Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018
SECONDARY 4 EXPRESS

PHYSICS **6091 / 01**
Paper 1 Multiple Choice **18 September 2018**
1 hour

Additional Materials:
Multiple Choice Answer Sheet

INSTRUCTIONS TO CANDIDATES

Write in soft pencil.
Do not use paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the spaces provided above and on the Multiple Choice Answer Sheet.

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

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.

This paper consists of **17** printed pages and **1** blank page.
Setter: Mrs Hsu L K

[Turn over

1 Which of the quantity is equivalent to one metre?

A 1.0×10^{-3} mm

B 1.0×10^{-3} Mm

C 1.0×10^{6} km

D 1.0×10^{9} nm

2 Which is a scalar quantity?

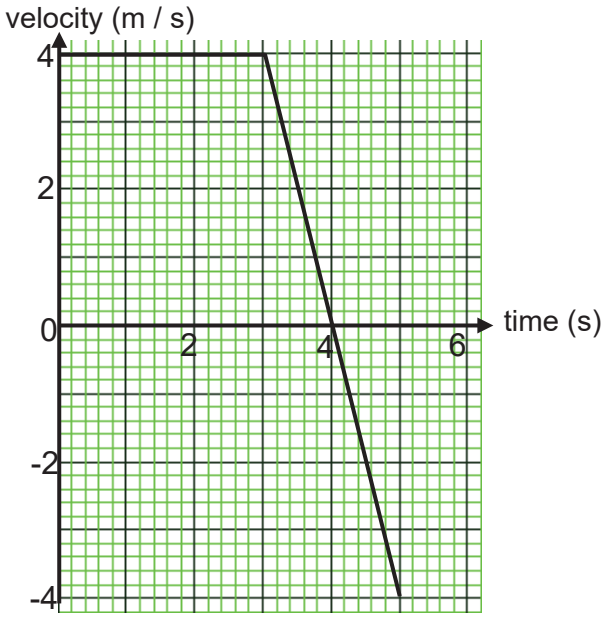
A weight

B electric field

C moment of a force

D electromotive force

3 The diagram shows the velocity-time graph for the motion of a body.



What is its displacement in the first 5 seconds?

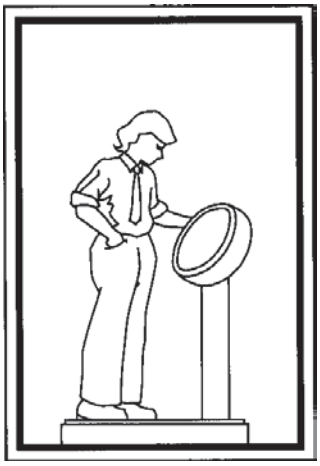
A 8.0 m **B** 12 m **C** 14 m **D** 16 m

4 A car of mass 1000 kg is moving at a constant speed of 20 m / s.
What is the average braking force needed for it to come to a stop in 100 m?

A 1000 N **B** 2000 N **C** 3000 N **D** 4000 N

[Turn over

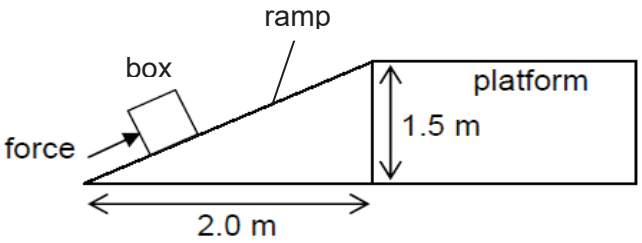
5 A man is standing on a weighing scale inside a lift. The weighing scale reads 500 N when the lift is stationary.



Which option describes correctly the reading on the weighing scale when the lift accelerates upwards and when the lift accelerates downwards?

	lift accelerates upwards	lift accelerates downwards
A	more than 500 N	less than 500 N
B	less than 500 N	more than 500 N
C	500 N	less than 500 N
D	more than 500 N	500 N

6 A man has to push a box weighing 500 N up a ramp from the ground to the raised platform.



Determine the minimum force required.

A 250 N

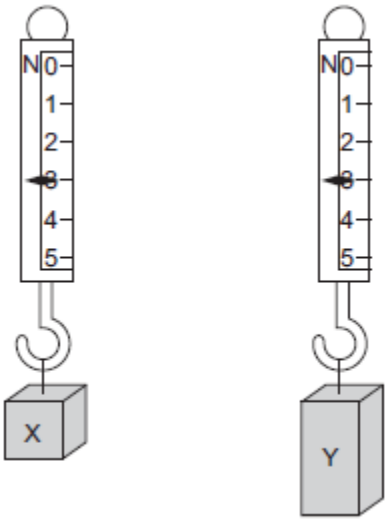
B 300 N

C 500 N

D 750 N

[Turn over

7 Two metal blocks X and Y are hanging from the spring balances at the same location in the laboratory as shown below.



Which statement is true about X and Y?

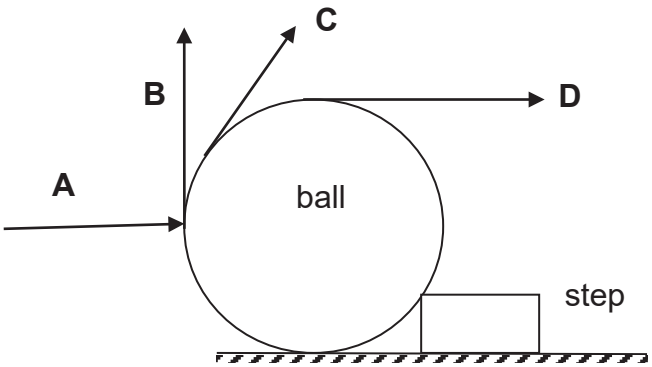
A They have same mass but different weight.

B They have same weight but different density.

C They have different volume and different weight.

D They have different density and different mass.

8 Which force **A**, **B**, **C** or **D** would be the **largest** force required to be exerted in order to push the ball up the step?

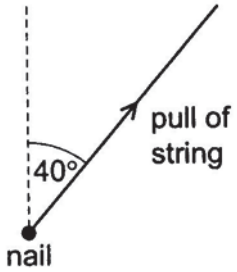


9 An object of mass 2 kg is thrown vertically upwards. The kinetic energy of the object when it is at a height of 3.0 m above the ground is 4.0 J.
Assuming negligible air resistance, what is maximum height reached by the object?
(The gravitational field strength is 10 N / kg.)

A 3.2 m **B** 3.5 m **C** 3.8 m **D** 4.0 m

[Turn over

10 A heavy nail is fixed firmly to a wall. It is pulled by a string at 40° to the vertical. The nail does not move.

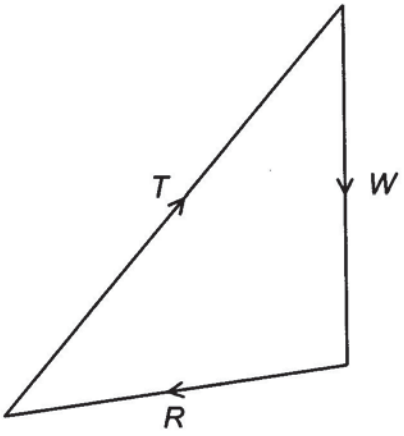


Three forces act on the nail.

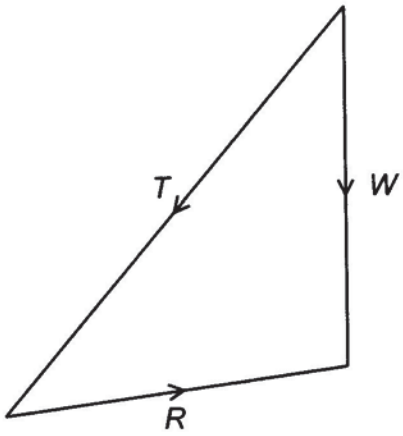
1 its weight *W*
2 the tension *T* in the string
3 the reaction force *R* between the nail and the wall

Which diagram, drawn to scale, represents the three forces in size and direction?

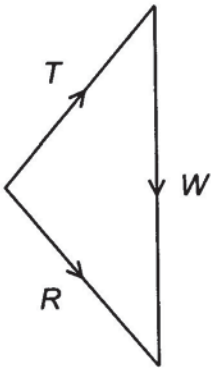
A



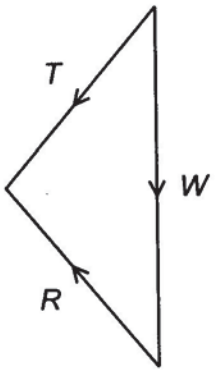
B



C

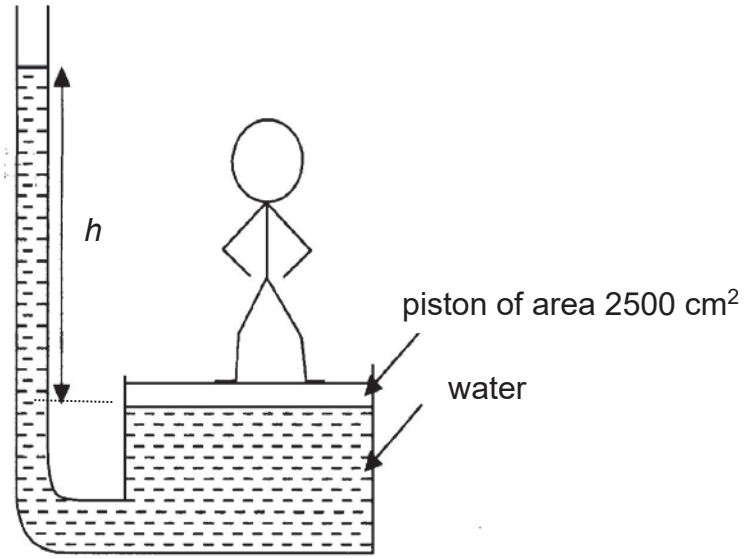


D



[Turn over

11 In the arrangement shown in the diagram, a person of mass 50 kg is standing on a piston of area 2500 cm^2.



Calculate the height *h* of the column of water.
(The gravitational field strength is 10 N / kg and the density of water is 1000 kg / m^3.)

