Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2018

PHYSICS **6091/01**

Paper 1 Multiple Choice **12 September 2018**

Wednesday 0800 – 0900 **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

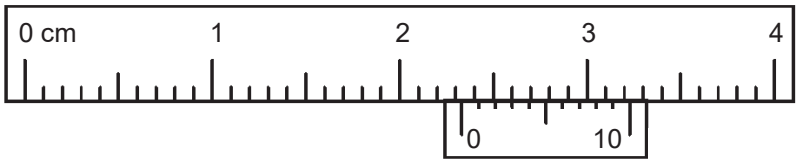
Write your name, class and register number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

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

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

Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

1. The diagram shows a vernier scale.



What is the vernier reading?

A 2.23 cm **B** 2.26 cm **C** 2.33 cm **D** 2.60 cm

2. A pendulum clock makes use of the oscillation of a pendulum to keep time. If the pendulum clock is found to be running slow, what can be done to correct the clock?

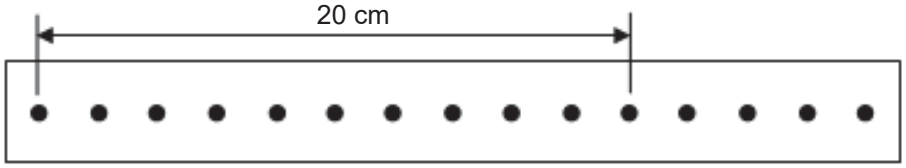
A decrease the amplitude of oscillation
B increase the amplitude of oscillation
C decrease the length of the pendulum
D increase the length of the pendulum

3. A car travels from Singapore to Genting Highlands in Malaysia. The map shows the route.

The route from Singapore to Genting Highlands is 425 km. If the car moves at an average speed of 80 km/h, what is the time taken for the journey?

A 0.19 hour
B 5.3 hours
C less than 5.3 hours as the journey is not a straight line
D more than 5.3 hours as the journey is not a straight line

4. The diagram shows a strip of paper tape pulled under a vibrating arm by a trolley moving at constant speed. The arm is vibrating regularly, making 40 dots per second.



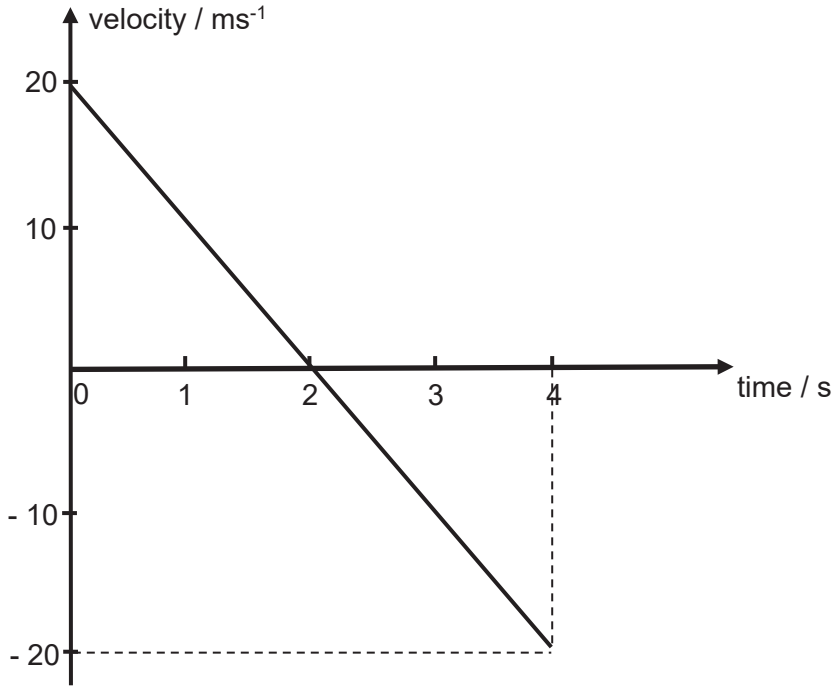
What is the speed of the trolley?

