seen by the observer.

……[1]

(iii) Explain why the coil will rotate continuously.

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……[2]

For Examiner's Use

11 **(b)** Fig 11.4 shows how the current varies with the potential difference for light bulbs J and K.

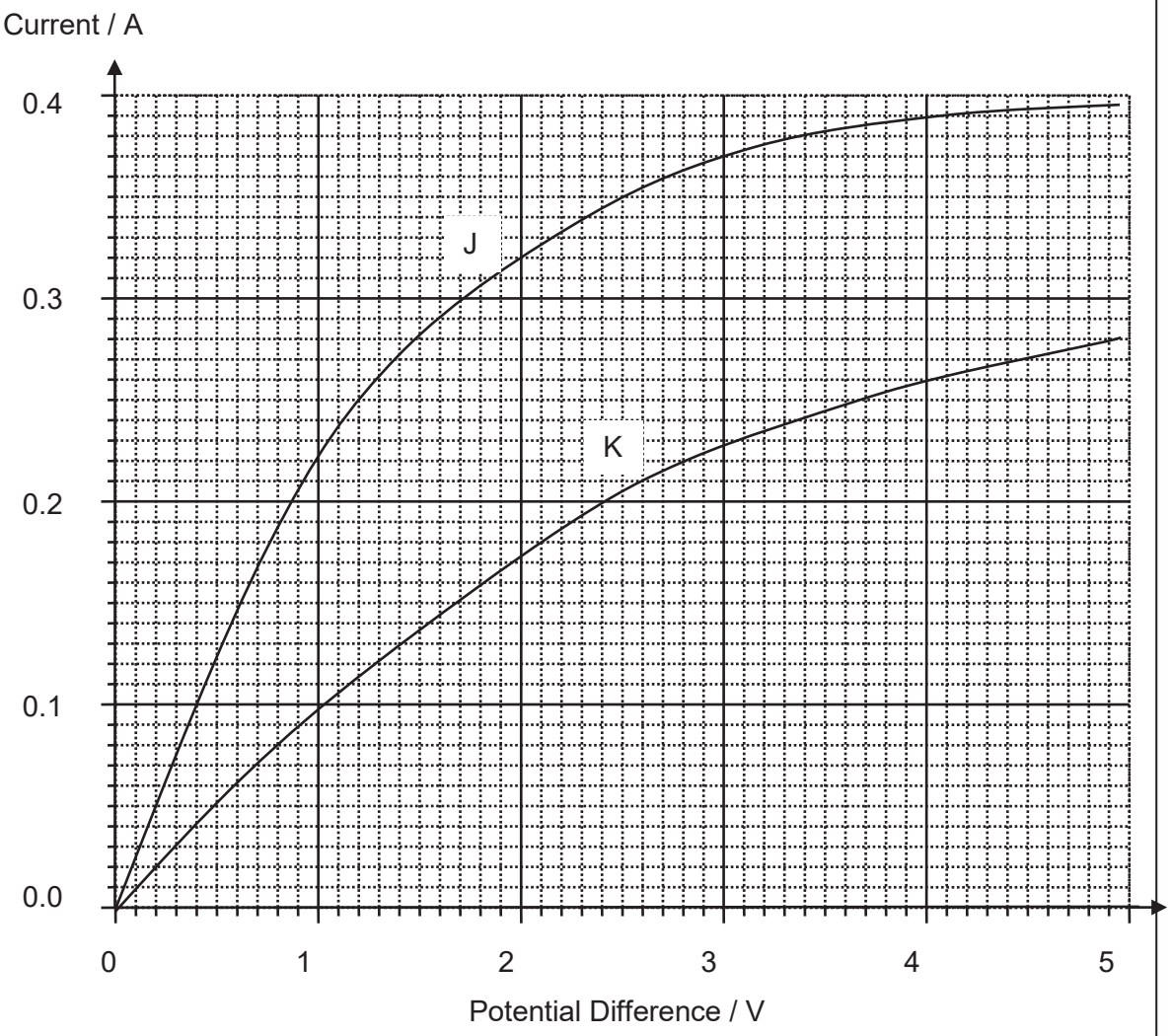

Fig 11.4

(i) State, with reason, if the filament of light bulb J and K are ohmic conductors.

