Name: .... (   )

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2021

PHYSICS
6091 / 01

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LEVEL:	Sec 4 Express	**DATE:**	27 August 2021
CLASS:	Sec 4/2	**DURATION:**	1 hour

Additional Materials provided: 1 sheet of OAS paper

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page and on the OAS paper. **Shade your index number on the OAS paper.**

There are 40 questions in this section. Answer **all** questions. For each question, there are four possible answers A, B, C and D. **Choose the correct answer and record your choice in soft or 2B pencil on the OAS paper provided. DO NOT fold or bend the OAS paper.**

At the end of the examination, hand in your OAS paper and question booklet separately.

This Question Paper consists of 19 printed pages including this page.
[Turn over

MULTIPLE CHOICE QUESTIONS (40 marks)
Answer **all** questions on the OAS paper provided.

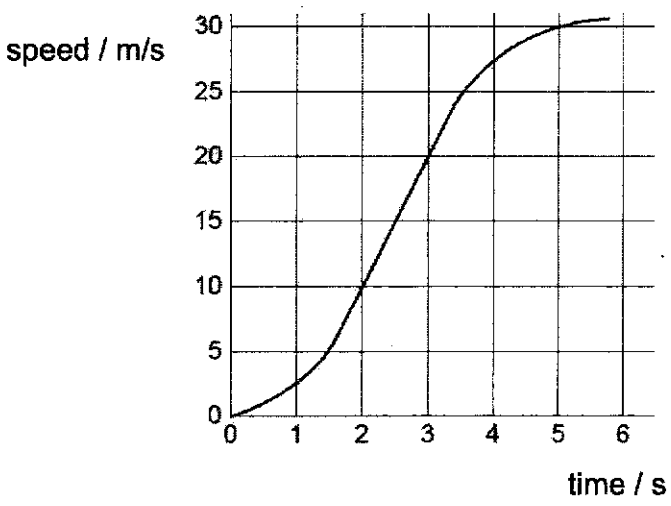
1 Which pair of units both measure the same quantity?

A J and W/s
B kg/m^3 and J/kgK
C N/m and Pa
D V/A and Ω

2 A cuboid was measured to have a specification of 2.5 cm by 3.12 cm by 4.0 cm. Which instruments were used to take these measurements?

A measuring tape and metre rule
B metre rule and vernier callipers
C micrometer screw gauge and measuring tape
D vernier callipers and micrometer screw gauge

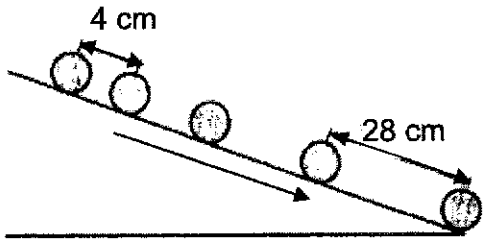
3 The graph shows the speed of a car as it accelerates from rest.



What is the acceleration of the car at 2 s?

A 0 m/s^2
B 5 m/s^2
C 6 m/s^2
D 10 m/s^2

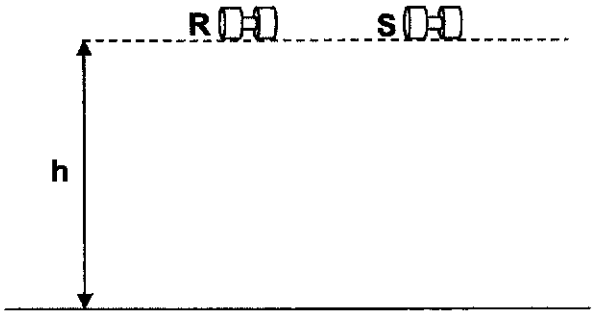
4 A ball bearing rolls down an inclined plane from rest. A high speed camera takes rapid multiple shots of the motion at a frequency of 10 Hz. The diagram below shows the shots compiled into one photograph.



What is the acceleration of the ball from the photograph?

	type of acceleration	magnitude of acceleration
A	constant	8 m/s^2
B	constant	10 m/s^2
C	increasing	8 m/s^2
D	increasing	10 m/s^2

5 Two dumb-bells **R** and **S** have the same size but different masses. It is observed that when both of them are released at the same time at the same height **h**, **R** reaches the ground first.



Which statement is **not** true?

A **R** and **S** accelerate at constant rate but with different magnitude.

B **S** has a smaller mass than **R**.

C The effect of air resistance on **R** is less than that on **S**.

D The final speed of **R** is higher than the final speed of **S**.

6 A mass of 50 kg is raised vertically.

How much force is required to lift the mass up with an acceleration of 4 m/s^2 given that gravitational field strength is 10 N/kg?

A	200 N	**B**	300 N
C	500 N	**D**	700 N

7 Two blocks **X** and **Y** are connected by a light, inextensible string that passes over a smooth pulley.

When **X** is released, the blocks move at constant speed as shown in Fig. 7.1 and after a while, the string is cut as shown in Fig. 7.2.

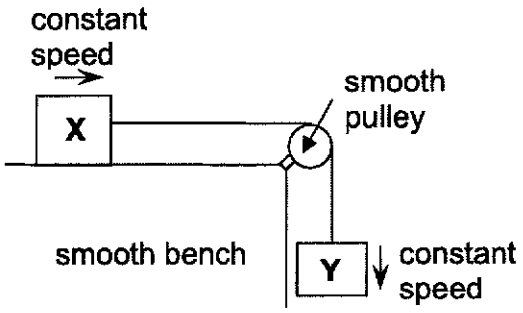


Fig. 7.1

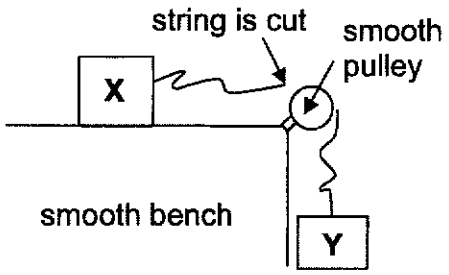


Fig. 7.2

What are the resultant forces acting on **X** and **Y** after the string is cut?

	resultant force on **X**	resultant force on **Y**
A	0 N	0 N
B	0 N	weight of **Y**
C	weight of **X**	0 N
D	weight of **X**	weight of **Y**

8 A bar made of iron has a total volume of 340 cm^3. Given that the density of iron is 7.87 g/cm^3, what is the weight of the iron bar on Earth where gravitational field strength is 10 N/kg?

A 0.23 N **B** 2.7 N

C 4.3 N **D** 27 N

9 A student made three statements.

- The inertia of an object is dependent on the size of the object.
- Metal is heavier than feather.
- When the mass of an object increases, the weight of the object will also increase.

How many statement(s) are is / are always true?

A 0 **B** 1

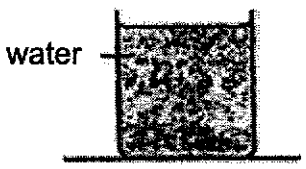
C 2 **D** 3

10 Four identical beakers are filled with different substances.

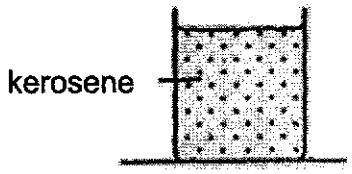
substance	density / g/cm^3
kerosene	0.81
sand	1.60
water	1.00

Which beaker has the lowest centre of gravity?

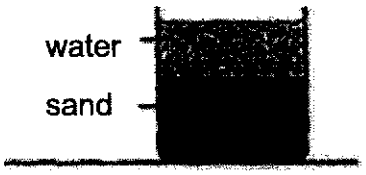
A



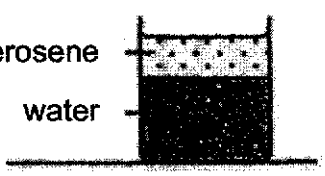
B



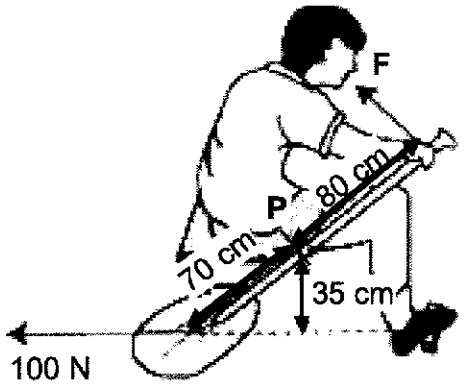
C



D



11 A boy is sitting in a boat and paddling with an oar. The oar is pivoted at **P**, and the water current can be seen as a single horizontal force of 100 N acting through the middle of the oar as shown in the diagram below.