A 0.2 m **B** 2.5 m **C** 5.0 m **D** 10.0 m

12 When fine pollen grains suspended in water are viewed under a microscope, they are seen to be making small random movements.
Which sentence explains this observation?

A There are convection currents in the water.

B The pollen grains are being hit by water molecules.

C The pollen grains are moving and colliding with one another.

D The pollen grains are living organisms so they move around.

13 The pressure of a gas in a cylinder is the **same** at all points in the cylinder.
Which statement explains this?

A The molecules of the gas are all of the same size.

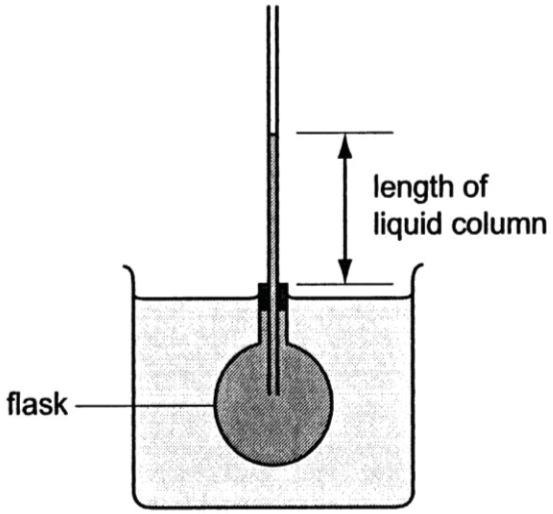
B The molecules of the gas attract one another.

C The molecules of the gas move at different speeds.

D There are many molecules, all moving at random.

[Turn over

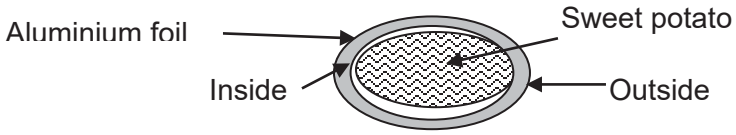
14 The diagram shows a flask of coloured liquid. A narrow tube passes through the stopper. When the flask is left in pure melting ice, the liquid column measured 100 mm. When the flask is left in boiling water, the liquid column measured 250 mm. When the flask is left in oil at a constant temperature, the length of the liquid column became 190 mm.



What is the temperature of the oil?

A 60 °C **B** 90 °C **C** 135 °C **D** 190 °C

15 Aluminium foils are commonly used to wrap sweet potatoes which are to be cooked in a barbecue fire as shown in the diagram.



How should the sweet potatoes be wrapped if the aluminium foil has one shiny side and one dull side?

A The shiny side should be on the outside because it is a better emitter of radiation.

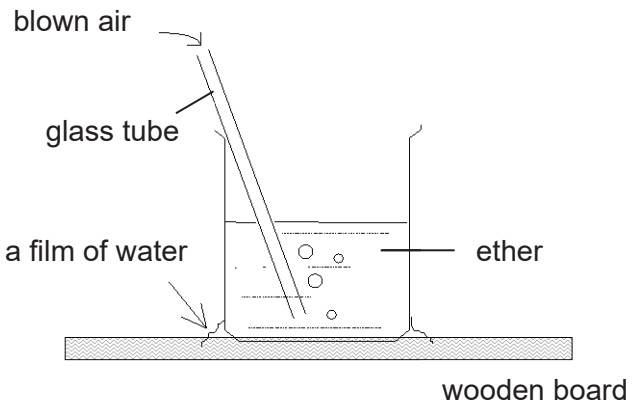
B The shiny side should be on the outside because it is a better conductor of heat.

C The dull side should be on the outside because it is a better absorber of radiation.

D The dull side should be on the outside because it is a better conductor of heat.

[Turn over

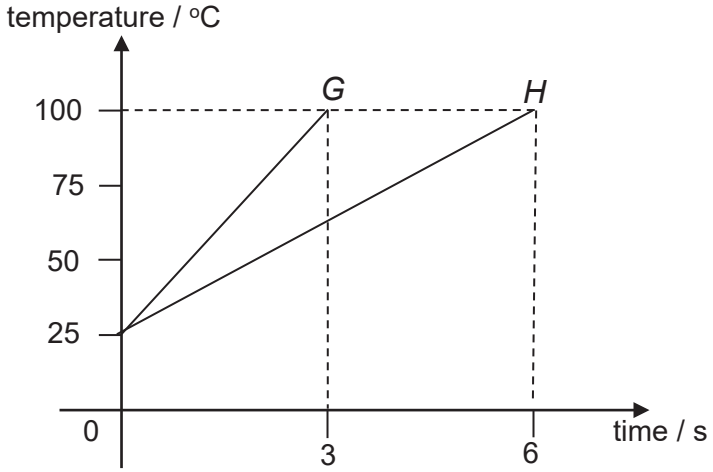
16 Air is blown into ether through the glass tube as shown in the diagram. After some time, it is observed that the film of water freezes into ice.



Which option **best** describes the processes that results from blowing the air?

	rate of evaporation of ether	temperature of ether	heat transfer
A	increases	rises	from water to ether
B	increases	falls	from water to ether
C	decreases	falls	from ether to water
D	decreases	rises	from ether to water

17 The ratio of the masses of two metal blocks *G* and *H* is 1: 2. They are both heated uniformly using identical heaters. The temperature-time graphs of the blocks are shown below.

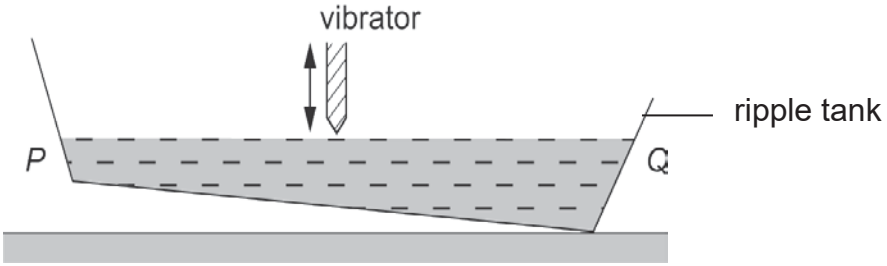


What is the ratio of the specific heat capacities of *G* and *H*?

A 1:1 **B** 1:2 **C** 2:1 **D** 4:1

[Turn over

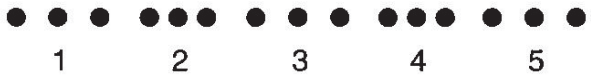
18 A vibrator is placed at the centre of an inclined ripple tank as shown.



How does the wavelength of the water wave change when it is moving towards the two ends *P* and *Q* of the ripple tank?

	towards *P*	towards *Q*
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	no change	no change

19 The diagram shows the position of air particles at a particular instance when a sound wave is passing.



The wavelength is the distance between

A 1 and 2

B 1 and 3

C 1 and 4

D 2 and 5

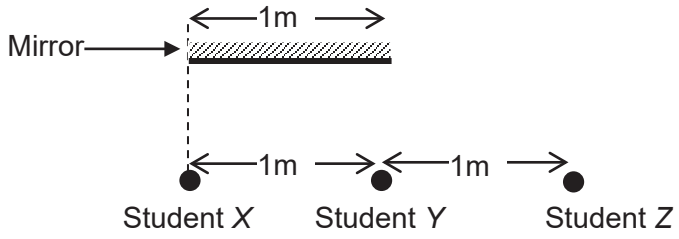
20 The diagram shows different regions of the electromagnetic spectrum with some of the regions identified.

radio waves	**A**	**B**	visible light	**C**	**D**	gamma radiation

Which region contains waves that can be used to detect counterfeit notes?

[Turn over

21 Three students stand 1 m apart in front of a plane mirror that is 1 m long.

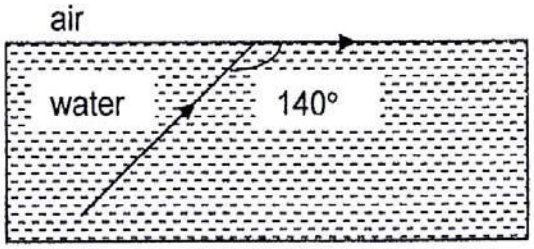


Student *X* stands in line with one edge of the mirror as shown above.

How many students can see the images of the other two?

A 0 **B** 1 **C** 2 **D** 3

22 The diagram shows the path of a ray of light as it strikes the water-to-air boundary.



What is the speed of light in water?

A 1.93×10^8 m / s

B 2.30×10^8 m / s

C 3.00×10^8 m / s

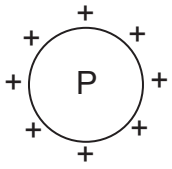
D 3.20×10^8 m / s

23 During a thunderstorm, a bolt of lightning sends out an electric charge of 20 C from a thundercloud to the Earth. If the energy produced by the lightning is about 500 MJ, determine the potential difference between the thundercloud and the Earth.