A 0.50 cm/s **B** 2.0 cm/s **C** 80 cm/s **D** 200 cm/s

5. A car accelerates uniformly from 10 m/s to 20 m/s. During this acceleration, the car travels 60 m. What is the acceleration of the car?

A 2.5 m/s^2 **B** 3.0 m/s^2 **C** 4.0 m/s^2 **D** 6.0 m/s^2

6. The graph shows how the velocity of a lump of plasticine varies after being thrown vertically upwards into the air from the ground.



What is the time needed for the plasticine to reach its highest point from the ground?

A 1 s **B** 2 s **C** 4 s **D** 8 s

7. A lion runs at a high speed to catch its prey. There is friction between the lion and the air and between the lion and the ground. Under which conditions of friction will the lion reach its greatest maximum speed?

	friction with air	friction with ground
A	high	high
B	high	low
C	low	high
D	low	low

8. A pulling force of 3.0 N causes a toy car to accelerate on a horizontal surface. The frictional force between the surface and the toy car is 1.0 N. Which of the following statements best describes the subsequent motion of the car when the pulling force is decreased to 1.0 N?

A It will continue to accelerate.
B It will decelerate.
C It will move with a constant speed.
D It will stop moving.

9. A child jumps onto a trampoline and bounces upwards.

On the second jump, he bounces higher. What will most likely remain constant on both jumps?

A his acceleration in the air
B his maximum gravitational potential energy
C his maximum kinetic energy
D his speed on contact with the trampoline

10. The table shows the density of various substances.

substance	density / gcm^{-3}
copper	8.9
iron	7.9
kerosene	0.9
mercury	13.6
water	1.0

Which statement is true?

A 1 g of iron has a smaller volume than 1 g of copper.
B 1 g of mercury has a greater volume than 1 g of water.
C The mass of 1 cm^3 of mercury is greater than 1 cm^3 of all the other substances.
D The mass of 1 cm^3 of water is smaller than 1 cm^3 of all the other substances.

11. A pendulum is attached to the roof of a truck. The truck is initially moving at a constant speed along a straight road.

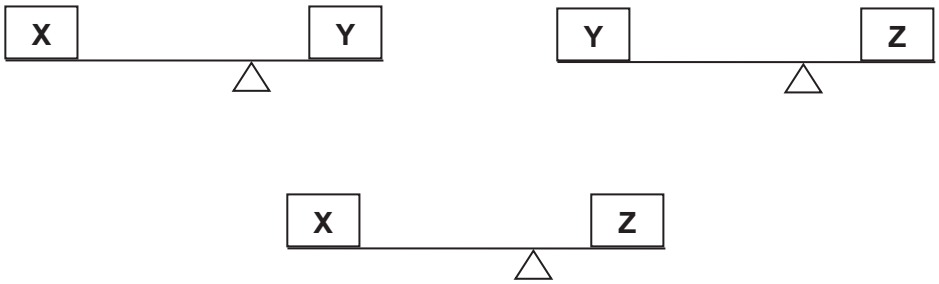
What is the motion of the pendulum bob when the truck starts to slow down?

A It will remain in its original position.
B It will swing to the left.
C It will swing to the right.
D It will swing to the right and left.

12. Which of the following quantities depends on the strength of the gravitational field?

A density **B** mass **C** volume **D** weight

13. The diagrams show how three blocks **X**, **Y**, and **Z** are balanced on a uniform beam.



Which of the following shows the three blocks arranged in order of increasing mass?

A **X**, **Y**, **Z** **B** **X**, **Z**, **Y** **C** **Y**, **X**, **Z** **D** **Z**, **Y**, **X**

14. A piece of card has its centre of gravity at **X**.

A

B

C

D

Which diagram shows how it hangs when suspended by a thread?