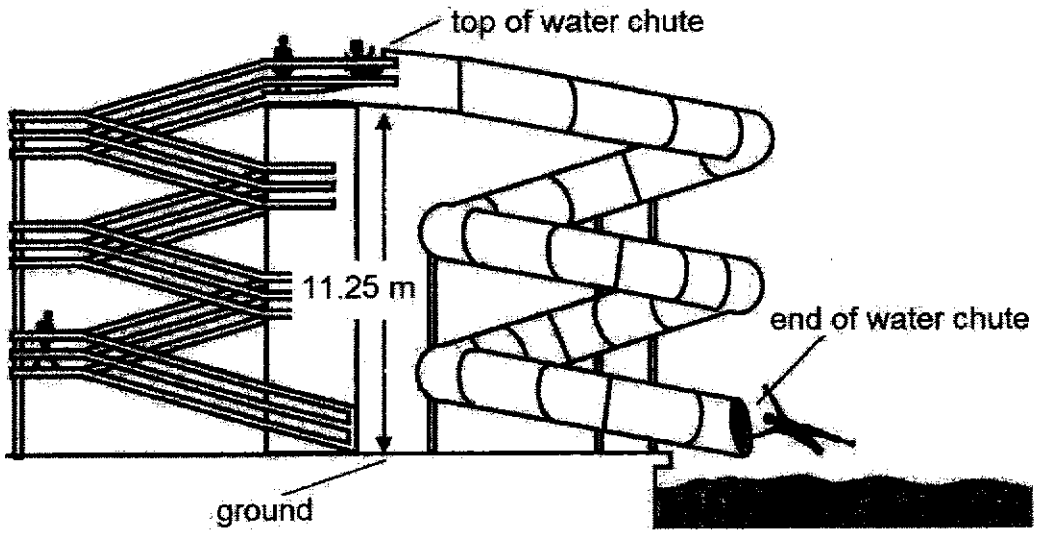


What is the minimum force **F** needed to support the oar?

A 28 N **B** 44 N

C 88 N **D** 200 N

12 A 50 kg boy pushes himself from the top of a water chute and starts sliding down with a speed of 2.5 m/s.

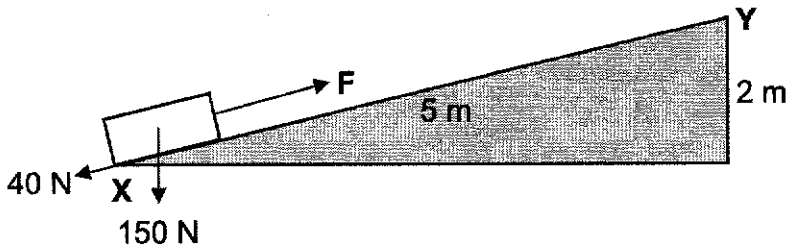


Assuming friction is negligible, what is the speed of the boy when he reaches the end of the water chute? The gravitational field strength is 10 N/kg.

A 15.0 m/s **B** 15.2 m/s

C 225 m/s **D** 231 m/s

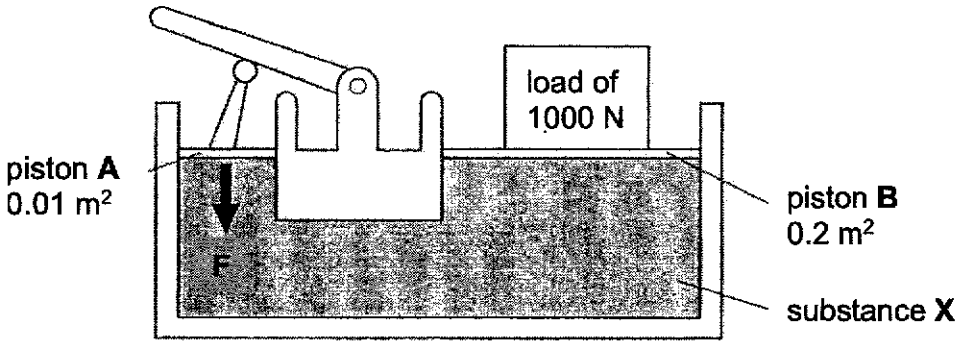
13 The diagram shows a box being pulled up a rough slope from **X** to **Y**. The box experiences a friction of 40 N during the motion.



What is the force **F** needed to pull the box up the slope and how much work is done by **F**?

	force **F**	work done by **F**
A	20 N	100 J
B	40 N	200 J
C	60 N	300 J
D	100 N	500 J

14 The hydraulic system shown in the diagram below contains substance **X**. A force **F** is applied at piston **A** to support the load of 1000 N placed at piston **B**.



Which statement is true?

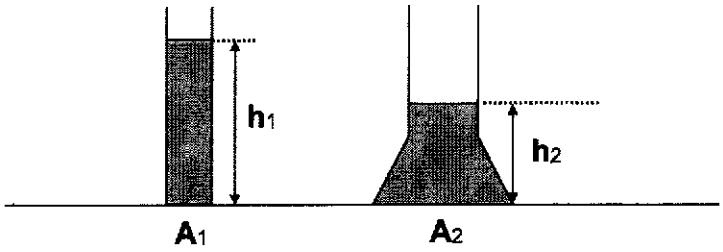
A A minimum force of 60 N is applied at piston **A** to lift up the 1000 N load.

B Substance **X** can be a liquid or gas but not a solid.

C The minimum force **F** is lowered if the area of piston **B** is larger.

D The pressure at piston **A** is larger than the pressure at piston **B**.

15 Water is contained in a container of base area A_1 up to height h_1. Some water is contained in a second container of bigger base area A_2, but up to a lower height h_2. The pressure exerted on the base of the container A_1 is P_1 while that exerted on base of the container A_2 is P_2.



Which comparison of P_1 and P_2 is correct?

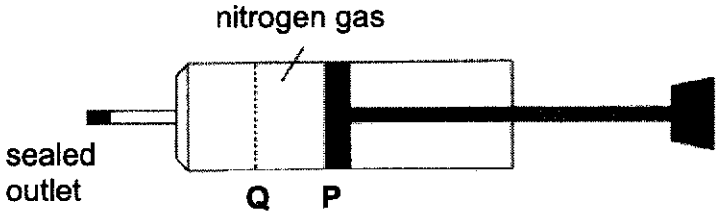
A $P_1 > P_2$ since $h_1 > h_2$

B $P_1 > P_2$ because $A_2 > A_1$

C $P_1 < P_2$ because $A_2 > A_1$

D $P_1 = P_2$ since $A_2 > A_1$ and $h_1 > h_2$

16 A fixed amount of nitrogen gas is kept in a container with a movable piston. The piston is moved from position **P** to **Q** while the temperature is kept constant.



How will this affect the properties?

	average molecular distance	frequency of collision with walls of container	average speed of molecules
A	stays constant	decreases	increases
B	stays constant	increases	increases
C	decreases	increases	stay constant
D	decreases	stays constant	decreases

17 The kinetic model of matter assumes that gases are made up of rapidly, irregularly moving molecules.

Which fact does **not** support this assumption?

A A tiny smoke particle in air undergoes Brownian motion.

B An inflated balloon can be compressed under pressure.

C Gas exerts equal pressure on all walls of its container.

D When released into an empty container, a gas will rapidly fill it.

18 Why are metals good conductor of electricity?

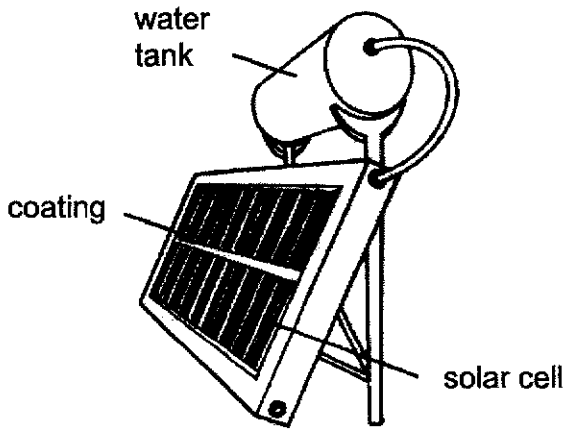
A absorption of heat from one molecule to the other

B electrons colliding with other molecules

C vibration and collision of adjacent molecules

D warmer molecules that are less dense rise to the top

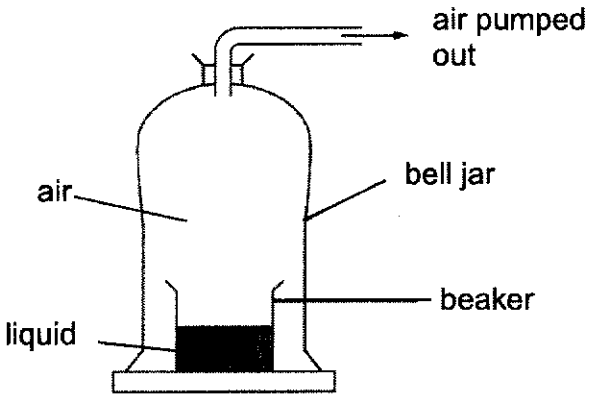
19 A solar heater shown below is used to absorb energy from the Sun before transferring the energy to water stored in a tank.



What should be the colour of the coating and what is the reason?

	coating	reason
A	black	a good absorber of radiation
B	black	a good emitter of radiation
C	white	a good absorber of radiation
D	white	a good emitter of radiation

20 A beaker of liquid is placed under a bell jar. The pressure of the air above the liquid is reduced and some of the liquid evaporates. This causes the liquid to become colder.