A 25 MV **B** 500 MV **C** 10 000 MV **D** 40 000 MV

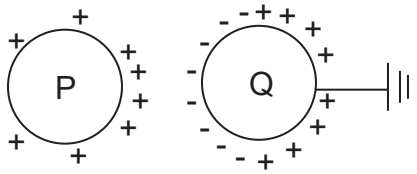
[Turn over

24 An isolated conducting sphere P has a charge distribution shown below.

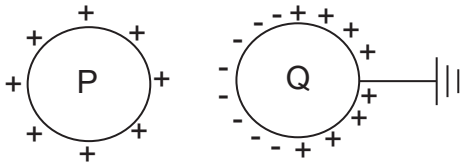


A similar sphere Q, connected to Earth by a long wire, is brought close to P.
Which diagram shows the final distribution of charge on the two spheres?

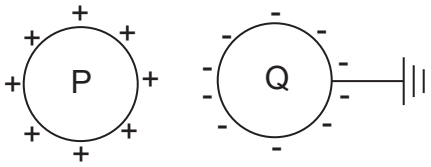
A



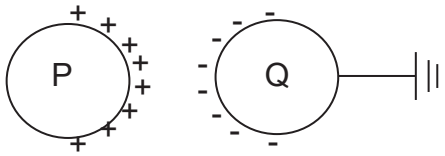
B



C

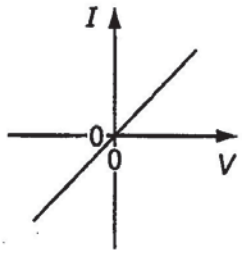


D

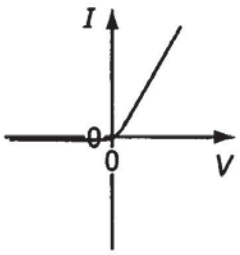


25 Which graph shows the I / V characteristic for a semiconductor diode?

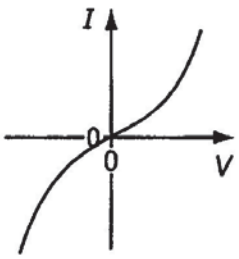
A



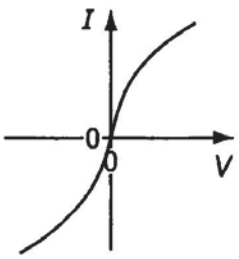
B



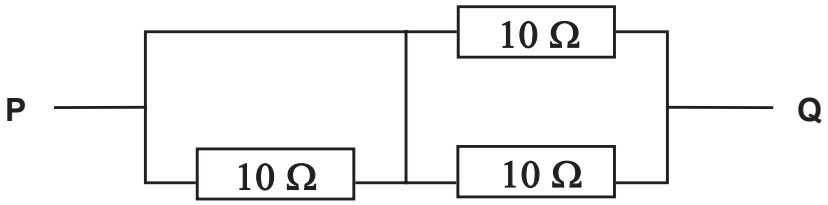
C



D



26 The diagram below shows a circuit.

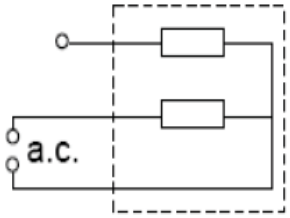


What is the effective resistance between terminals P and Q?

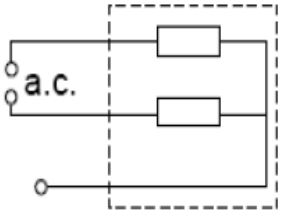
A 5 Ω **B** 15 Ω **C** 20 Ω **D** 30 Ω

[Turn over

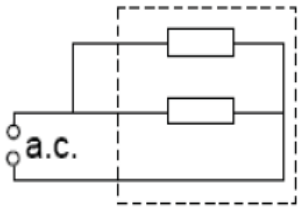
27 An electric heater has two heating coils with identical resistances. They can be connected in three different ways as shown in circuits X, Y and Z below.



X



Y



Z

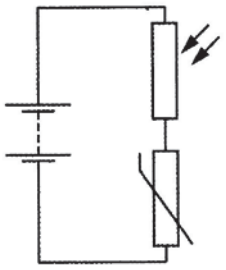
Which of the following correctly ranks the 3 circuits from the lowest to the highest based on the power of the circuit?

	lowest power	medium power	highest power
A	Y	X	Z
B	X	Z	Y
C	Z	X	Y
D	Z	Y	X

28 An electric iron marked 1000 W, 240 V is connected to a 120 V mains supply. What is the power dissipated by the electric iron?

A 250 W **B** 500 W **C** 1000 W **D** 2 000 W

29 A light-dependent resistor (LDR) and a thermistor are connected in series with a battery.



Which conditions cause the potential difference across the LDR to be the smallest?

A bright and cold

B bright and hot

C dark and cold

D dark and hot

[Turn over

30 The cost of a unit (kWh) of electricity is 10 cents.

appliance	power rating	time used
lamp	100 W	5 hours
heater	1.5 kW	3 hours
cooker	3 kW	30 minutes

What is the total cost when all these appliances are used in the times shown above?

A 6.5 cents **B** 65 cents **C** 265 cents **D** 5060 cents

31 Which statement best describes an example of induced magnetism?

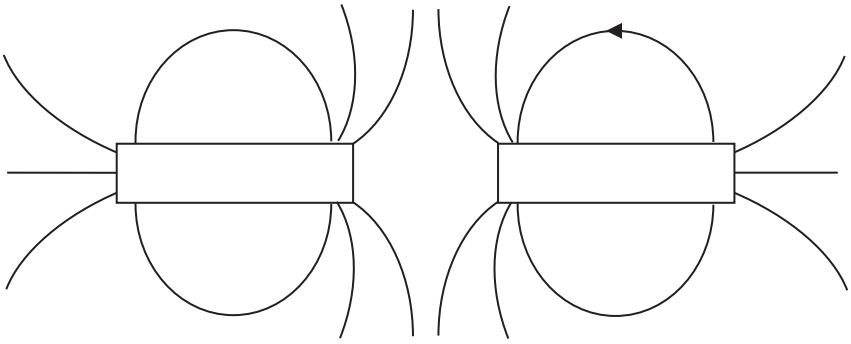
A A bar magnet attracts a piece of soft iron.

B A bar magnet loses its magnetism if it is repeatedly dropped.

C A bar magnet, swinging freely, comes to rest pointing in the North-South direction.

D Two North poles repel each other, but a North pole attracts a South pole.

32 The magnetic field lines of two bar magnets are shown below. The direction of **one** of the field lines is also shown.



Which diagram represents the correct arrangement of the magnets?

A

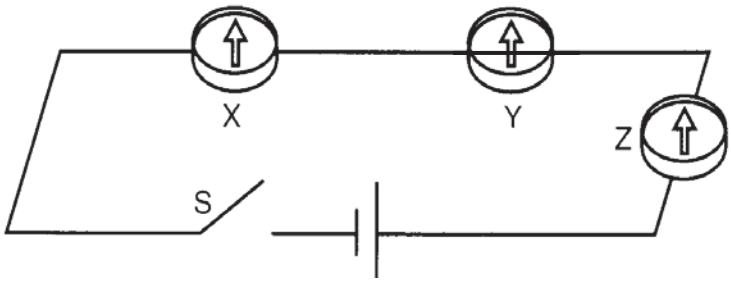
B

C

D

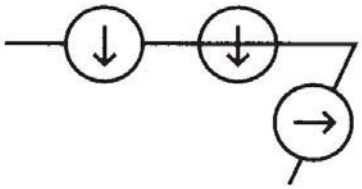
[Turn over

33 The diagram below shows a circuit with a wire connected to a battery and the switch S. The compasses X and Z are placed above the wire and the compass Y is placed below the wire.

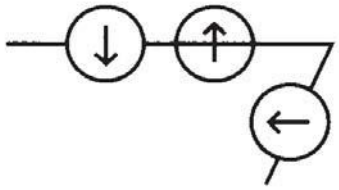


When switch S is closed, which diagram correctly shows the orientations of the compass needles?

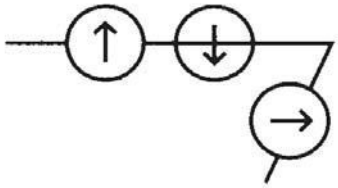
A



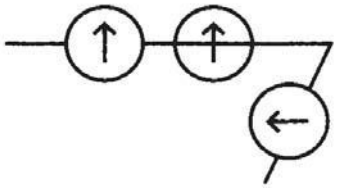
B



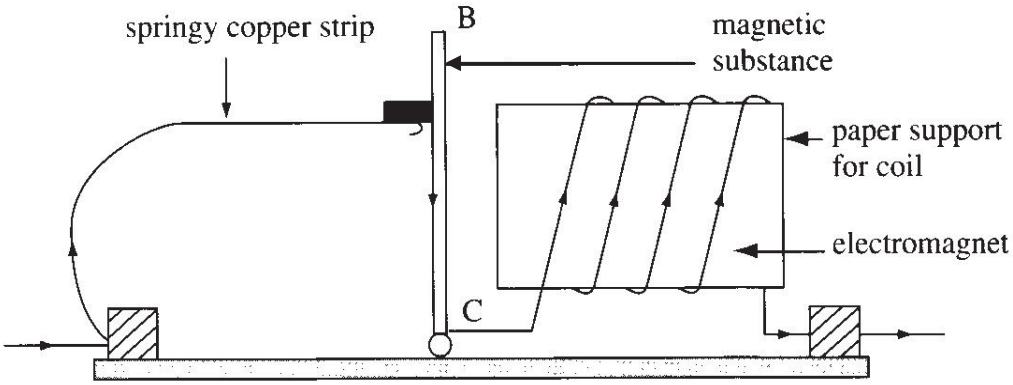
C



D



34 The diagram shows a model circuit breaker. If the current flowing in the circuit is excessive, the electromagnet attracts BC to break the circuit.