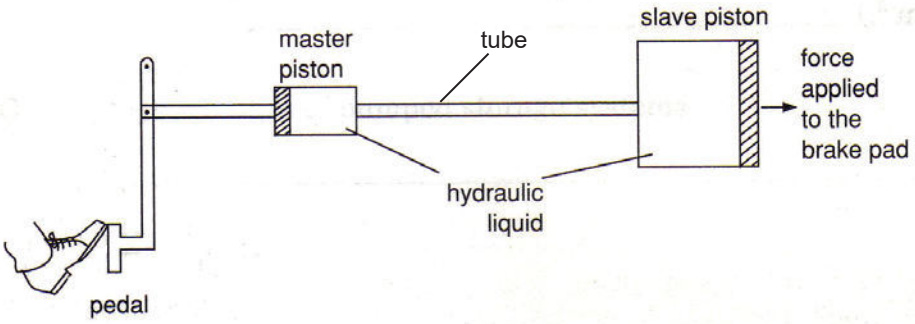
15. A car initially moving with a velocity **v** has kinetic energy **K**. What is the kinetic energy of the car when the velocity is 2**v**?

A **K** **B** 2**K** **C** 4**K** **D** 8**K**

16. A boy pushes a toy cart at constant speed along a level road. What is the biggest energy change?

A chemical potential to heat
B chemical potential to kinetic
C kinetic to gravitational potential
D kinetic to heat

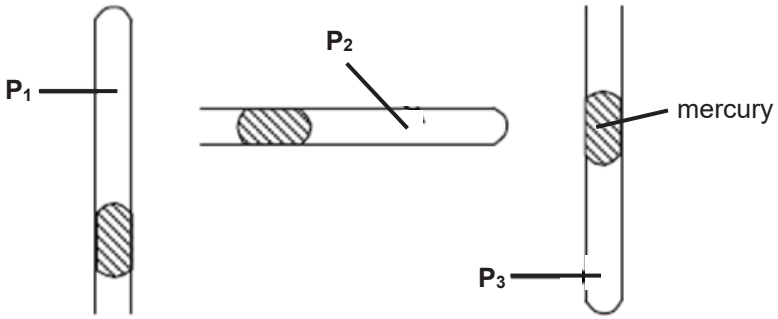
17. The diagram shows a hydraulic brake system used in vehicles. A hydraulic liquid is used to fill the system and a hollow tube links the master piston to the slave piston. Both pistons are cylindrical and the diameter of the slave piston is twice that of the master piston.



If the driver presses down on the pedal such that a force of 450 N is applied on the master piston, what is the force applied by the slave piston to the brake pad?

A 113 N **B** 225 N **C** 450 N **D** 1800 N

18. A column of air is trapped by some mercury in a capillary tube. The capillary tube is held in different positions as shown in the diagram.



P_1, P_2 and P_3 are pressures of the enclosed air in the capillary tube. Which relationship is correct?

A $P_1 = P_2 = P_3$ **B** $P_1 > P_2 > P_3$ **C** $P_1 > P_3 > P_2$ **D** $P_3 > P_2 > P_1$

19. Which of the following correctly states the properties of solids, liquids and gases?

	solids	liquids	gases
A	does not flow easily	flow easily	flow easily
B	hard to compress	easily compressed	easily compressed
C	fixed shape	fixed shape	no fixed shape
D	fixed volume	fixed volume	fixed volume

20. Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly. Which of the following best explains the motion of the smoke particles?

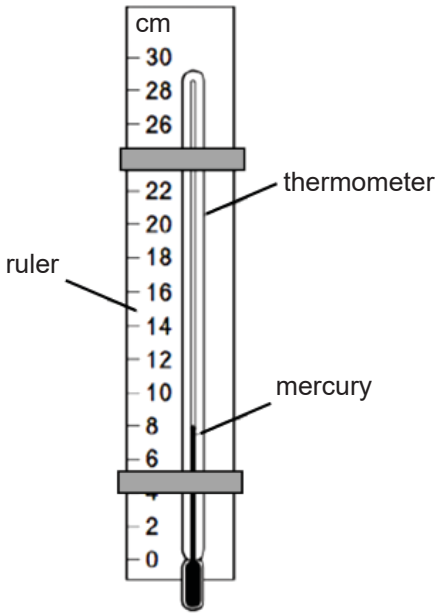
A air molecules are far apart from each other
B air molecules collide with each other
C air molecules move randomly
D smoke particles move randomly

21. A vacuum flask keeps water hot for long periods of time. Which of the following statements are correct?

1 The plastic cap prevents heat loss by radiation.
2 The silvered surfaces reduce heat loss by radiation.
3 The vacuum in the flask prevents heat loss by conduction and convection.