Why does the temperature of the liquid fall?

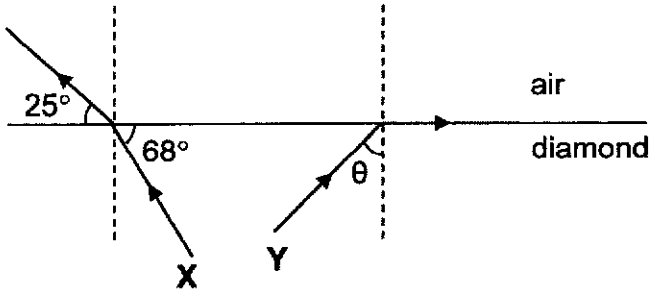
A The average internal energy of the liquid decreases.

B The higher energy air molecules leave the bell jar.

C The higher energy liquid molecules leave the beaker.

D There are less collision between the air molecules and the liquid surface.

21 The figure shows a two light rays, **X** and **Y**, travelling from diamond to air. Both light rays come from the same light source.

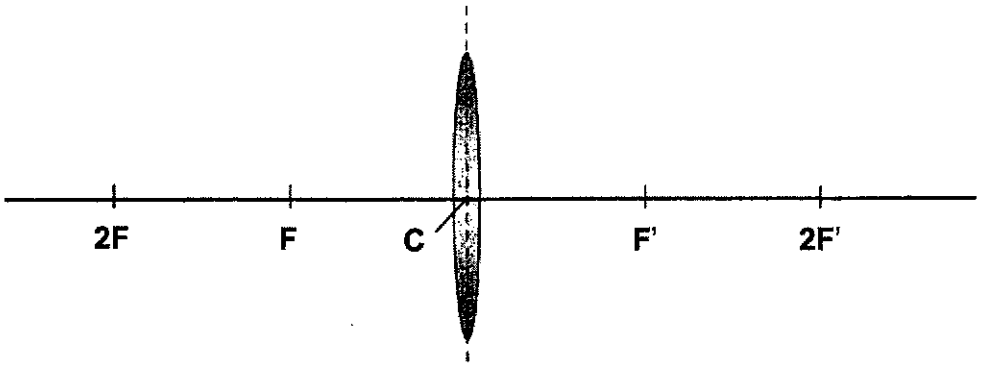


What is angle θ?

A 21.6° **B** 24.4°

C 27.1° **D** 45.0°

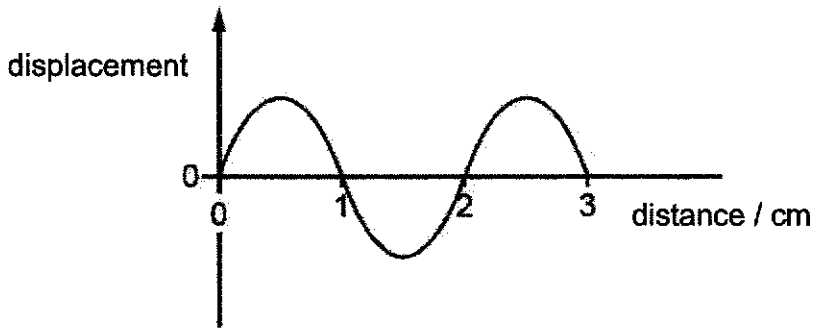
22 **F** and **F'** are the foci of the converging lens and **C** is the optical centre.



In order for the converging lens to be used in a photocopier, where should the original document and the photocopied paper be placed to produce image of the same size?

	original document	photocopied paper
A	between **F** and **C**	at **F'**
B	at **F**	at **2F**
C	between **F** and **2F**	between **F'** and **2F'**
D	at **2F**	at **2F'**

23 A water wave is generated in a ripple tank. The displacement-distance graph of the wave are shown below.

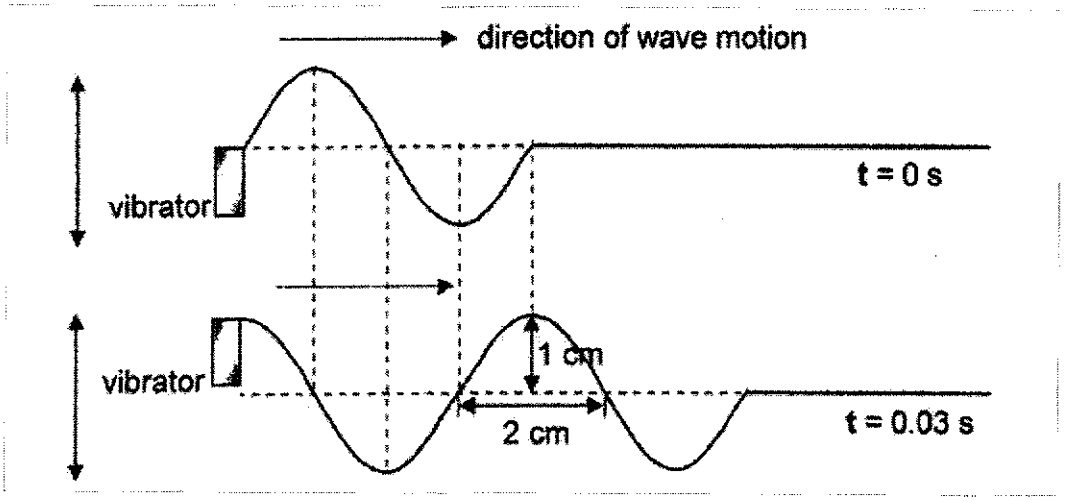


What is the speed of the wave if the frequency of the ripple tank is set at 50 Hz?

A 25 cm/s **B** 50 cm/s

C 100 cm/s **D** 150 cm/s

24 A wave on a string is produced by a vibrator. The waveforms at time **t** = 0 s and **t** = 0.03 s are shown in the diagram below.



What is **not** true about the wave?

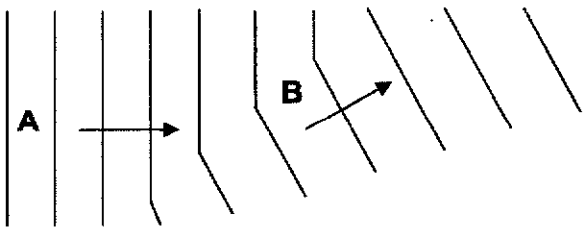
A The distance between two adjacent particles of the same phase is 2 cm.

B The maximum displacement of the wave is 1 cm.

C The particles on the string take 0.12 s to complete one oscillation.

D The particles on the string vibrate perpendicularly to the wave motion.

25 The diagram shows water waves in a ripple tank in which parts **A** and **B** are of different depths.



How do the frequency and speed of the waves change from **A** to **B**?

	frequency	speed
A	increases	increases
B	increases	no change
C	no change	decreases
D	no change	increases

26 Which is an example of application of ultrasound?

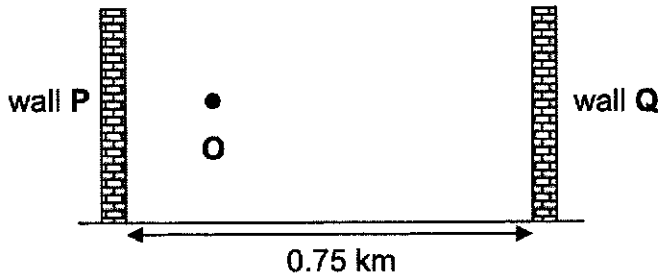
A detecting abnormality in the heartbeats using a stethoscope

B listening to the music from the radio to the human's ear

C locating obstacles in underwater

D transmitting signals from the radio station to the radio

27 A man stands at point **O** between two parallel walls **P** and **Q** and fires a starting pistol. He hears two echoes one after another at 1.2 s apart.



Given that the speed of sound in air is 333 m/s, how far is the man standing away from **P**?

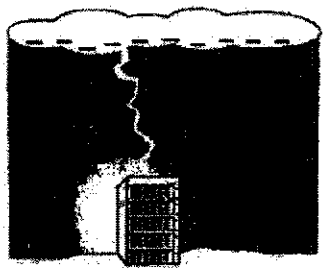
A 200 m **B** 275 m

C 475 m **D** 550 m

28 Penny holds a rod in one hand and rubs the rod with a thin sheet of material held in her other hand. Both the rod and the thin sheet become charged and remain charged. What could the rod and the thin sheet be made?

	rod	thin sheet
A	copper	silk cloth
B	glass	aluminium foil
C	iron	plastic comb
D	nylon	woollen duster

29 The lower part of a cloud is negatively charged. The cloud discharges in a flash of lightning. What are the directions of electron flow and conventional current?



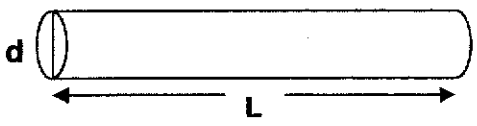
	electron flow	conventional current
A	downwards	downwards
B	downwards	upwards
C	upwards	downwards
D	upwards	upwards

30 A device is switched on for 30 minutes and the total electrical energy consumption is 108 kJ. It is connected to a battery which e.m.f. is 12 V. What is the total amount of charge passing through the device in 30 minutes?