……

……[2]

For Examiner's Use

11 (b) (ii) Estimate the resistance of bulb J and the resistance of bulb K when they are operating at V = 0.20 V.

resistance of bulb J = ……..

resistance of bulb K = …… [2]

(iii) The filaments of both bulbs are coiled tungsten wire. Describe two differences between the filaments of the bulbs that would cause their difference in resistance.

……

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……

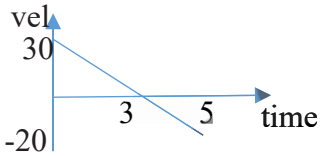
……

……..[2]

END OF PAPER

Answer for 2020 Sec 4Ex Pure Phy Prelim P1 Ans

1	**C**	2	**D**	3	**D**	4	**B**	5	**D**	6	**C**	7	**A**	8	**C**	9	**A**	10	**B**
11	**A**	12	**C**	13	**A**	14	**B**	15	**C**	16	**B**	17	**D**	18	**D**	19	**B**	20	**C**
21	**D**	22	**A**	23	**B**	24	**C**	25	**B**	26	**C**	27	**D**	28	**B**	29	**A**	30	**C**
31	**B**	32	**A**	33	**C**	34	**A**	35	**C**	36	**D**	37	**C**	38	**B**	39	**D**	40	**A**

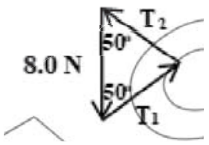
1	Addition of vectors must ensure resultant point from starting point of first force and end off at the ending point of last force	**C**
2	0.004 Gm = 4 x 10^6 m while 40 Mm = 4 x 10^7 m	**D**
3	Distance fall by X = ½ (3)(30) = 45 m Distance fall by Y = ½ (6)(60) = 180 m	**D**
4	Distance covered in the first 3 s = 45 m Distance covered in the next 2 s = 25 m Total distance covered = 65 m 	**B**
5	In the first 2 s, there's a net force of 2 N bringing about an acceleration of 2m/s^2 In the next 1 s, there's a net force of -2 N bringing about an acceleration of -2 m/s^2 In the last 2 s, there's net force of 6 N bringing about an acceleration of 6 m/s^2	**D**
6	Elephant has the largest mass thus highest inertia	**C**
7	Liquid with hydrometer floating the most is the highest density	**A**
8	Gravitational field attraction is acting towards the centre of the Earth	**C**
9	Let new pivot point be x cm 50 (x – 15) = 200 (45 – x) x = 39 cm	**A**
10	Force at B will create an anticlockwise moment equal to the clockwise moment created by F due to a shorter perpendicular distance from pivot point	**B**
11	Pressure at A = Pressure at B Density of A x g x (0.4) = Density of B x g x (0.3) Density of B = (4/3) Density of A	**A**
12	Marking at X -= 22 cm Marking over mercury level in barometer = 74 cm Height of mercury above X = 74 – 22 = 52 cm	**C**
13	Total work done = 200 x 15 = 3000 J Useful work = 500 (5) = 2500 J Efficiency = (2500/3000) 100% = 83.3 %	**A**
14	The velocity after 1 s = 10 m/s Gain in PE = Loss in KE = ½ (0.5)(20)^2 – ½ (0.5)(10)^2 = 75 J	**B**
15	As gas is in a rigid sealed container, there's no change in its volume thus the average distance remain the same.	**C**

16	Liquid has strong molecular bonding and they are free to move their position	**B**
17	Letter 'M' cool down the most as it has the largest surface area	**D**
18	Infra red radiation is used to transfer thermal energy	**D**
19	During melting, there is no change in its temperature and work is done to overcome forces of attraction and not break.	**B**
20	The relationship between ε and θ does not give a unique value	**C**
21	8 division rep 100^{o}C 10 division rep (100/8) x 10 = 125^{o}C	**D**
22	Heat gained by Q = Heat lost by R C_Q (45-20) = C_R (90- 45) C_Q / C_R = 9/5	**A**
23	The rise in temperature is the fastest for a material with low specific heat capacity	**B**
24	As wavefront enters into the deeper region, its speed increase and its wavelength increases. The direction of wave is bending away from normal.	**C**
25	Centre of rarefaction is the point with lowest pressure	**B**
26	Image of object is perpendicular distance away from the mirror (double reflection)	**C**
27	1.45 = sin(i) / sin (35) i = 56.3 change in direction = 56.3 – 35 = 21.3^{o}	**D**
28	After locating the image of object, draw the ray P towards the tip of the image arrow	**B**
29	Gamma has the highest frequency with visible light having the longest wavelength.	**A**
30	v = f x λ λ = (3 x 10^{8}) / (6 x 10^{5} x 10^{9}) = 5 x 10^{-7} m	**C**
31	Loudness is proportional to amplitude Pitch is proportional to frequency Frequency is inversely proportional to wavelength	**B**
32	Metal is a good conductor of electricity. Once there's an excess charges, it will be discharged away easily. The other options will result in charging object by rubbing as they are non metal.	**A**
33	As the negative charge attracted to positive charge, there must be presence of positive charge at the top and thus the electric field is downwards. Do not use Fleming's Left Hand rule.	**C**
34	Q = It I = (1 x 10^{10} x 1.6 x 10^{-19})/4 x 10^{-6} = 0.0004 A V = IR = 0.0004 x 5 = 0.002 A	**A**
35	With switch P closed, the effective resistance of the 3 resistors will become lesser and thus the total resistance of the whole circuit will decrease leading to an overall increase in the current in the circuit. Thus the pd across lamp will increase.	**C**