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

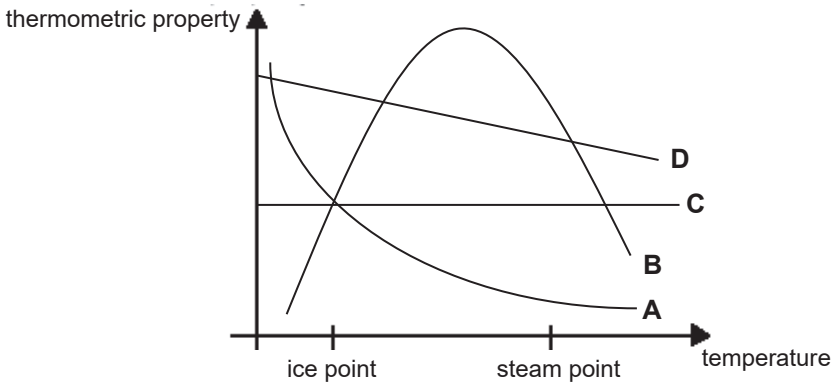
22. An unmarked mercury thermometer is attached to a ruler as shown in the diagram.



When the thermometer is placed in pure melting ice, the mercury level falls to 2.0 cm. When the thermometer is placed in steam above boiling water, the mercury level rises to 22.0 cm. What is the temperature shown by the mercury level in the diagram?

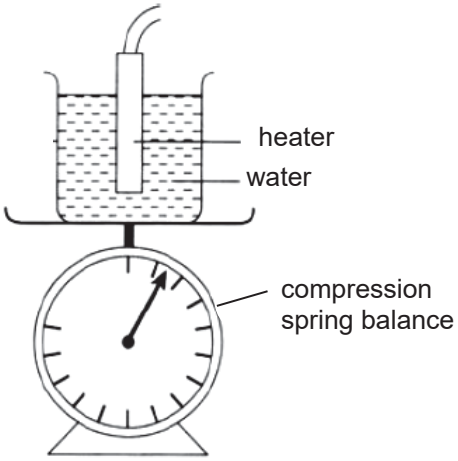
A 6 °C **B** 8 °C **C** 30 °C **D** 40 °C

23. The graph shows how the thermometric property of four substances changes with temperature.



Which substance can be used to construct a temperature scale?

24. The setup shown in the diagram is used to measure the specific latent heat of vaporisation of water.



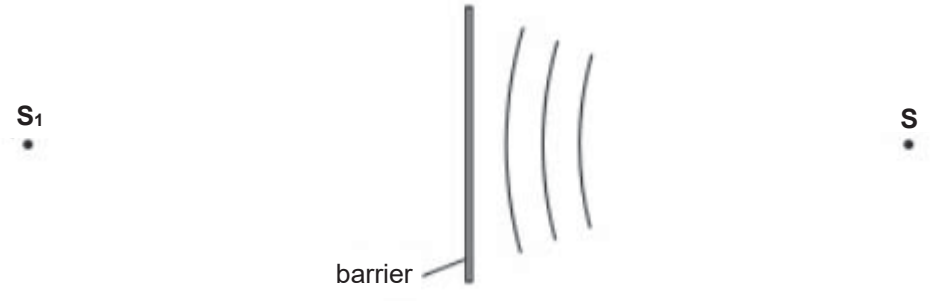
Three readings are taken by the compression spring balance.

m_1 = mass of the setup at the start of the experiment
m_2 = mass of the setup 5 minutes after the water starts to boil
m_3 = mass of the setup 8 minutes after the water starts to boil

If the heater has a power of 80 W, which expression could be used to calculate the specific latent heat of vaporisation of water?