A 270 C **B** 300 C

C 9000 C **D** 16200 C

31 A segment of a uniform copper wire has length **L** and diameter **d**.



Which change will cause the resistance of the wire to increase by four times?

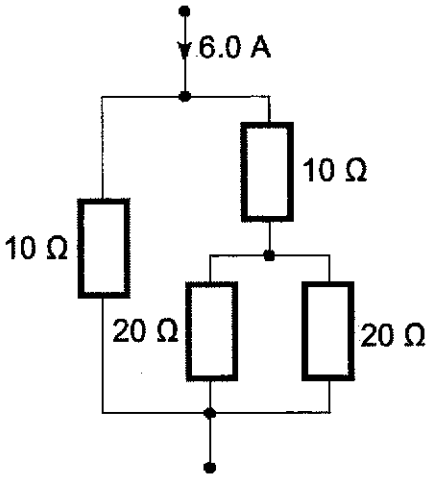
A decreasing length to **L**/2 and increasing diameter to 2**d**

B decreasing length to **L**/4 and decreasing diameter to **d**/8

C increasing length to 2**L** and decreasing diameter to **d**/2

D increasing length to 16**L** and increasing diameter to 2**d**

32 The diagram shows part of a complete circuit.

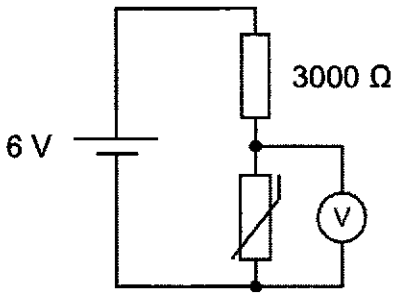


What is the current through the 20 Ω resistor?

A 0.5 A **B** 1.0 A

C 4.0 A **D** 6.0 A

33 A thermistor is connected in a circuit with a 6 V cell, a 3000 Ω resistor and a voltmeter.



How would the voltmeter reading change if the temperature increases?

A decreases and eventually becomes 0 V

B decreases but will not reach 0 V

C increases and eventually become 6V

D increases but will always be below 6V

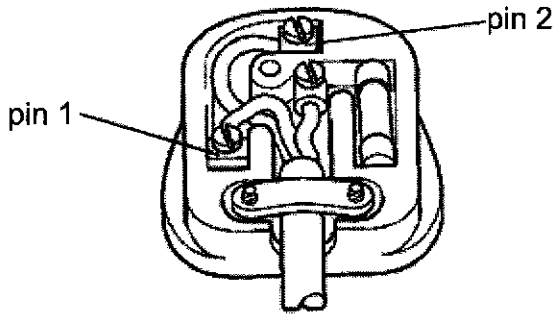
34 2.0 kW heater and three 950 W fans are connected in parallel to a 240 V mains supply. Each day, the heater is switched on for 1 hour 20 minutes and the fans are switched on for 12 hours.

What is the total cost of electricity per day if each kWh is charged at 29.05 cents?

A $4.09 **B** $5.52

C $10.71 **D** $12.75

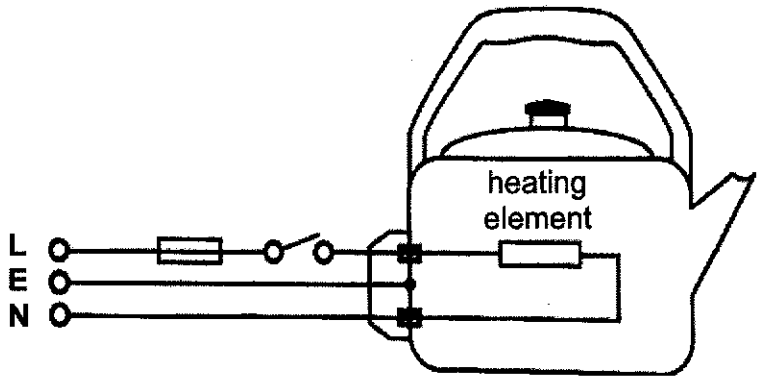
35 The diagram below shows a three-pin plug with its cover removed.



What colour is the wire connected to pin 1 and what is the function of the wire connected to pin 2?

	colour of wire connected to pin 1	function of wire connected to pin 2
A	blue	direct current from the mains to the appliance
B	blue	direct current to the ground
C	brown	direct current from the mains to the appliance
D	brown	direct current to the ground

36 The diagram below shows the connections of an electric metal kettle.



Why is the earth wire necessary?

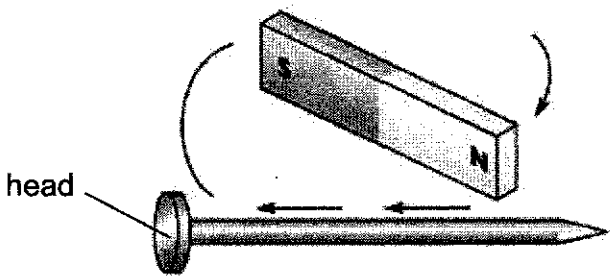
A It allows current to flow through instead of flowing to a person.

B It breaks the circuit when the current becomes too high.

C It is cheaper than double insulation.

D It prevents the wires from overheating.

37 A nail is permanently magnetised using the stroking method shown in the diagram below.



Which statement is true?

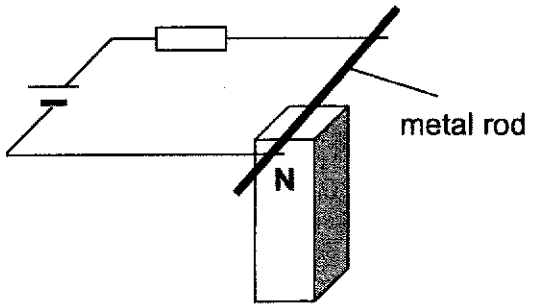
A The nail is most likely made of copper.

B The nail is most likely made of iron.

C The polarity formed at the head is a North pole.

D The polarity formed at the head is a South pole.

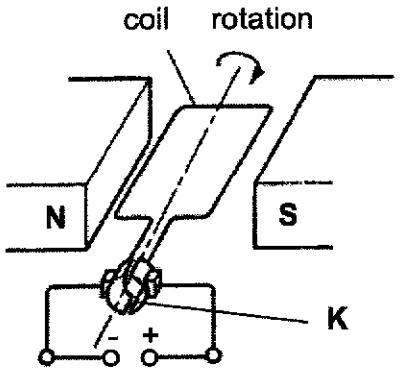
38 A metal rod is placed on stiff wires as shown in the diagram. A permanent magnet is placed under the centre of the rod with the north pole nearest to it.



What is the direction of current in the metal rod and in which direction will it move?

	direction of current	direction of motion of rod
A	↙	to the left
B	↙	to the right
C	↗	to the left
D	↗	to the right

39 The diagram below shows a simple d.c. motor.



What is the main function of **K**?

A It acts as a contact between the coil and the connecting wires.

B It induces e.m.f. in the coil and causes it to rotate.

C It increases the strength of electromagnetism in the coil.

D It reverses the direction of current in the coil every half a cycle.

40 **X** and **Y** are wires carrying electric currents either into or out of the page. **P**, **Q** and **R** are plotting compasses. Any effect of the Earth's magnetic field can be ignored.

Which row about **X** and **Y** is correct?

	directions of currents	sizes of current	force between **X** and **Y**
A	same	larger in **X** than in **Y**	attraction
B	same	smaller in **X** than in **Y**	repulsion
C	different	larger in **X** than in **Y**	attraction
D	different	smaller in **X** than in **Y**	repulsion

– End of Paper –

Name: .... (   )

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2021

PHYSICS
6091 / 02

LEVEL:	Sec 4 Express	**DATE:**	27 August 2021
CLASS:	Sec 4/2	**DURATION:**	1 hour 45 minutes

Additional Materials provided: -NIL-

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page. This paper consists of two sections.

SECTION A (50 marks)
SHORT-STRUCTURED QUESTIONS
Answer **all** questions. Write your answers in the spaces provided on the question paper.

SECTION B (30 marks)
FREE-RESPONSE QUESTIONS
Answer all **three** questions. Write your answers in the spaces provided on the question paper.

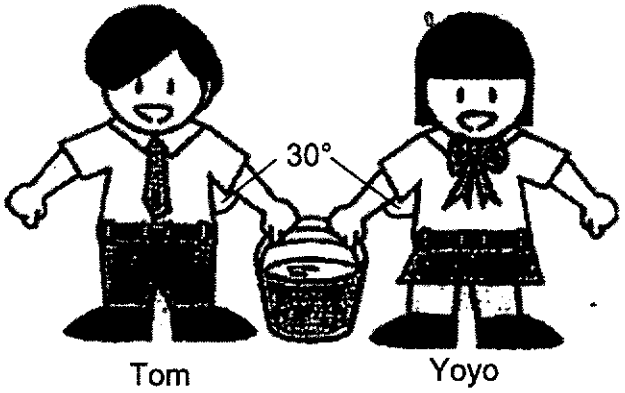
For Examiner's Use	
Paper 1	/40
Paper 2 Section A	/50
Paper 2 Section B	/30
Paper 3	/40
Total (100%)	/100%

At the end of the examination, hand in this question booklet.