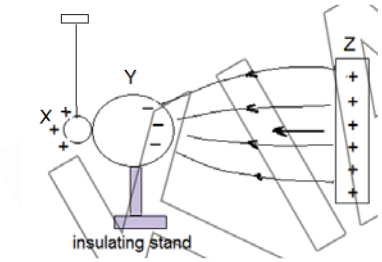
36	Electrical energy = 2 x 0.1 x 6 x 7 = 8.4 kWh in a week Total cost = 8.4 x 24 = 201.6 cents Total saving = 300 – 201.6 = 98.4 cents	**D**
37	The compass needed is not being influenced by the field strength of the permanent magnet.	**C**
38	Every half rotation, the current direction will be reversed in the coil	**B**
39	Using Fleming's Left Hand rule, the coil will move into the paper	**D**
40	Same directional current conductor will attract each other.	**A**

2020 Sec 4 Prelim Pure Physics Marker's report

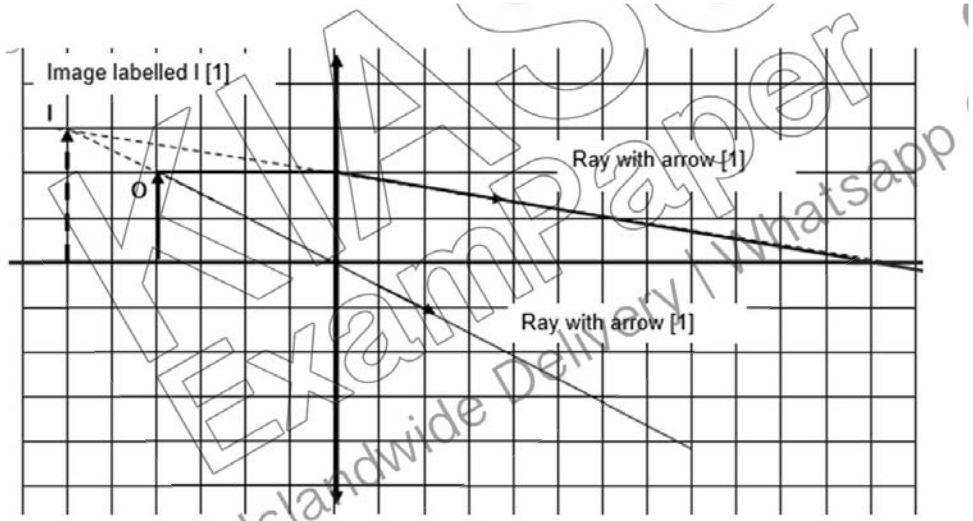
Que	Ans	Marks	Marker's Comments
1a	**10^{-8} to 10^{-7}** m	[1]	Most are not able to recall the size of virus
1bi	**micrometer screw gauge**	[1]	Most can do
1bii	**Check for zero error** to ensure that zero error is accounted for. Check for thickness of hair at **different portion of the hair** and obtain the **average** to get accurate reading	[1] [1]	Most can update about the zero error BUT not able to include read off at different part of the hair
2a	Displacement of 5 km meant that **5 km was travelled in a stated direction**	[1]	Most can stated the meaning well with some overlook the need to include the magnitude 5 km in the answer
2b	Alex would have covered a **total of 5 km in distance** and NOT displacement in order to complete the race As Alex travelled a total distance of 5 km in 20 mins, he is **having an average speed of 15 km/h and NOT velocity**	[1] [1]	Most can state the errors
2ci	Alex is running at greatest acceleration between **13 min and 16 min** The **change in velocity per unit time is the highest** during this duration **Gradient is the steepest** (also acceptable)	[1] [1]	Most can do it
2cii	Highest acceleration = (8 – 5) / 3(60) = 0.0167 m/s^2 F = ma ➔ 50 (0.0167) = **0.833 N** (Award 1 mark based on student's acceleration if correct mass is used in calculation)	[1] [1]	Most overlook that the unit used for time is minutes and thus calculated the resultant force wrongly