A $\frac{14400}{m_1 - m_2}$ **B** $\frac{14400}{m_2 - m_3}$ **C** $\frac{24000}{m_1 - m_2}$ **D** $\frac{38400}{m_1 - m_3}$

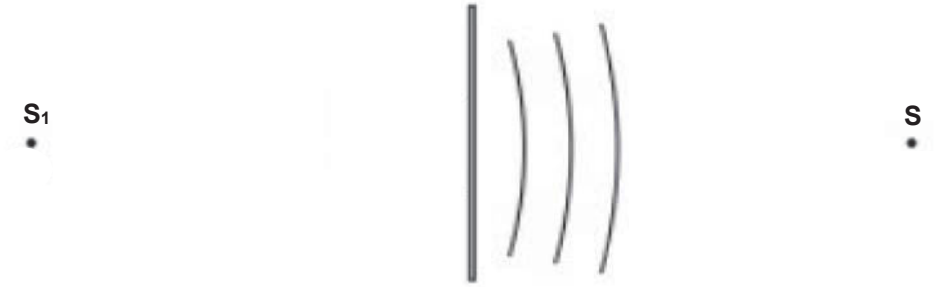
25. The diagram represents circular wavefronts coming from **S**. The wavefronts are about to strike a solid barrier from which they will be reflected so as to appear to come from $\mathbf{S_1}$.



Which diagram correctly shows the reflected wavefronts?

A

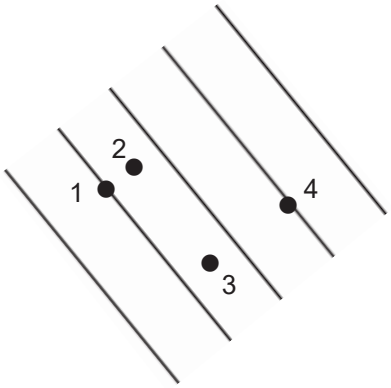
B



C

D

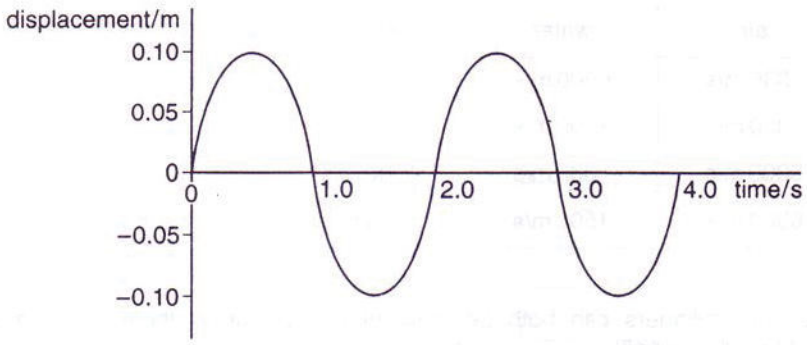
26. Four bottles are floating in a lake. The diagram shows the bottles as seen by a pilot in a hovering helicopter. The lines represent the crests of the waves in the lake.



Which two bottles are on the same wavefront?

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

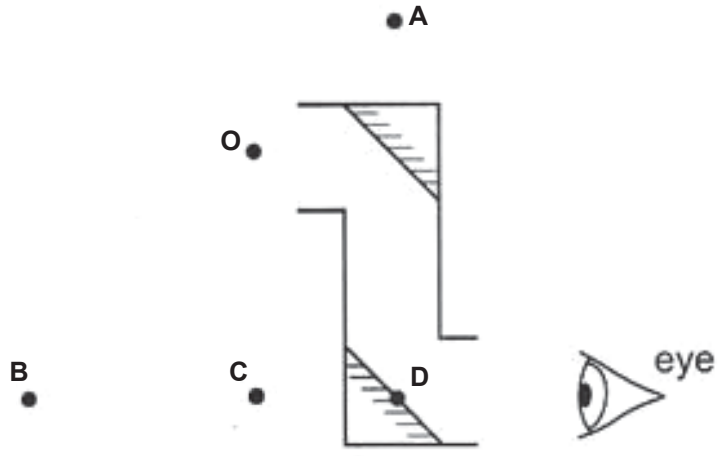
27. The diagram shows how displacement varies with time as a wave passes a fixed point.



What is the frequency of this wave?