This Question Paper consists of 20 printed pages including this page.
[Turn over

SECTION A – SHORT-STRUCTURED QUESTIONS (50 marks)
Answer **all** the questions in the spaces provided.

1 Two students, Tom and Yoyo, lift up a pail of water from the ground. The weight of the water is 60 N and the angle made between their hands and bodies is 30°.



(a) The weight of the water is represented in Fig. 1.1.

Draw a vector diagram, using a scale of 1.0 cm representing 10 N, to determine the force needed by each student to lift up the pail of water in this stationary position.

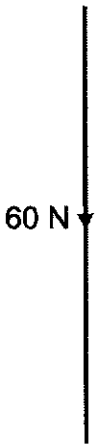


Fig. 1.1 (TO SCALE)

force needed by Tom = ...

force needed by Yoyo = ... [3]

(b) Tom stands further away from the pail and the angle between his hand and body is increased. There is no change to the angle between Yoyo's hand and body.

State any change to the force needed by Tom and Yoyo to lift up the same pail of water.

Tom: .....

Yoyo: ..... [1]

2 A stone is launched directly upward into the air from the ground with an initial upward speed of 30 m/s. It is acted on by the Earth's gravitational field.

(a) The table below is for the magnitude and the direction of the acceleration of the stone after it is launched upward.

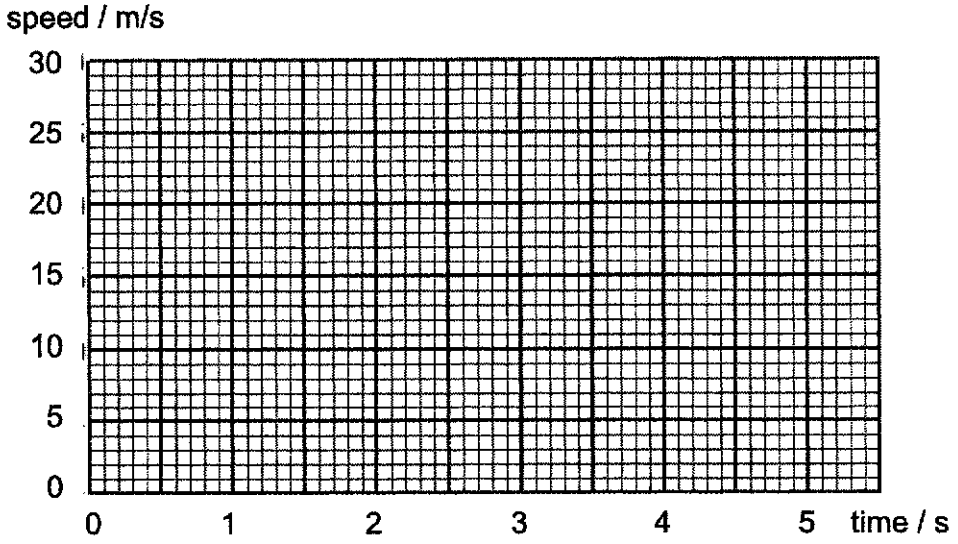
Complete the table. Give the unit for the magnitude of any acceleration that you write down.

	magnitude of acceleration	direction of acceleration
as the stone moves upwards		
at the highest point of the motion		

[2]

(b) The stone is launched at time = 0 s.

On the grid below, sketch the speed-time graph for the entire motion. You may assume that air resistance is very small when it is moving upwards but becomes significant when it is falling to the ground.



[3]

(c) Calculate the maximum height obtained by the stone.

maximum height = ... [2]

3 In Fig. 3.1, a bus breaks down on a road while moving. The passengers get out and push the bus at a constant speed. The diagram shows the passengers exerting a force of 17 kN on the bus parallel to the road.

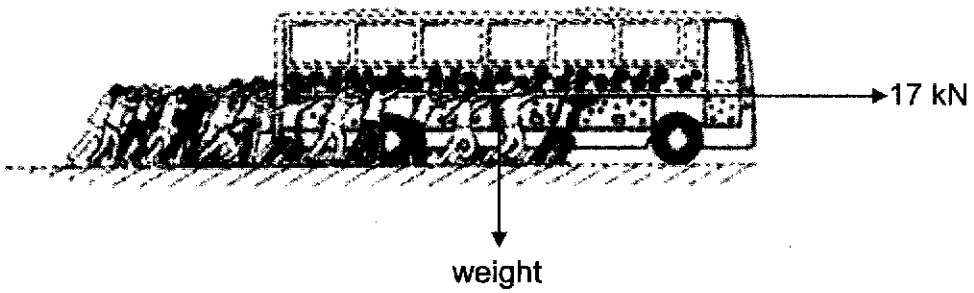


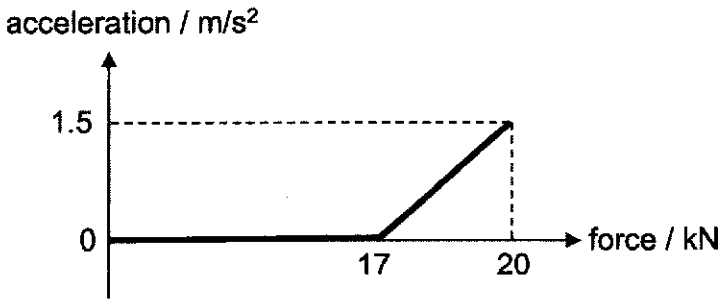
Fig. 3.1

(a) State the friction and the resultant force acting on the bus.

friction = ...

resultant force = ... [1]

(b) The graph below shows how the acceleration of the bus varies with the force applied by the passengers as they continue to push the bus.



Calculate the weight of the empty bus. The gravitational field strength is 10 N/kg.

weight = ... [3]

(c) Describe one force acting on the bus that is not shown in the diagram in Fig. 3.1.

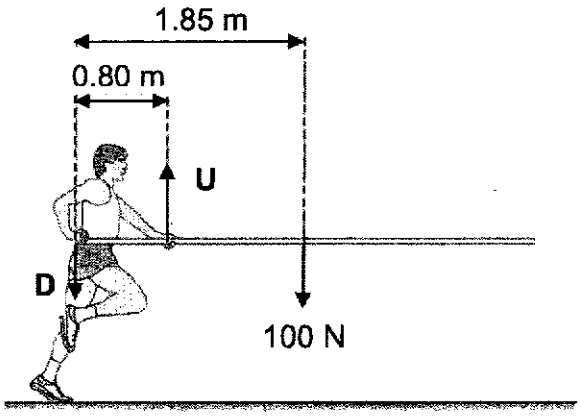
.....

.....

.....

..... [2]

4 The diagram below shows a pole-vaulter holding a uniform pole horizontally. He keeps the pole in equilibrium by exerting an upwards force **U** with his left hand, and a downwards force **D** with his right hand.



(a) State the *principle of moments*.

.....

.....

..... [1]

(b) By taking moments, determine forces **U** and **D**.

U = ...

D = ... [3]

(c) In the diagram above, the pole-vaulter lifts up his right leg while holding the pole.

Explain why this position is unstable for the pole-vaulter.

.....

.....

..... [1]

5 In Fig. 5.1, a 300 W electric heating coil is used to heat up 600 g of liquid **Z**. The container has a mass of 220 g and a specific heat capacity of 400 J/kgK.

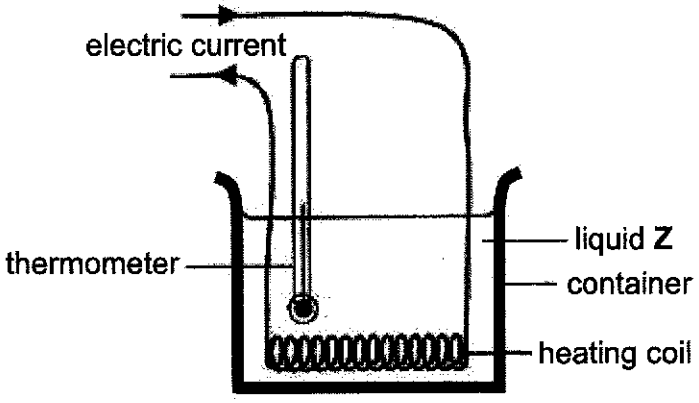


Fig. 5.1

Fig. 5.2 shows the temperature of liquid **Z** against time of heating.