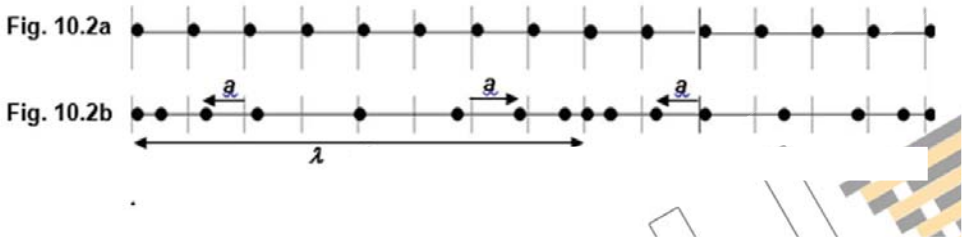
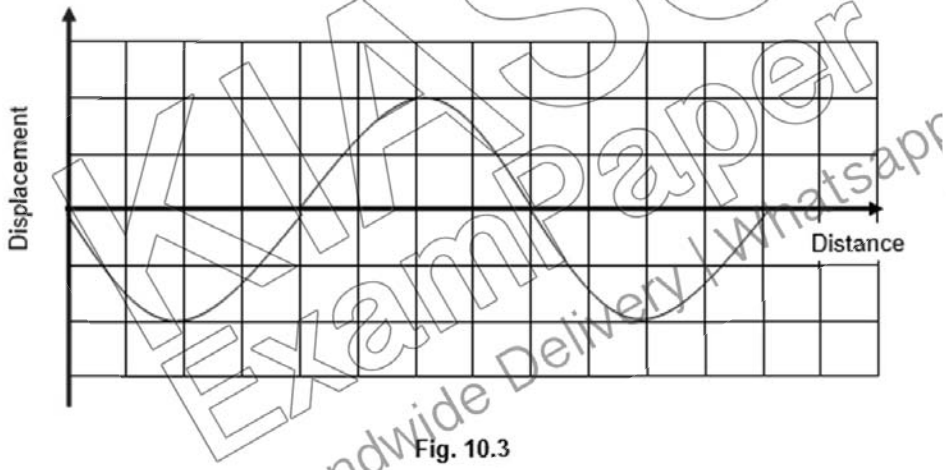
Que	Ans	Marks	Marker's Comments
3a	Mass is the measure of the **amount of matter in a body**. Weight is the measure of the amount of **gravitational force acting on an object**. Mass is a **scalar** quantity. Weight is a **vector** quantity Mass is measured in **kg** while weight is measured in **Newtons** Mass is measured by **electronic balance** while weight is measured by **spring balance** (Any two)	[1] [1]	Most can do it
3b	W = mg = 0.80 x 10 **= 8.00 N** (3 sig fig with correct unit)	[1] [1]	Most can do it
3c	1.0 cm : 1.0 N [1.0cm : 2.0N was not accepted] Scale too small 6.3 N [Accepted range: 6.2 N ~ 6.5 N]  Appropriate Scale Parallelogram or Tip-to Tail Correct arrows drawn Magnitude and unit for tension	[1] [1] [1] [1]	Most can do it
4a	Andres should push the door at a **further distance** away from the hinge to maximise the distance **away from the hinge so as to bring about** a lower force needed to produce the same moment. He could also push the door at **perpendicularly** so that the distance measured is the furthest from the hinge	[1] [1]	Most can state at a further distance from hinge but many did not mention about pushing at 90 deg to the door to have a higher perpendicular distance. Some overlook that efficiency means use a lesser force and mention about using a higher force to push
4b	Moment is the **turning effect** of force. It can be found by using **product of force applied and the perpendicular distance** from the **line of action of force to the pivot**.	[1] [1]	Most can do it