Which statement about the circuit breaker is correct?

A BC is best made of copper.

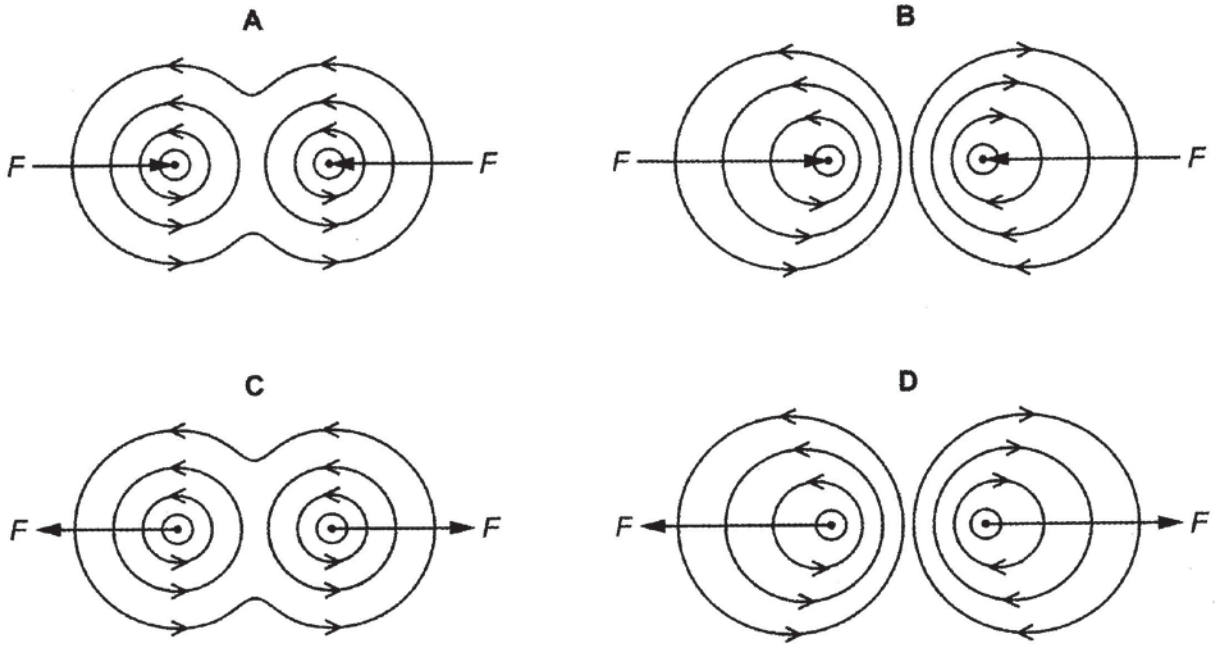
B The circuit breaker is suitable for circuit carrying an alternating current.

C The limiting current in the circuit increases if the current in the circuit is reversed.

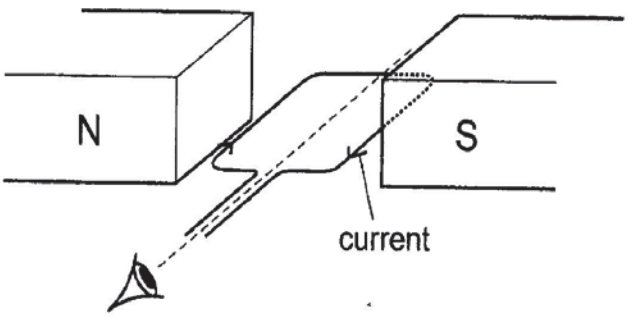
D The limiting current in the circuit will not change by placing a soft iron core inside the coil.

[Turn over

35 Two parallel, vertical wires each carry an upward current.
Which diagram shows the magnetic field pattern around the wires and the direction of the force **F** on each wire?



36 The diagram shows a pivoted coil held between the two poles of a magnet.
The pivoted coil carries a steady current in the direction shown.

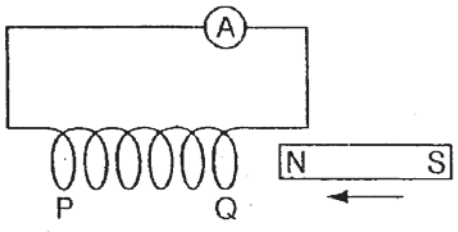


When the coil is released, it rotates and then stops at an angle ɵ to its initial position.
When viewed as shown, in which direction does the coil rotate and what is the value of ɵ ?

	direction	ɵ
A	anticlockwise	90 º
B	anticlockwise	180 º
C	clockwise	90 º
D	clockwise	180 º

[Turn over

37 A student pushes the N-pole of a bar magnet into the end Q of a long solenoid and observes a deflection to the right on the sensitive ammeter.



Which process will produce a deflection in the same direction?

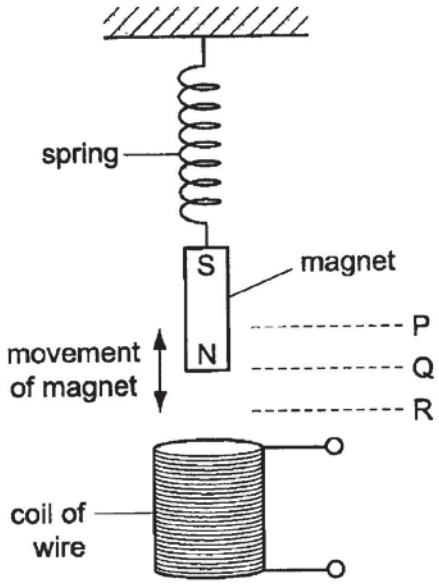
A pulling the N-pole out of end Q

B pulling the S-pole out of end P

C pushing the N-pole into end P

D pushing the S-pole into end P

38 A magnet moves up and down above a coil of wire.
The bottom of the magnet moves up and down between P and R.



Where is the bottom of the magnet when there is no induced electromotive force in the coil?

A at Q only

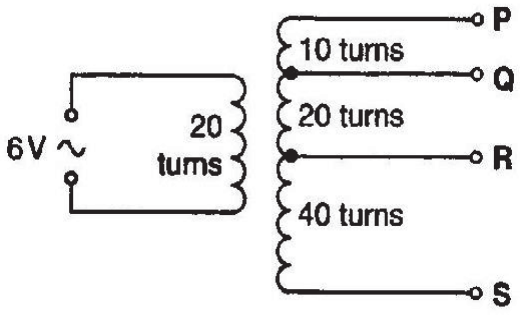
B at R only

C at P and Q

D at P and R

[Turn over

39 The number of turns between each pair of output terminals of a transformer is shown in the diagram.



Between which two terminals will the output be 12 V?

A P and Q

B Q and R

C R and S

D P and R

40 The diagram shows a long transmission line supplying energy at 230 V to two houses X and Y without using transformers. In both houses, electric heaters are switched on.

The occupier of house X switches off the heater in his house.
What happens in house Y?

	the voltage supplied to house Y	the power supplied to house Y
A	decreases	decreases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

End of Paper

[Turn over

Class	Register No.

Candidate Name _____

PEIRCE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018
SECONDARY 4 EXPRESS

PHYSICS **6091 / 02**
Paper 2 Theory **11 September 2018**
1 hour 45 minutes

Candidates answer on the Question Paper.
No additional materials are required.

INSTRUCTIONS TO CANDIDATES
Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams and graphs.
Do not use paper clips, highlighter, glue or correction fluid.

Section A.
Answer **all** questions.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
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 together.
The number of marks is given in brackets [ ] at the end of each question or part question.

PARENT'S SIGNATURE

For Examiner's Use	
Section A	
Section B	
Total	

This paper consists of **21** printed pages and **1** blank page.
Setter: Mrs Hsu L K

[Turn over

Section A (50 marks)

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

1 A petrol-driven car accelerates from rest to its cruising speed along a straight level road.

(a) State the main energy changes in the car and in its surroundings, when

1. the car is accelerating,

……..... [1]

2. the car is cruising at a constant speed.

……..... [1]

(b) The car now moves up a slope with constant speed.
Explain whether the rate of petrol consumption will increase, stay the same or decrease.

…….

……..... [1]

2 A small jet plane which can carry six people is shown in Fig. 2.1.

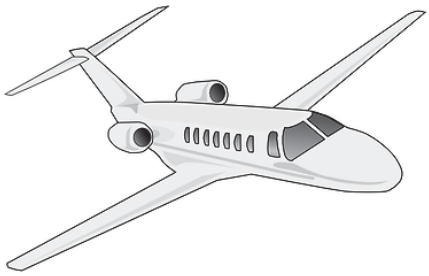


Fig. 2.1

The mass of the fully-loaded plane is 2560 kg. It is initially at rest. When the plane is taking off, the two jet engines can exert a total thrust force of 8000 N and the friction between the wheels and the ground is 340 N. Both forces remain constant during take-off.

(a) Calculate the acceleration of the plane as it starts to move.

acceleration = ... [2]

[Turn over

(b) Explain what happens to this acceleration as the plane speeds up.

.....

.....

.....

.....

..... [2]

(c) The average acceleration during take-off is 2.2 m / s^2.

(i) Calculate the time that the plane will take to reach a take-off speed of 55 m / s.

time taken = ... [1]

(ii) What is the minimum length of the runway that is required for the plane to take off?

minimum length = ... [2]

(d) Suggest why the wheels of the plane are folded into the body of the plane after take-off.

.....

..... [1]

[Turn over

3 An archer pulls the string of his bow and it is stretched a horizontal distance of 40 cm as shown in Fig. 3.1. As he releases the string, an average force of 150 N acts on the arrow before it loses contact with the string.