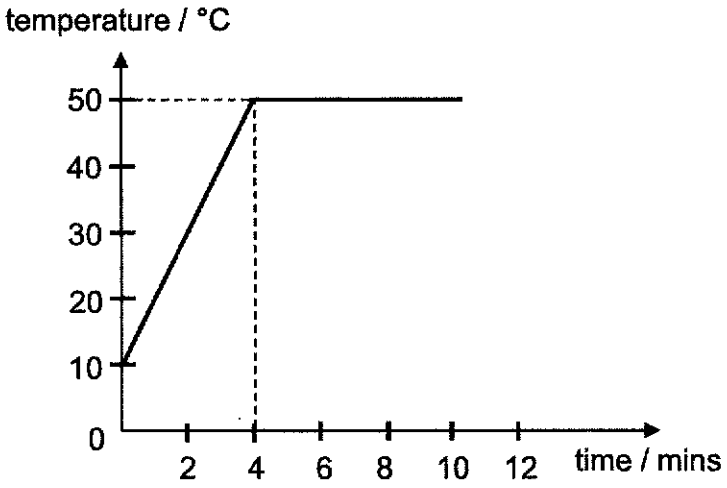


Fig. 5.2

(a) Determine the specific heat capacity of liquid **Z**.

specific heat capacity = ... [3]

(b) After 4 minutes the temperature has stopped rising, even though heat is still supplied at the same rate to the liquid. Explain why.

.....

.....

.....

..... [2]

(c) **(i)** Suggest a modification to the experiment so that the rate of rise in temperature is higher.

.....

..... [1]

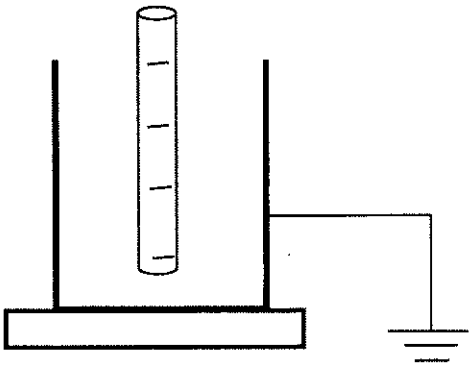
(ii) Give a reason for your answer.

.....

.....

..... [1]

6 **(a)** A negatively charged polyethene rod is lowered into an uncharged metal cylinder standing on an insulating slab. The external surface of the cylinder is then touched with a wire connected to earth.



State and explain what happens to the charge on the cylinder during the charging process.

.....

.....

.....

..... [2]

(b) State one example where electrostatic charging can be dangerous and explain how the danger is reduced.

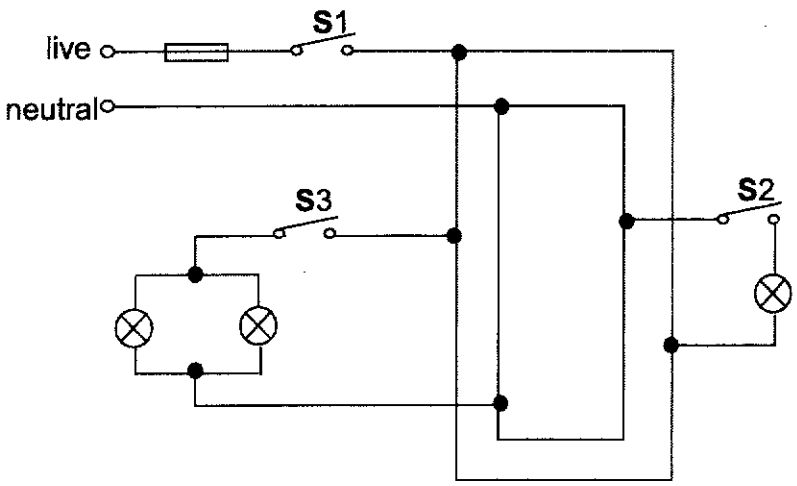
.....

.....

.....

..... [2]

7 A diagram of electrical wiring of a house is as shown.



The potential difference between the live wire and neutral wire is 240 V. The lamps are identical and each lamp has a resistance of 800 Ω.

(a) Determine the current in the circuit when only **S**1 and **S**2 are closed.

current = ... [2]

(b) Calculate the rate of energy consumption when all three lamps are in used.

rate of energy consumption = ... [2]

(c) Identify a wiring mistake in the circuit. Explain why this connection is unsafe.

.....

.....

.....

..... [2]

(d) The lamp emits two components in the electromagnetic spectrum with a range of wavelengths from 200 nm to 2000 nm.

(i) Identify these two components.

.....

..... [1]

(ii) State the speed of all electromagnetic radiations in vacuum.

speed = ... [1]

8 **(a)** Fig. 9.1 shows view of a wire carrying a current downwards through a horizontal board. Fig. 9.2 shows the view of the wire from the top.

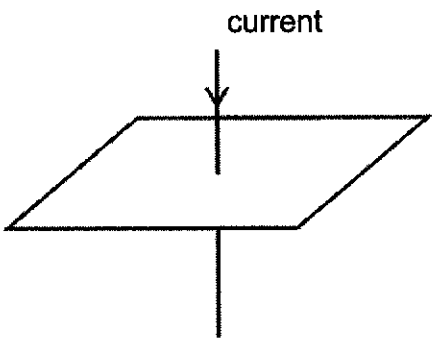


Fig. 9.1

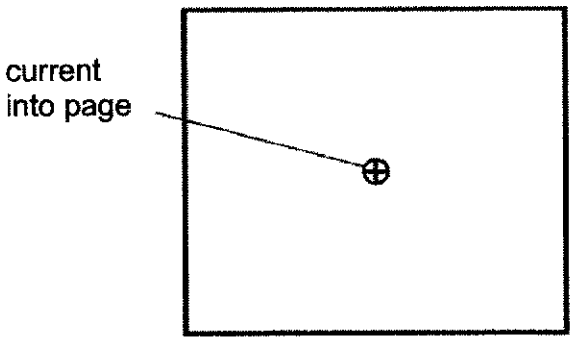


Fig. 9.2

(i) On Fig. 9.2, draw the magnetic field pattern due to the current flowing in the wire. [1]

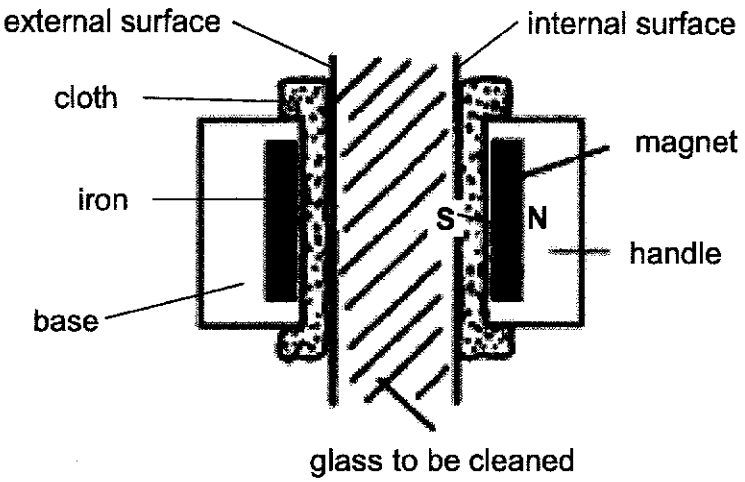
(ii) Describe briefly how you determine the direction of the magnetic field in part **(a)(i)**.

.....

.....

..... [1]

(b) A magnetic wiper is designed to clean a window glass safely from the internal surface. When the handle with the magnet is moved, the base that contains the iron from the external surface would follow. This would allow both sides of the glass to be cleaned at the same time.



Explain why the base at the external surface follows the movement of the handle.

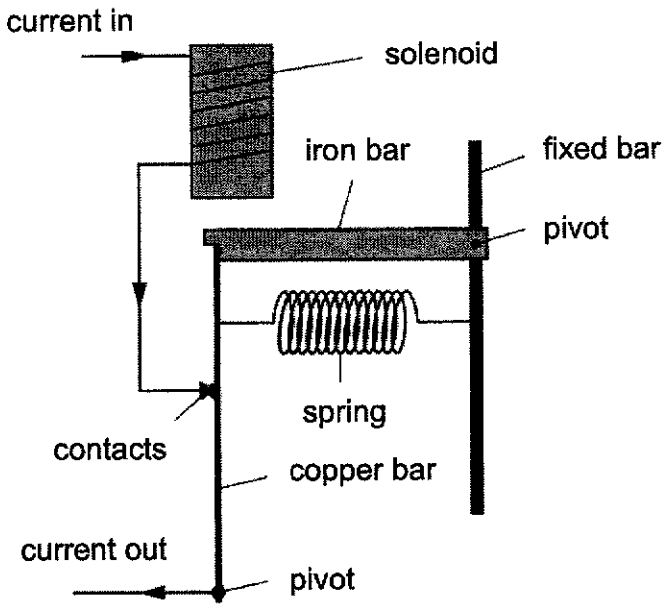
.....

.....

.....

..... [2]

9 The diagram shows the structure of a circuit breaker that operates when the current is more than 10 A.



(a) Describe how the circuit breaker works as a safety device when the current is more than 10 A.

.....

.....

.....

.....

.....