Que	Ans	Marks	Marker's Comments
4c	Moment is measured by the product of the **perpendicular** distance from the pivot point and the force applied. For measurement to be in Joule, it has to be the product of distance travelled **in the same direction** as the force applied. Moment is a **vector quantity** (in Nm) while work done is a **scalar quantity** (in J)	[1] [1]	Most could not state that moment is a vector while work done is a scalar
5a	Pressure of atmosphere is lower than gas pressure by 15 cm Hg Pressure gas = 76 + 15 = **91 cm Hg** Pressure = pgh = 13600 x 10 x 0.91 = 123 760 Pa = **124 000 Pa**	[1] [1]	Most can do it except for some who uses 15 cm instead of 0.15 m in the calculation
5b	Pressure difference = 0.15 x 10 x 13 600 With the new liquid X, the pressure difference still stays 0.15 x 10 x 13 600 = h x 10 x 6800 Therefore h = **0.30 m**	[1] [1]	Most can do it
5c	Since **liquid is incompressible**, the volume of liquid displaced at piston A has to be the **same volume** displaced at piston B. A **large cross sectional** at piston B will create **a small displacement** at piston B due to the displacement at piston A in order to obtain the same volume displaced. As the pressure created at piston A **is the same as** the pressure at piston B, piston B is of a larger cross sectional area than piston A, it will create **a larger force** at piston B Given that **work done = Force x distance** travelled in the direction of force. Work done at A = Force at A x distance travelled at A Work done at B = Force at B x distance travelled at B A **small force** at A with **large displacement** at A will create a **large force** at B with a **small displacement**. Thus the principle of conservation of energy is applicable in hydraulic system.	[1] [1] [1] [1]	Most are not able to explain fully when the principle of consevation of energy is valid in hydraulic system. Alot of points are missing in their explanation

Que	Ans	Marks	Marker's Comments
6a	GPE = mgh ➔ GPE = 0.2 (10) (0.05) = **0.1 J**	[1] [1]	Most can do it
6b	Loss in GPE = Gain in KE 0.1 = ½ (0.2) v^2 v = **1 m/s**	[1] [1]	Most can do it
6c	Energy is not being lost as the pendulum swings from B to A. All the gravitational potential energy lost is equal to the kinetic energy gained All gravitational potential energy is converted to kinetic energy	[1]	Most can do it
7a	An electric field is a **region in which a (unit positive) charge experiences an electric force**.	[1]	Most can do it
7b	X : **positive** Y : **negative**	[1]	Most can do it
7c		[1]	Most can do it
7d	As Z touches Y, **negative charges in Y will move to Z**. As Z is removed, both **X and Y will both be positively charged** and **X is repelled from Y** as like charges repel.	[1] [1] [1]	Some overlook and mention that the postive charges move and not electrons which is the wrong concept.
8a	Maximum reading = **20 V** Minimum reading = 200/600 x 20V = **6.67 V (to 3 sf)**	[1] [1]	Most can do it

Que	Ans	Marks	Marker's Comments
8b	I = V / R = 20 / (250 + 200) = **0.0444 A (to 3 sf)**	[1] [1]	Most can do it
8c	I through thermistor = V / R = 20 / (1 200 + 400) = 0.0125 A (to 3sf) Ammeter reading = 0.0444 A + 0.0125 A = 0.0569 A (to 2sf) Reading on V_2 = 400 / (400 + 1 200) x 20 = **5 V**	[1] [1]	Most can do it
Section B			
9a	Hair dryer produces **fast moving hot air molecules** which collide with the water molecules on the hair and transfer thermal energy to it. More water molecules **increase its KE** and they move more vigorously. There's an **increased in the number of fast moving surface water molecules that will successfully break the forces of attraction between the remaining molecules** and overcome atmospheric pressure to become gaseous state thus increases the rate of evaporation.	[1] [1] [1]	Most can explain with some overlooked that the hair dryer will produce fast moving air molecules used to heat up the water molecules
9bi	$P = V^2/ R = 230^2 / 25 = 2116$ W In 1 s, it will produce 2116 J of thermal energy. Energy produced by heater in 1 s = Energy gained by air in 1 s $2116 = m c \vartheta$ 2116 = 46 (c) (33 - 28) c = **9.20 J/g °C**	[1] [1]	Most are not able to use the resistance of heating element in the calculation and instead uses resistor R too! They overlooked that the whole circuit is a parallel circuit with the heating element getting the full emf instead of having to share with the resistor R