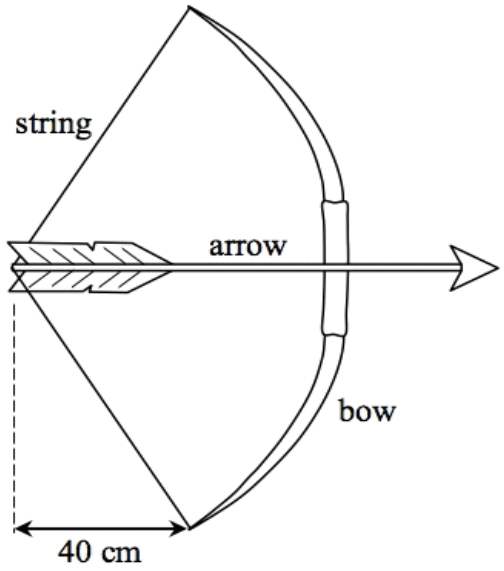


Fig. 3.1

(a) Calculate the average work done on the arrow.

work done = …… [1]

(b) What is the speed of the arrow as it leaves the bow, if the arrow has a mass of 100 g?

speed = ..…… [2]

(c) State **two** ways in which the speed of release may be increased.

……..……..

……..……..

.....

……..…..... [2]

[Turn over

4 A radar system, such as the one shown in Fig. 4.1, is often used in airports for air traffic control. The system consists of microwave transmitters and receivers arranged in a spherical structure. By emitting microwave signals and receiving reflected signals, the radar system provides tower controllers with information on the movement of aircrafts approaching the airport.

Fig. 4.1

An aeroplane is approaching the airport. The time delay of receiving a microwave signal reflected from the aeroplane is 9.0×10^{-5} s.

(a) What is the distance of the aeroplane from the air traffic control system?

distance = ... [2]

(b) The wavelength of the microwave signal is 4 cm. Calculate its frequency.

frequency = ... [2]

[Turn over

(c) Explain why the microwave transmitters and receivers are arranged in a spherical structure.

.....

.....

..... [1]

(d) Stealth fighter planes are “invisible” to radar systems because they prevent the microwave signals from being reflected back to the receiver of the system. Suggest one way in which stealth fighter planes can achieve this.

.....

.....

..... [1]

[Turn over

5 Fig. 5.1 shows the temperature changes of a solid substance as thermal energy is supplied to the substance at a constant rate.

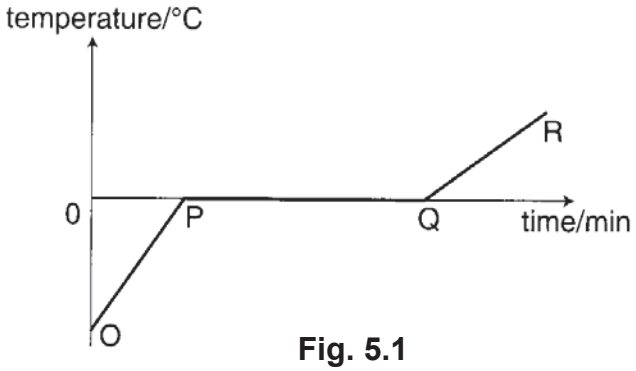


Fig. 5.1

(a) State the process that is happening between **P** and **Q**.

……..... [1]

(b) Explain, in molecular terms, what happens to the energy supplied between:

(i) **P** and **Q**;

……

……

……

……..... [2]

(ii) **Q** and **R**.

……

……..... [1]

(c) State how the specific heat capacity of the liquid differ from the specific heat capacity of the solid, and explain how you deduced this from the graph shown in Fig. 5.1.

……

……

……

……

……..... [3]

[Turn over

6 Fig. 6.1 shows the object and its image with ray **X** moving towards a converging lens.

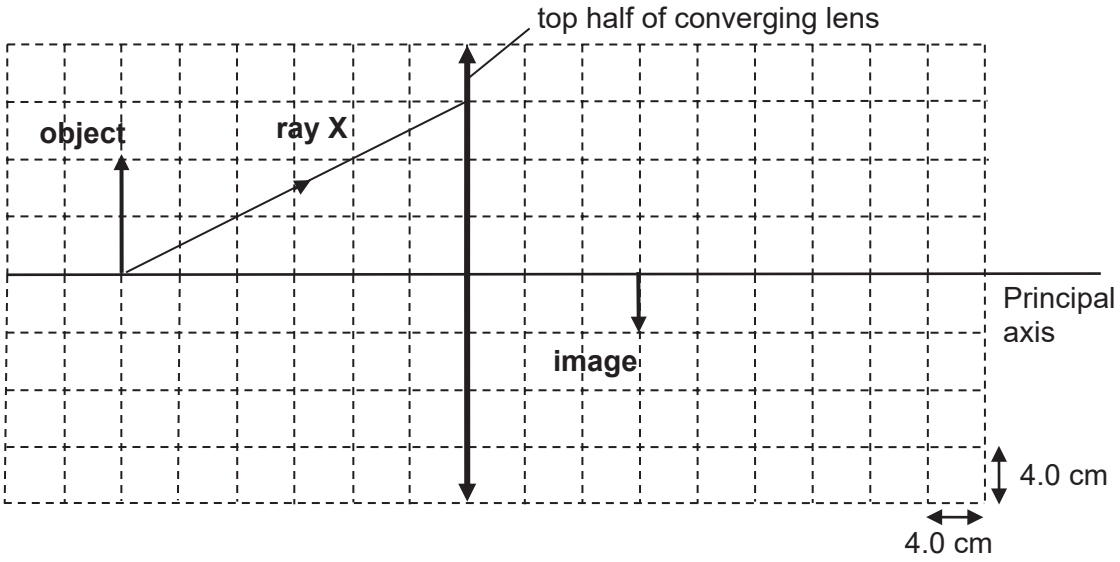


Fig. 6.1

(a) **(i)** Draw, on Fig. 6.1, one ray to locate the focal point of the lens.
Mark the focal point with the letter **F**. [1]

(ii) Determine the focal length of the lens in Fig. 6.1.

focal length = ... [1]

(iii) Complete the path for ray **X**. [1]

(b) If the top half of the converging lens is removed, state and explain whether the image is still formed.

.....

.....

.....

..... [2]

[Turn over

7 A cling film, shown in Fig. 7.1, is a thin plastic film typically used for sealing food items in containers to keep them fresh over a longer period of time. The film clings onto many smooth surfaces and thus can remain tight over the opening of a container without adhesives or other devices. It is made of a material which becomes charged easily.

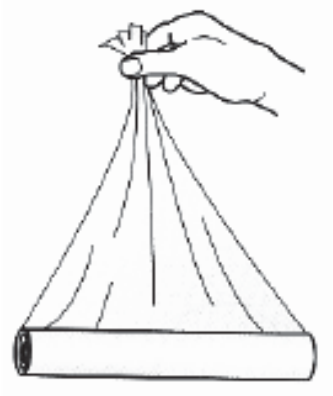


Fig. 7.1

(a) Explain, in terms of charges, how a neutral cling film is different from a charged cling film.

.....

.....

.....

..... [2]

(b) A student tries to peel a cling film from its roll. He does this with much difficulty as he finds that the cling film tends to 'stick' to the roll.
Explain, in detail, why this happens.

.....

.....

.....

.....

.....

..... [3]

[Turn over

8 **(a)** Fig. 8.1 shows an iron ring suspended by a thread. A bar magnet is held close to the ring. The iron ring is attracted to the magnet.

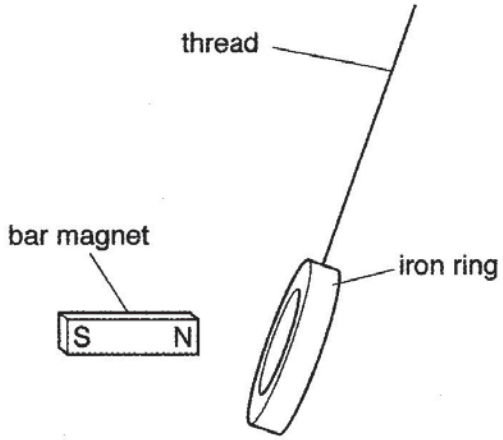


Fig. 8.1

Explain why the iron ring is attracted to the bar magnet.

……

……

……

…….... [2]

(b) Fig. 8.2 shows an aluminium ring suspended by a thread, close to a bar magnet.

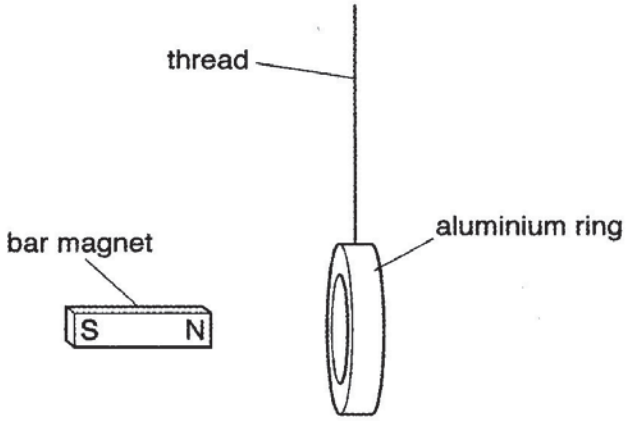


Fig. 8.2

Explain why the aluminium ring is not attracted to the magnet.

……

……... [1]

[Turn over

(c) When the N-pole of the bar magnet in Fig. 8.2 is moved quickly towards the aluminium ring, there is an induced current in the ring and the ring moves away from the bar magnet.

(i) Explain why a current is induced in the aluminium ring.

……...

……...

……...