..... [3]

(b) The number of turns of coil in the solenoid is higher now. Explain how this will affect the minimum operating current of the circuit breaker.

.....

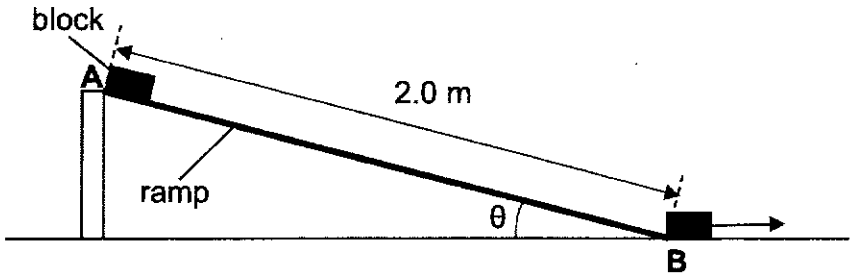
.....

.....

..... [2]

SECTION B – FREE RESPONSE QUESTIONS (30 marks)
Answer **all** the questions from this section.

10 In an experiment, a 10 kg block is placed at the top of a 2.0 m ramp. When the block is released, a stopwatch is started and when the block reaches the bottom of the ramp, the stopwatch is stopped. The time for the block to travel 2.0 m is then recorded in a table.



The experiment is repeated again at different angles of elevation θ. Table 10.1 shows the results of the experiment and other calculated measurements such as gravitational potential energy (GPE) and kinetic energy (KE).

Table 10.1

θ / °	time / s	average speed / m/s	final speed / m/s	GPE at **A** / J	KE at **B** / J	efficiency / %
20	1.53	1.31	2.61	68.4	34.1	49.8
30	1.10	1.82	3.64	100	66.2	66.2
40	0.89	2.25	4.50	129	101	78.3
50	0.78	2.56	5.12	153	131	85.6
60	0.72	2.78	5.56	173	155	89.6

(a) (i) Describe how the average speed and the final speed of the object are determined in this experiment.

.....

.....

.....

..... [2]

(ii) State an assumption in this experiment.

.....

..... [1]

(b) The efficiency of the experiment is 78.3 % when $\theta = 40°$.

(i) Explain, using data from Table 10.1, what is meant by the *efficiency of the experiment is 78.3 %.*

.....

..... [1]

(ii) State the relationship between the angle of elevation and the efficiency.

.....

..... [1]

(iii) Explain your answer in part **(b)(ii)**.

.....

.....

.....

..... [2]

(c) The ramp is then replaced by a 4.0 m ramp of the same material. The same block is released from rest at **A** with an angle of elevation of 60°.

Calculate the final speed of the object given that the efficiency is the same.

final speed = ... [3]

11 Fig. 11.1 shows a young boy lying on his back at the bottom of a swimming pool. He is holding his breath and his eyes are open.

A red light is positioned on the ground at **Q**. One particular ray of the red light travels along the air-water interface from **Q** into the water.

At first, the boy's head is touching the pool wall and at this position, he is unable to see the red light at **Q**. As he slides away from the pool wall, his eyes reach a point **P** where he first sees the light at **Q**.

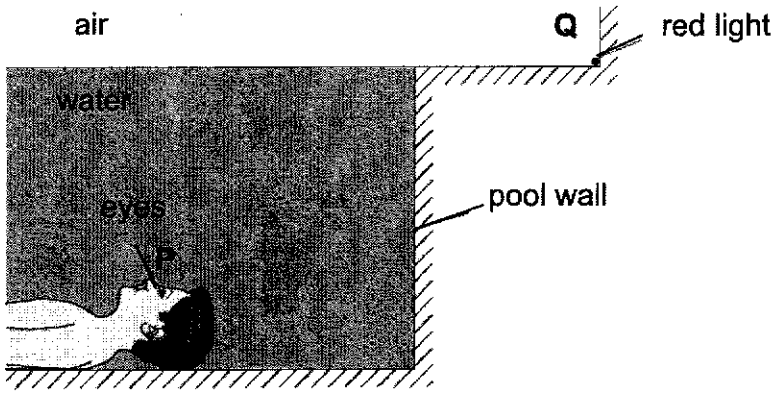


Fig. 11.1 (NOT TO SCALE)

(a) **(i)** On Fig. 11.1, draw a ray of light travelling from **Q** to **P**. Mark the critical angle for light in water and label it **C**. [1]

(ii) The critical angle of water is 49°. Calculate the refractive index of water.

refractive index = ... [2]

(b) Explain why the boy is unable to see the red light at **Q** when his eyes are at distance less than **P** away from the pool wall.

.....

.....

.....

..... [2]

(c) The boy continues to slide further away from the pool wall. At a certain distance, the air-water surface acts as a mirror and he is able to see the image of the object shown in Fig. 11.2.

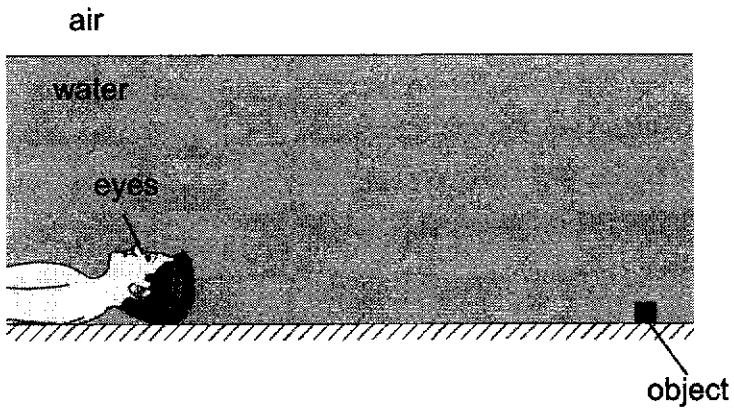


Fig. 11.2 (NOT TO SCALE)

(i) On Fig. 11.2, draw a ray of light from the object, reflected by the air-water surface, to the boy's eyes. [1]

(ii) On Fig. 11.2, mark the angle of incidence of the ray at the air-water surface. Label this angle **i**. [1]

(iii) State what is meant by the *angle of incidence*.

.....

..... [1]

(iv) Explain why the boy is able to see the image of the object.

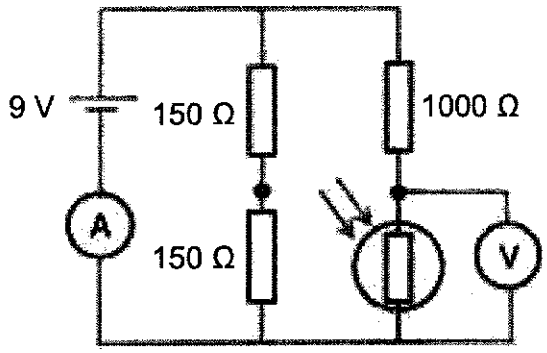
.....

.....

.....

..... [2]

12 A student sets up a potential divider that consists of a dry cell of e.m.f. 9.0 V, three resistors and a light dependent resistor (LDR). The resistance of the LDR is 3500 Ω when there is no light falling on it, and 1000 Ω under a light source.



(a) State what is meant by the *e.m.f. of the dry cell is 9 V*.

.....

..... [1]

(b) No light falls on the LDR. Calculate

1. the ammeter reading,

ammeter reading = ... [3]

2. the voltmeter reading.

voltmeter reading = ... [2]

(c) The student moves a lit lamp towards the LDR and the voltmeter reading keeps changing.

Discuss how the potential difference across the LDR changes as the intensity of the light that falls on it increases.

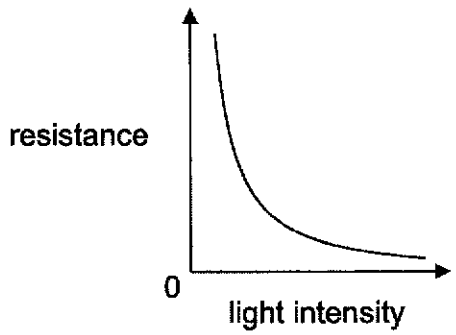
.....

.....

.....

..... [2]

(d) The graph below shows how the resistance of the LDR varies with light intensity.



State and explain whether LDR is an ohmic or non-ohmic conductor.

.....

.....

.....