Que	Ans	Marks	Marker's Comments
9c	There will be **reduction to the temperature** of the air that is flowing out of the hairdryer. AND The flow **rate of air through the hairdryer increases** The flow rate increases due to a **lower resistance path** along the motor leading to a **higher current** flowing through the motor. As the flow rate of air increases and **power of heater stays unchanged** as it is still in parallel to the emf, the temperature of air flowing out of the body drops.	} [1] } [1] [1]	Most can explain that the temperature of air flowing out decreases but could not relate to the flow rate to explain
9d	A higher air flow rate will be when the switch is at K. E = 2.116 x (25/60) = 0.8817 kWh Cost of electricity = 0.8817 x unit cost = 28 cents Unit cost = **31.8 cents**	 [1] [1]	Most could not calculate as they were using resistor R in the calculation which is not needed if you need a higher flow rate of air
10ai		[3]	Most ended up drawing a real image wihich is 1.5 times instead of virtual ray and the whole ray diagram is wrong

Que	Ans	Marks	Marker's Comments
10aii	Distance of image from lens = **15 cm**	[1]	Poorly done
10bi		[1] for amplitude [1] for wavelength	Most can identfy the ampitude and wavelength correctly.
10bii	 Fig. 10.3	[1] A negative displacement must be drawn first [1] compression and rarefaction position must matches Fig. 10.2b Equal amplitude throughout	Most can identify the wavelength and the point with maximum displacement but could not recognise that the wavefrom must start with negative displacement first before drawing the positive displacement.

Que	Ans	Marks	Marker's Comments
10biii	There will be an **increase in amplitude** due to the loudness. The **wavelength will be shorter** as the higher pitch brings about higher frequency and thus shorter wavelength.	[1] [1]	Most stated the increase in the wavelength BUT overlook that the axis used in Fig. 10.3 is distance and NOT time.
E11ai	Total energy input by motor = P x t = 5000 x 30 = 150 000 J Energy input by motor = Gain in PE 150 000 = mgh = (200) (10) (h) h = **75 m**	[1] [1]	Most can do it
E11aii	Area under vel time graph = 75 m ½ (v)(t) = 75 ½ (10 t) (t) = 75 t = **3.87 s**	 [1] [1]	Most can do it
E11bi	The weight of falling weight = 0.02 x 10 = 0.2 N The magnetic force by the electromagnet B **must be more than 0.2 N** so that it can create a deceleration ie a **negative net force** so as to bring to an instant halt for the falling weight.	[1] [1]	Most did not realise that there is a need for the force to be higher than the weight in order to bring about a deceleration. IF it is the same as the weight the outcome is that the masss will fall with constant velocity instead of stopping
E11bii	**Increase the number of turns** coiling the electromagnet **Increase the current** flowing in the solenoid	[1] [1]	Most can do it
E11biii	There is **no need to increase/ change the strength** of the electromagnet B as the amount of force needed is still the same ie to overcome the weight	[1] [1]	Most did not realise that the force is the same as the weight is still the same despite falling from a higher height
O11ai	**South** polarity at Q	[1]	Most can do it

Que	Ans	Marks	Marker's Comments
011aii	The coil will rotate in a **clockwise** manner	[1]	Most can do it
011aiii	As the coil rotates past the vertical position, there is a **reverse in the direction of the current** flowing in the coil due to the presence of the split ring. This will allow the coil to rotate continuously as the **force acting on the left side of the coil is always up while the right side of coil is always down**.	[1] [1]	Most did not relate well the resason for continuously rotation but merely state there is presence of split ring
011bi	Both bulb J and K are **not ohmic conductors** as the **voltage is not directly proportional to current**	[1] [1]	Some overlooked the definition of ohms law and think that both are ohmic as it passes through the origin
011bii	At V = 0.2 V Bulb J current = 0.05 A thus resistance = V/I = 0.2/0.05 = **4 Ω** Bulb K current = 0.02 A thus resistance = V/**I = 0.2/ 0.02 = 10 Ω**	 [1] [1]	Most can do it
011biii	The **longer** the length of the wire used, the **higher the resistance** and the **thicker** the wire, the **lower the resistance**	[1] [1]	Most can do it