…….. [2]

(ii) Explain why the aluminium ring moves away from the magnet.

……..

……..

……...

…….. [2]

[Turn over

9 An alternating input voltage is applied across the Y-plates of a cathode ray oscilloscope and produces the trace shown in Fig. 9.1.

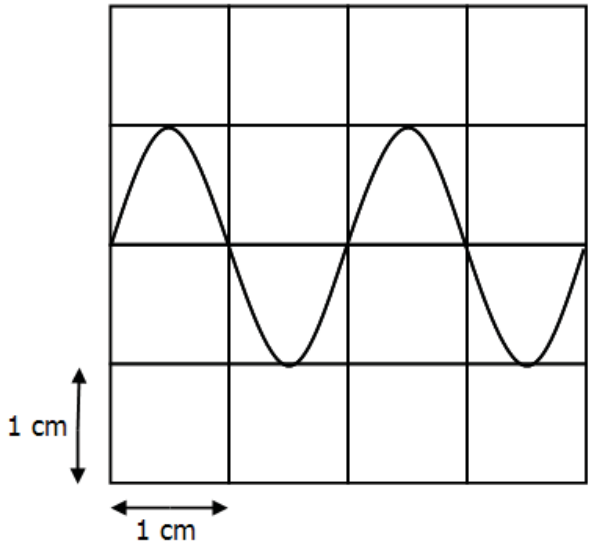


Fig. 9.1

If the peak voltage of the alternating input voltage is 5.0 V and its frequency is 50 Hz, determine the

(a) Y- gain setting,

Y – gain setting = ... V / cm [1]

(b) time - base setting,

time - base setting = ... ms / cm [1]

(c) Sketch on Fig. 9.1, the new trace which will be obtained for the same input voltage if the Y-gain is changed to 10 V per division and the time-base setting to 5.0 ms per division. [2]

[Turn over

Section B (30 marks)

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

Answer **only one** of the two alternative questions in **Question 12**.

10 Fig. 10.1 shows a sonar which is used to determine the speed of a vehicle.
The sonar sends pulses of ultrasound towards oncoming vehicles and receives the reflected pulses.

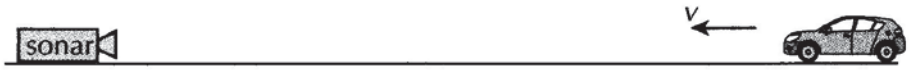


Fig. 10.1

A time-strip showing when the pulses are emitted and received is printed as shown in Fig. 10.2. The speed of ultrasound in air, at room temperature, is 340 m / s. The car is travelling at a constant speed, v, to the left.

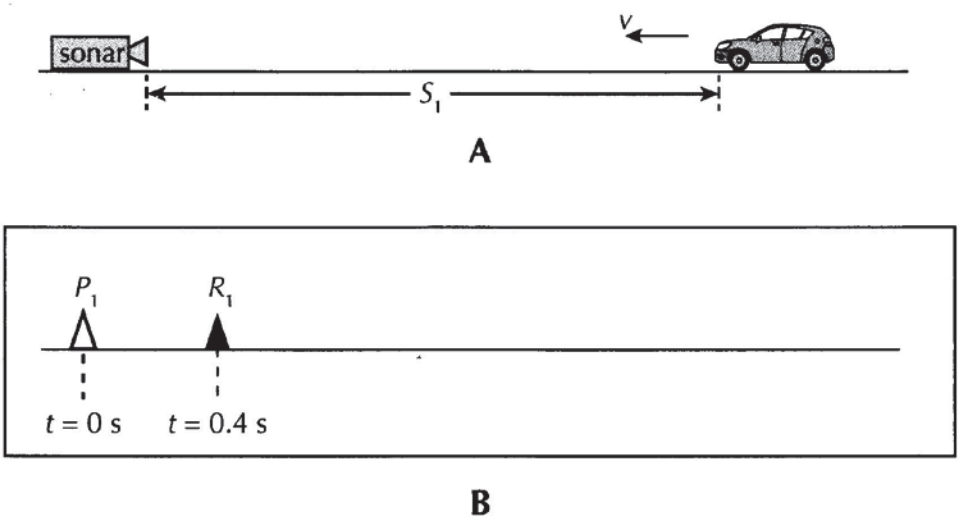


Fig. 10.2 (Not drawn to scale)

(a) At time t = 0 s, the sonar emits a pulse P_1. At time t = 0.4 s, the sonar receives the reflected pulse R_1. The time-strip for these two recorded pulses are shown in Fig. 10.2.

(i) State the time that the emitted pulse P_1 will meet the oncoming car.

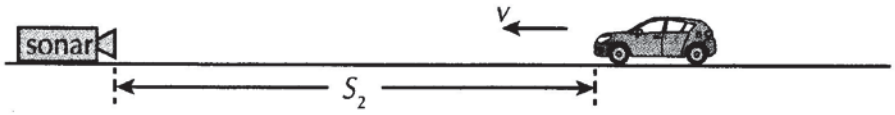
time = ... [1]

[Turn over

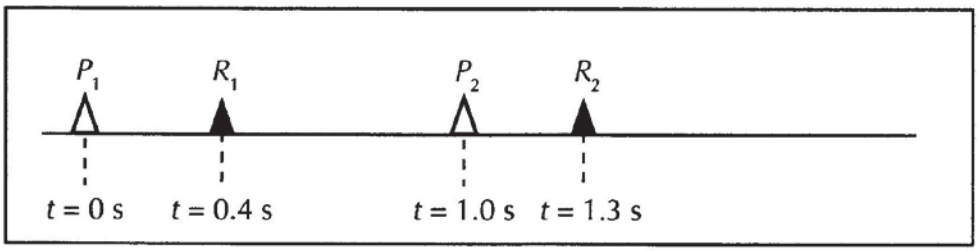
(ii) Calculate the distance S_1 of the car from the sonar.

distance S_1 = ... [2]

(b) At time t = 1.0 s, the sonar emits a second pulse P_2 and receives the second reflected pulse R_2 at time t = 1.3 s. The car is now at a distance S_2 from the sonar. The time-strip for these two recorded pulses are shown in Fig. 10.3.



A



B

Fig. 10.3 (Not drawn to scale)

(i) Calculate the distance S_2 of the car from the sonar.

distance S_2 = ... [2]

(ii) Calculate how far the car has moved to the left during this period of time.

distance moved = ... [1]

[Turn over

(c) Determine the speed, v, of the car.

speed of car v = ... [2]

(d) **(i)** Explain why the reflected pulse is smaller in amplitude than the emitted pulse.

.....

..... [1]

(ii) Describe, using ideas about the vibration of molecules in the air, what is meant by *a lower amplitude*.

.....

..... [1]

[Turn over

11 Fig. 11.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre.

Fig. 11.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the light dependent resistor (LDR) is turned on. A computer is used to measure the potential difference across RS.

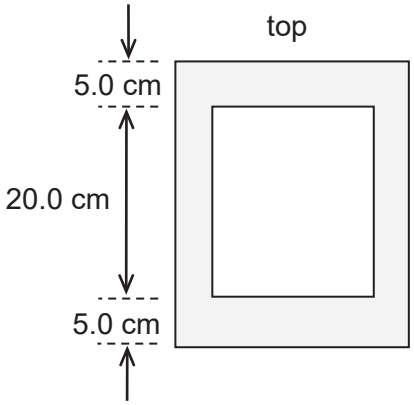


Fig. 11.1

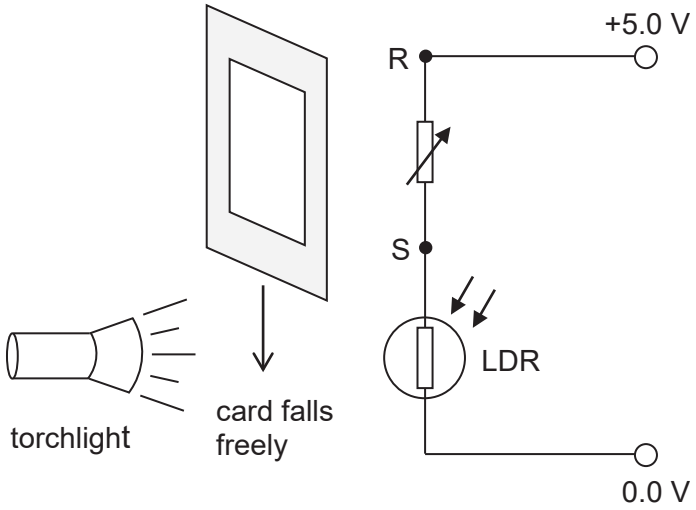


Fig. 11.2

Fig. 11.3 shows the graph of potential difference (p.d.) across RS against time.

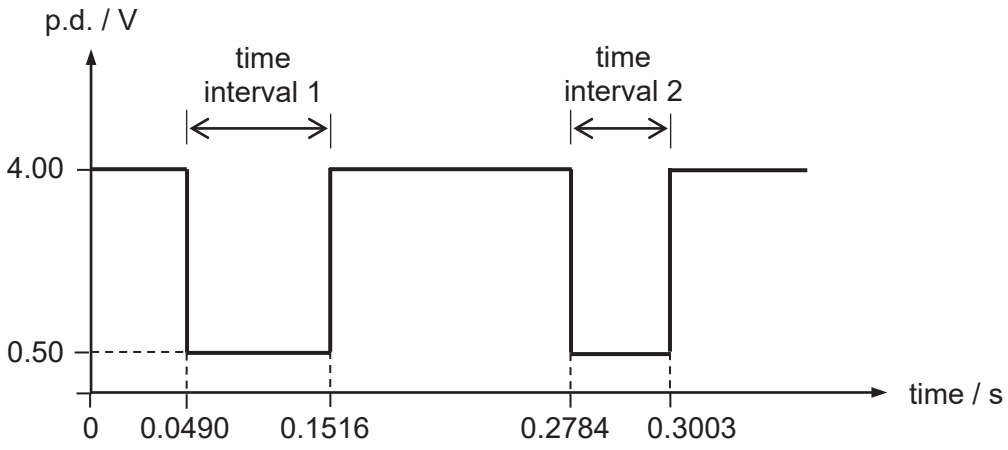


Fig. 11.3

[Turn over

(a) State what happens to the resistance of the LDR as the card falls.