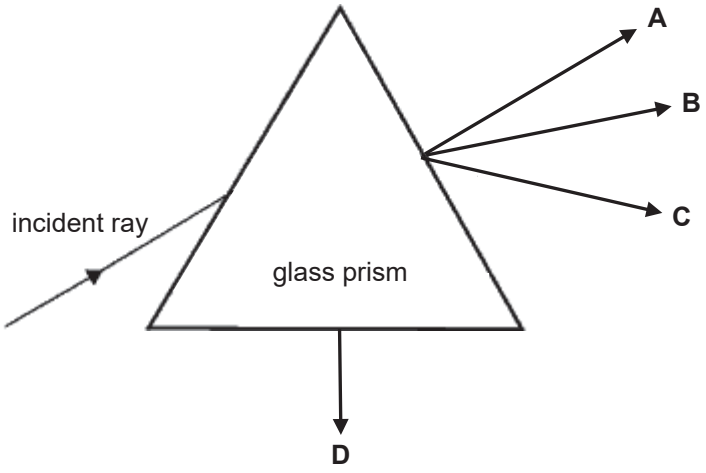
A 0.25 Hz **B** 0.50 Hz **C** 1.0 Hz **D** 2.0 Hz

28. A student looks into a periscope.

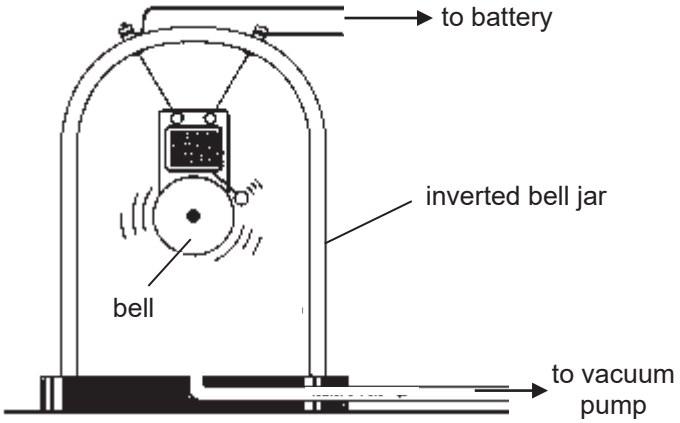


Where will he see the image of the object at **O**?

29. Which of the rays shows the correct direction of the emergent ray when the incident ray strikes the glass prism?



30. The diagram shows a bell ringing inside an inverted bell jar connected to a vacuum pump.



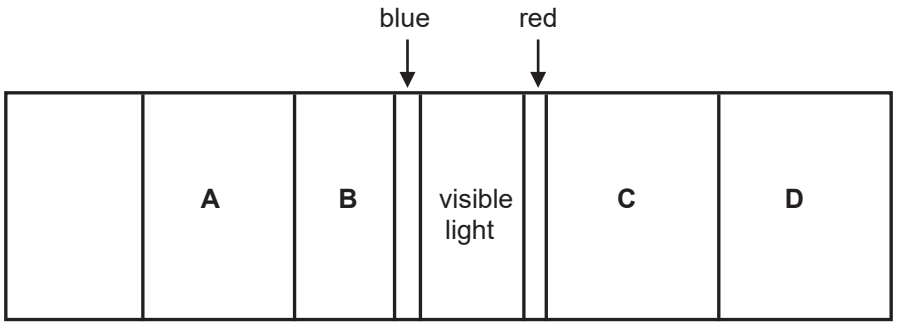
What happens to the pitch and loudness of the sound when the vacuum pump is switched on?

	pitch	loudness
A	decreases	decreases
B	decreases	increases
C	remains the same	decreases
D	remains the same	increases

31. A student faces a wall which is 800 m away and fires a starting pistol. His friend, standing 300 m behind him, hears two sounds. If the speed of sound is 340 m/s, what is the time interval between the two sounds heard by his friend?

A 3.24 s **B** 4.71 s **C** 5.59 s **D** 6.47 s

32. The diagram shows the electromagnetic spectrum, with the blue and red ends of the visible spectrum marked.

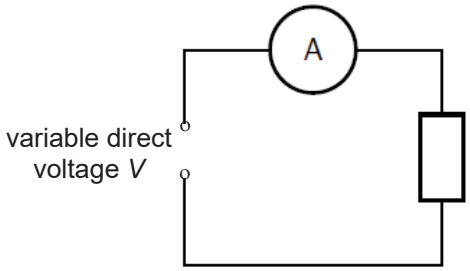


Which section of the spectrum has waves with the longest wavelength?