..... [2]

– End of Paper –

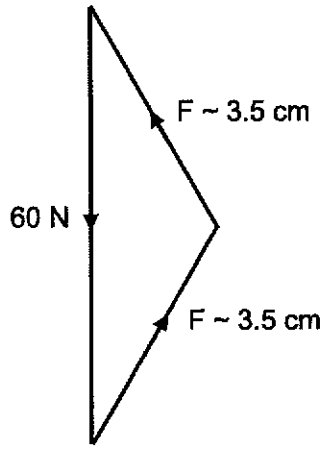
Sec 4 Express Preliminary Examination 2021
Physics 6091
Answer Keys and Marking Scheme

PAPER 1 – 40 M

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

PAPER 2 SECTION A – 50 M

1a



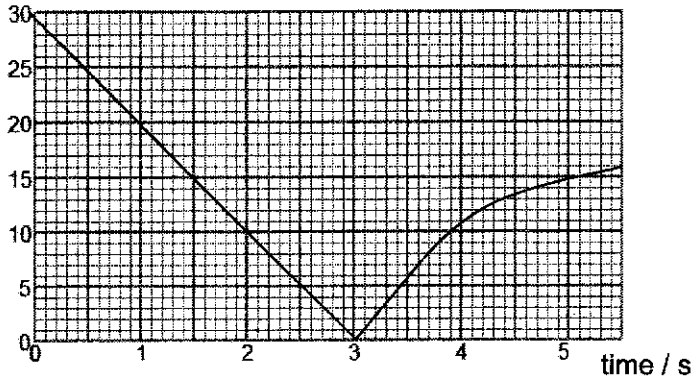
Correct vector diagram with arrows indicated in the correct direction — B1
Correct magnitude of force for Tom (accept 34 N to 36 N) — B1
Correct magnitude of force for Yoyo (accept 34 N to 36 N) — B1

1b

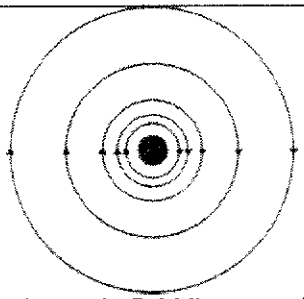
Tom: smaller force
Yoyo: larger force — B1

2a

	magnitude of acceleration	direction of acceleration	
as the stone moves upwards	10 m/s^2	Downwards	B1
at the highest point of the motion	10 m/s^2	Downwards	B1

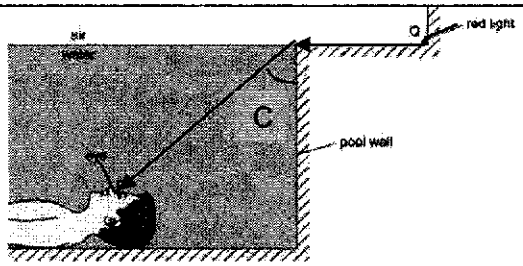
2b	speed / m/s  Downward sloping straight line from 30 m/s to 0 m/s between 0 to 3 s Upward sloping straight line at 3 sec Turning into a curve after that and below 20 m/s	 B1 B1 B1
2c	$height = area$ $= \frac{1}{2}(3)(30)$ $= 45m$ [ecf from 2b]	C1 A1
3a	Friction = 17 kN Resultant force = 0 N	B1
3b	$F = ma$ $20000 - 17000 = m(1.5)$ $m = 2000kg$ Weight = 20000 N [ecf from 3a]	 C1 C1 A1
3c	It is the normal reaction force **by the ground on the wheel**. This normal reaction force and the **forced exerted by the wheels of the bus on the ground** form an **action-reaction force pair**. Or It is the **force by the bus on the people.** This force and the **force acted by the people on the bus** form an **action-reaction force pair**.	B1 B1
4a	For an object in **equilibrium**, the sum of anticlockwise moments is equal to the sum of clockwise moments about the **same pivot**. [reject if answer did not include the words in bold]	B1

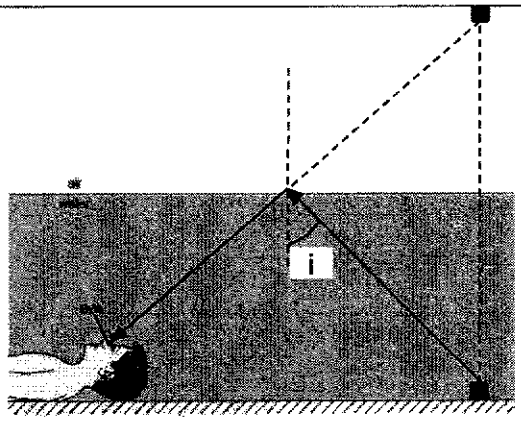
4b	$U(0.80) = 100(1.85)$ $U = 231N$ $D(0.80) = 100(1.85 - 0.80)$ $D = 131N$	C1 A1 A1
4c	He will topple as the overall centre of gravity is outside the base of his left foot.	B1
5a	$Pt = mc\theta + mc\theta$ $300(4)(60) = 0.600c(50 - 10) + 0.220(400)(50 - 10)$ $c = 2850J / kgK$	C1C1 A1
5b	The heat supplied was used to overcome the forces of attraction between liquid particles to become gas. The kinetic energy remained constant so temperature did not increase. Or The rate of heat supplied by the heater is equal to the rate of heat loss by the liquid. The kinetic energy remained constant so temperature did not increase.	B1 B1
5ci	Cover the container with a lid. Or Change to another container with a lower specific heat capacity.	B1
5cii	It prevents convection current from setting up above the surface of liquid Z. Or The container will absorb less heat. / More heat will be absorbed by Z.	B1
6a	When the negatively charged rod is first lowered into the cylinder, positive charges are induced at the internal surface of the cylinder. Due to like charges repel, negative charges moved to the external surface of the cylinder. When the earth wire is connected, negative charges flow to the earth. Therefore, the cylinder acquired a net positive charge. B2 – 3 points, B1 – 1 to 2 points	B2
6b	Lightning. A metal pole is installed the top of a building so that lightning will strike the pole instead of the building itself. [accept other reasonable answers]	B1 B1

7a	$I = \frac{V}{R}$ $= \frac{240}{800}$ $= 0.3A$	C1 A1
7b	$P = VI$ $= 240(0.3)(3)$ $= 216W$ [ecf from 7a]	C1 A1
7c	S2 should be connected to the live wire instead of the neutral wire. Even when the switch is opened, the lamp is still connected to the high voltage and may cause electric shock.	B1 B1
7di	Infra red radiation and visible light	B1
7dii	3.0×10^8 m/s	B1
8ai	 Magnetic field lines are in the clockwise direction and must get further.	B1
8aii	Using the right hand grip rule, the thumb that represents current points into the page. The fingers curl clockwise, which represent the direction of magnetic field.	B1
8b	The iron is a soft magnetic material. A North pole is induced at the side of the iron nearer to the magnet. Due to unlike poles attract, the base will follow the movement of the handle. B2 – 3 points, B1 – 1 to 2 points	B2
9a	When the current is more than 10 A, the solenoid becomes a very strong electromagnet that it can attract the iron bar. When the iron bar moves up, the spring pulls the copper bar towards it and causes the contacts to break. As the circuit is opened, large current is prevented from flowing into the circuit.	B1 B1 B1

9b	With more turns of coil around the electromagnet, the strength of magnetism increases. Therefore, it can attract the iron bar at a lower minimum operating current.	B1 B1

PAPER 2 SECTION B – 30 M

10ai	Average speed is obtained by dividing 2.0 m by time taken. Final speed is obtained by multiplying average speed by 2.	B1 B1
10aii	The friction between the block and the ramp is always constant. [accept other reasonable answers]	B1
10bi	The percentage of kinetic energy at B over the gravitational potential energy at A is $\frac{101}{129}\times 100\% = 78.3\ \%$.	B1
10bii	As the angle of elevation increases, the efficiency increases non-linearly.	B1
10biii	At a greater elevation, the amount of gravitational potential energy is higher. Thus, it will obtain a greater final speed and therefore a greater kinetic energy. Therefore the efficiency increases.	B1 B1
10c	$GPE = 173(2)$ $= 346J$ $KE = \frac{89.6}{100}\times 346$ $= 310.016$ $\frac{1}{2}(10)v^2 = 310.016$ $v = 7.87m/s$	 C1 C1 A1
11ai	 [no B1 for missing arrow]	B1
11aii	$n = \frac{1}{\sin 49}$ $= 1.33$	C1 A1
11b	At distance less than P, the angle of incidence at the air-water surface is **less than 49°**.	B1

	Therefore, **light refracts away from the normal into air** where angle of refraction is less than 90°.	B1
11ci 11cii	 [no B1 for missing arrow] [do not penalise for missing arrow if already penalised in 11ai]	B1 B1
11ciii	Angle of incidence is the angle between the incident ray and the normal.	B1
11civ	The angle of incidence at the air-water surface is **greater than the critical angle**. Therefore, since light is moving from an **optical denser water to a less optical dense air**, total internal reflection occurs.	B1 B1
12a	9 J is required to drive a unit charge around a complete circuit.	B1
12b1	$\frac{1}{R} = \frac{1}{150+150} + \frac{1}{1000+3500}$ $= \frac{4}{1125}$ $R = 281.25\Omega$ $I = \frac{V}{R}$ $= \frac{9}{281.25}$ $= 0.032A$	M1 M1 A1
12b2	$V = \frac{3500}{3500+1000} \times 9$ $= 7V$	M1 A1
12c	As the light intensity increases, the **resistance of the LDR decreases**. By using the formula $V = \frac{1000}{1000+1000} \times 9 = 4.5V$, **the potential difference decreases to 4.5 V**.	B1 B1
12d	It is a non-ohmic conductor. The resistance of the LDR **does not remain constant** when the external condition (light intensity) changes.	B1 B1