.....

.....

.....

..... [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

.....

.....

.....

.....

..... [2]

(c) Explain why time interval 1 is longer than time interval 2 (as shown in Fig.11.3) when the rigid card falls.

.....

.....

.....

..... [2]

(d) Calculate the average acceleration of the card in cm / s^2.

acceleration = ... cm / s^2 [4]

[Turn over

12 EITHER

In order to check whether a pipe section is leaking, both ends of the pipe are sealed. A syringe is connected to one end while a water manometer is connected to the other end as shown in Fig. 12.1.

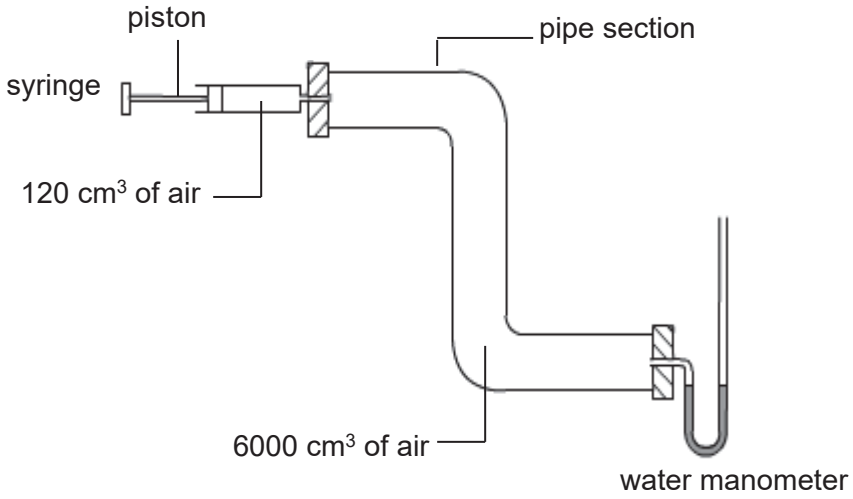


Fig. 12.1

The syringe initially contains 120 cm^3 of air while the pipe has 6000 cm^3 of air.
All the air initially has a pressure of 1.00×10^5 Pa.
The piston of the syringe is then pushed in and held steadily in position.
This causes the volume of air in the syringe to decrease.

(a) Explain, in terms of molecules, why the pressure of the air inside the pipe increases when the piston of the syringe is pushed in.

……

……

.....

……..... [2]

(b) Assuming that the pipe **does not** leak and the temperature of the air inside the pipe remains constant when the piston is pushed fully in and held in place, calculate

(i) the new air pressure in the pipe in Pa,

pressure = …….. Pa [2]

[Turn over

(ii) the difference in water levels in both arms of the manometer.
(Assume the strength of the Earth's gravitational field is 10 N / kg and the density of water is 1000 kg m^{-3}.)

difference in water levels = …….. [2]

(c) If the pipe is leaking very slowly, what will be the observation after the piston is pushed fully in and held in place.

……

……

……

……

……

……. [3]

(d) State one way how the manometer could be modified to give a larger difference in liquid level for the same pressure in the pipe.

……

……. [1]

[Turn over

12 OR

A farmer connects a house to the mains supply of electricity.
The house is at a long distance from the nearest 230 V mains supply of electricity.
Fig.12.2 shows the mains supply connected to the house.

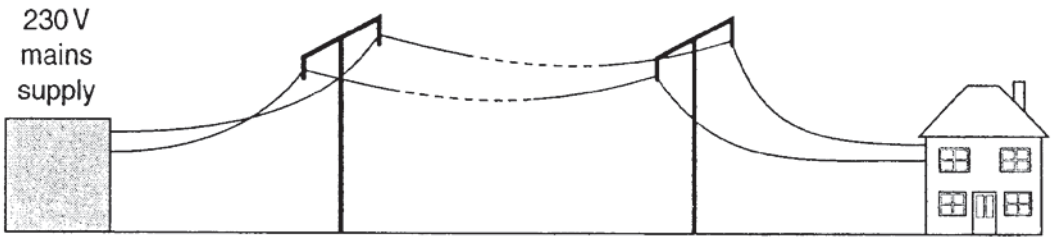


Fig. 12.2

(a) The farmer uses 230 V lamps in the house but they do not light up at their normal brightness. Explain why the lamps are dim.

.....

.....

.....

..... [2]

(b) The farmer added transformers, as shown in Fig.12.3.

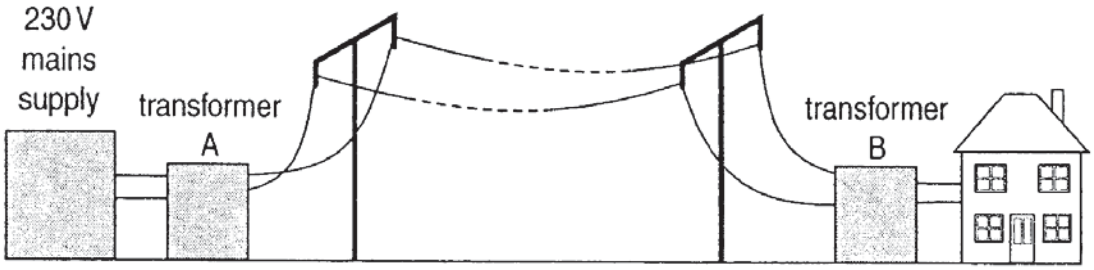


Fig. 12.3

The lamps in the house now light up at their normal brightness.
Explain why the lamps are now brighter.

.....

.....

.....

..... [2]

[Turn over

(c) Explain in detail how a transformer produces an output voltage.

.....

.....

.....

.....

.....

..... [3]

(d) The 230 V mains supply provides 690 W of power to transformer A in Fig.12.3.

(i) Calculate the current supplied to the transformer.

current = ... [1]

(ii) Calculate the energy supplied to the transformer in 10 minutes.
Give your answer in joules.

energy = ... J [2]

END OF PAPER 2

[Turn over

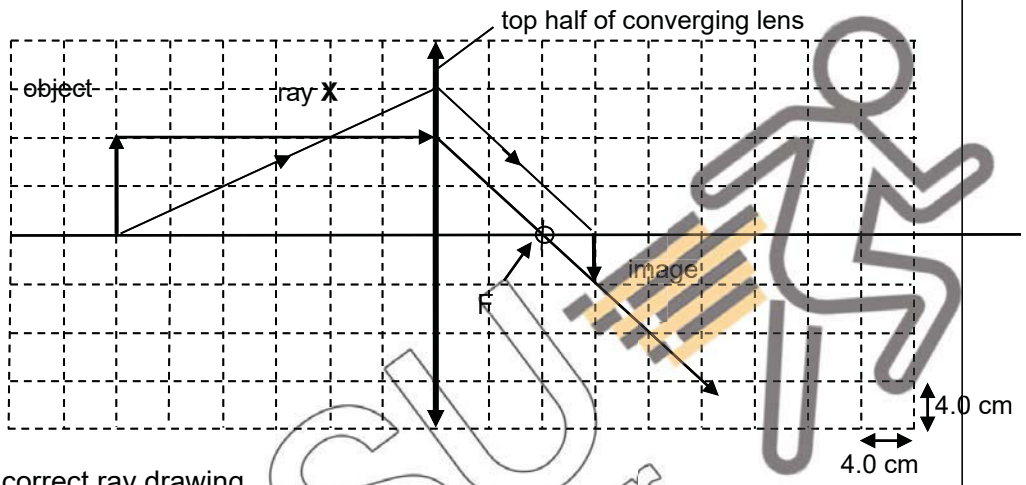
2018 PRELIMINARY MCQ 4E Physics 6091/1

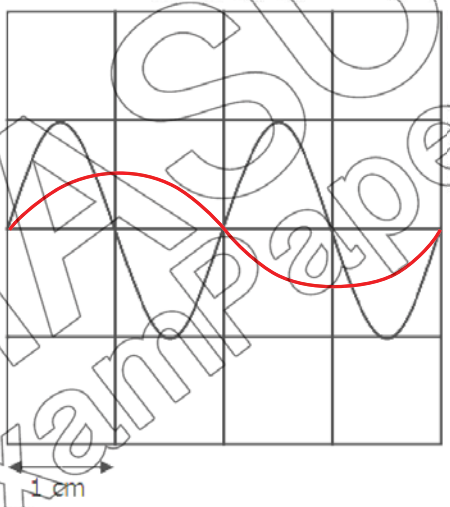
Question No.	Answer	Question No.	Answer
1	D	21	B
2	D	22	B
3	B	23	A
4	B	24	D
5	A	25	B
6	B	26	A
7	B	27	A
8	A	28	A
9	A	29	A
10	A	30	B
11	A	31	A
12	B	32	D
13	D	33	C
14	A	34	B
15	C	35	A
16	B	36	A
17	A	37	D
18	B	38	D
19	B	39	C
20	C	40	C

2018 Preliminary Examination
4E Physics (6091/2)
Marking Scheme

Section A (50 marks)		
Question No.	**Answers**	**Marks**
1(a)	1. Chemical energy in the fuel is primarily converted to kinetic energy of the car.	B1
	2. Chemical energy in the fuel is mainly converted to work done against friction and air resistance.	B1
(b)	The rate of consumption of petrol will increase as the car has a net gain in energy due to its increasing gravitational potential energy.	B1
2(a)	F_{net} = 8000 - 340 = 7660 N	C1
	From F_{net} = ma, a = 7660 / 2560 = 2.99 m/s^2 (3SF)	A1
(b)	As the plane speeds up, the air resistance it experiences increases. Since the forward force is constant, the net force acting on the plane decreases and this leads to a decrease in its acceleration.	B1 B1
(c)(i)	Using a = (v – u) / t, t = (55 – 0) / 2.2 = 25 s	A1
(ii)	Minimum length of runway = area under v-t graph Length = 1/2 x 25 x 55 ECF = 687.5 m = 688 m (3SF)	M1 A1
(d)	The wheels are folded into the body of the plane to reduce air resistance when in flight.	B1
3(a)	Work Done = F x d = 150 x 0.4 (deduct 1 mark if unit is wrong) = 60 J	A1
(b)	½ m v^2 = 60 ½ x 0.100 x v^2 = 60 ECF for energy v = 34.6 m / s (3SF)	M1 A1

(c)	Pull the string a longer horizontal distance back. Use a lighter arrow.	B1 B1
4(a)	Speed of microwave, c = 3 x 10^8 m / s Distance of the aeroplane = 1/2 x (3 x 10^8) x 9.0 x 10^{-5} ECF = 13500 m	B1 A1
(b)	Using v = f λ, f = (3 x 10^8) / 0.04 ECF for value of c = 3 x 10^8 = 7.5 x 10^9 Hz (deduct 1 mark if unit is wrong	M1 A1
(c)	The spherical structure allows microwaves signals to be sent and received from all directions, hence providing the tower controllers with accurate information of all incoming aircrafts.	B1
(d)	The body of the fighter planes absorbs the microwaves and hence prevents them from being reflected back. or The body of the fighter plane is shaped in a way that reflects the microwave signals away from the source.	B1
5(a)	Melting	B1
(b)(i)	Energy is gained by the solid to overcome the intermolecular bonds between the molecules so that there is a change of state from solid to liquid. This results in an increase in the internal potential energy of the liquid molecules.	B1 B1
(ii)	Energy is gained by the liquid to increase the internal kinetic energy of the molecules. So the temperature of the liquid increases.	B1
(c)	The specific heat capacity of the liquid is higher than the specific heat capacity of the solid. gradient of the line = rate of change in temperature of the substance (Δθ / t) P t = m c Δθ so c = P / (m (Δθ / t)) The gradient of the line OP (solid) is greater than the line QR (liquid). The rate of heat supplied (P) to the substance of mass m is constant. Therefore the specific heat capacity c of the solid is smaller than that of the liquid.	B1 B1 B1

6(a)		
(i)	correct ray drawing correct marking of F	C1
(ii)	focal length = 2x4 = 8.0 cm	A1
(iii)	correct subsequent ray drawing for ray X	B1
(b)	The image is still formed as all the rays from the object can still be refracted through the bottom part of the lens.	B1 B1
7(a)	A neutral cling film has an equal number of positive and negative charges while a charged cling film has an excess of either positive or negative charges.	B1 B1
(b)	When the cling film is peeled from the roll, friction between the surfaces will cause electrons to be transferred between the peeled cling film and the one remaining on the roll. One side of the cling film will lose electrons and become positively charged, while the other side will gain electrons and become negatively charged. Since unlike charges attract, the attractive forces between these two sides will cause the cling film to 'stick' to the roll.	B1 B1 B1
8(a)	Iron is a magnetic material so it becomes magnetized by induction with an induced South pole facing the North pole of the bar magnet. Unlike poles attract. So the iron ring is attracted to the bar magnet.	B1 B1
(b)	Aluminium is a non-magnetic material so it will not be attracted to the bar magnet.	B1
(c)(i)	As the bar magnet moves quickly towards the aluminium ring, there is a change in magnetic flux linkage with the ring / cutting of magnetic flux by the ring. So electromagnetic induction occurs and an induced current is produced in the ring.	B1 B1

(ii)	According to Lenz's Law (Law of Conservation of Energy), <u>the induced current flowing in the metal ring will produce its own magnetic field with its North pole facing the North pole of the bar magnet approaching it.</u> <u>Like poles repel</u> so the freely suspended ring will swing away from the bar magnet.	B1 B1
9(a)	Peak voltage = 5.0 V, so Y gain setting = <u>5.0 V / cm</u>	A1
(b)	T = 1/f = 1/50 = 0.020 s = 20 ms so 1 div = 0.02 ÷ 2 = 0.01s = 10 ms hence, time-base = <u>10 ms / cm</u>	A1
(c)	 correct height correct period	A1 A1

Section B (30 marks)		
Question No.	**Answers**	**Marks**
10(a)(i)	The emitted ultrasound pulse will meet the vehicle at time t = 0.2 s.	A1
(ii)	Using distance s_1 = constant speed x time taken = 340 m/s x 0.2 s = 68 m	M1 A1
(b)(i)	Distance s_2 = 340 x (0.3 / 2) = 51 m	M1 A1
(ii)	The difference in distance, $s_1 - s_2$ = 68 – 51 = 17 m ECF	A1
(c)	The time interval between the 2 emitted pulses reaching the car = 1.15 – 0.2 = 0.95 s During this time interval, the car advances 17 m. So the speed of the car, v = 17 / 0.95 = 17.9 m / s (3SF)	C1 A1
(d)(i)	As the sound wave passes through the air and reflects back, part of the wave energy is dissipated into the surrounding air and absorbed by the reflecting surface. So the reflected pulse is smaller in amplitude than the original pulse.	B1
(ii)	The air molecules vibrate with smaller maximum displacement from their original position.	B1
11(a)	When light from the torchlight is blocked by the card, the resistance of the LDR increases. When the light is not blocked by the card and reaches the LDR, the resistance of the LDR decreases.	B1 B1
(b)	When light is blocked by the card, the brightness around the LDR is low, hence the resistance of the LDR increases. When resistance of LDR increases, the potential difference across the LDR also increases. Since the variable resistor is in series with the LDR, when p.d. of LDR increases, the p.d. across the variable resistor will decrease. (emf = V_{RS} + V_{LDR})	B1 B1

(c)	The time interval 1 is caused by the bottom of the card which reaches the LDR level first OR time interval 2 is caused by the top of the card which it reaches the LDR level later. (Mark can be given if student somewhat makes the correct link between the time intervals and the part of the card)	B1
	When the top of the card reaches the LDR level, the speed of the card is faster due to acceleration caused by gravity, hence the shorter time in interval 2.	B1
(d)	Initial speed = 5.0 / (0.1516 – 0.0490) = 48.73 cm / s	C1
	Final speed = 5.0 / (0.3003 – 0.2784) = 228.31 cm / s	C1
	Time interval = (0.3003 + 0.2784) / 2 - (0.1516 + 0.0490) / 2 = 0.18905 s	C1
	Average acceleration = (v - u) / t = (228.31 – 48.73) / 0.18905 = 950 cm / s^2 (TO 3SF) [A1, ECF allowed] or $s = ut + \frac{1}{2} at^2$ $30 = 0 + \frac{1}{2} a (0.3003 – 0.0490)^2$ $a = 950$ cm/s^2	A1
12 Either (a)	When the piston is pushed in, the number of molecules per unit volume inside the pipe increases.	B1
	As a result, the frequency of collisions between the air particles and the inner wall of the pipe increases. Hence, the pressure increases.	B1
(b)(i)	$P_1V_1 = P_2V_2$ $P_2 = (1.00 \times 10^5) \times 6120 / 6000$	C1
	$= 1.02 \times 10^5$ Pa	A1
(ii)	$h\rho g = (1.02 \times 10^5) – (1.00 \times 10^5)$ ECF $h \times 1000 \times 10 = 2000$	C1
	$h = 0.200$ m	A1

(c)	The water level in the left arm of the manometer will increase while the water level in the right arm will decrease until both are at the same level.	B1 B1 B1
(d)	Use a liquid with a lower density than water in the manometer.	B1
12 Or (a)	When the current I from the mains supply flows through the long cable of resistance R, electrical energy will be wasted as heat due to the heating effect in the cable. ($P = I^2 R$). So the power (energy) output at the house is lower and the voltage supplied to the house is also lower (< 230 V). Hence the lamps are dim.	B1 B1
(b)	The step-up transformer A increases the voltage but reduces the current I in the cables. So less energy will be wasted as heat in the transmitting cables. So output power at step-down transformer B will be higher than (a) and the voltage supplied to the house is almost 230 V.	B1 B1
(c)	When an alternating current flows through the primary coil (input), it sets up an alternating magnetic field which links with the secondary coil (output) via the soft iron core. Due to the change in magnetic flux linkage with the secondary coil, electromagnetic induction occurs at the secondary coil and an alternating e.m.f. is produced across the ends of the secondary coil.	B1 B1 B1
(d)(i)	P = I V I = P / V = 690 / 230 = 3.0 A	A1
(ii)	E = P t = 690 x 10 x 60 = 414 000 J	M1 A1

Note:

- 3SF for final answer – For each mistake, deduct 1 mark up to a maximum of 3 marks per paper.
  (For exact value, need not write answer to 3 SF.)
- No unit written for final answer - For each mistake, deduct 1 mark up to a maximum of 3 marks per paper.
- Method not shown for calculations, then only give mark for Answer.
- Don't give ½ mark.

Setter: Mrs Hsu Lay Keok

THE END