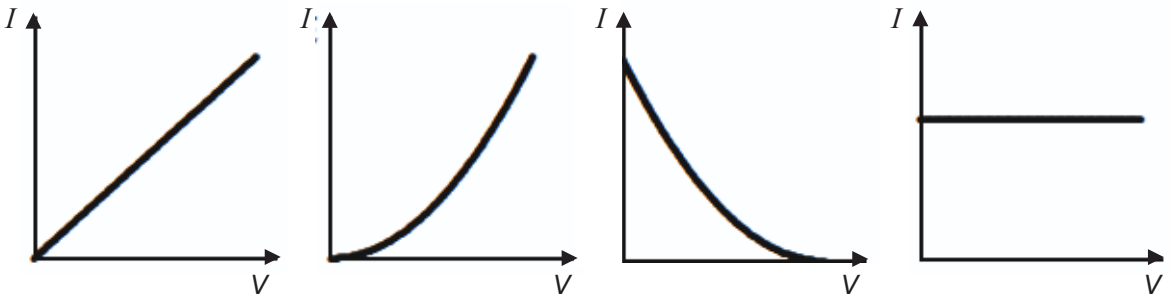
33. Which of the following statements about an electric field is correct?

A It is a field that contains electric charges.
B It is a field that surrounds electric charges.
C It is a region where a metal experiences a force.
D It is a region where an electric charge experiences a force.

34. A circuit is used to find the current I passing through a fixed resistor for various voltages V.

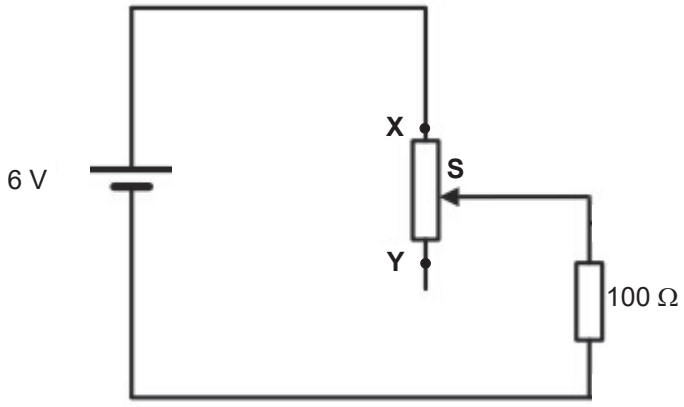


Which graph shows how the current I varies with voltage V?



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

35. The diagram shows a 100 Ω resistor connected to a variable resistor.



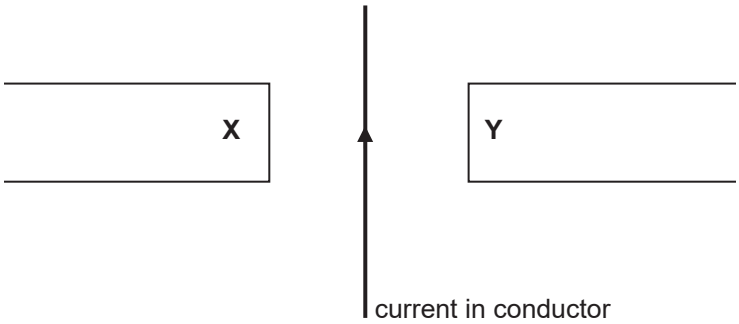
What happens to the potential difference across the 100 Ω resistor as the slider **S** is moved from **X** to **Y**?

A It becomes zero.
B It decreases.
C It increases.
D It remains at 6 V.

36. A mains electrical circuit uses insulated copper cable. The cable overheats. Which of the following changes will prevent the cable from overheating?

A use a thicker copper cable as it has less resistance
B use a thicker insulation to reduce heat loss to the surroundings
C use a thinner copper cable as it has less resistance
D use a thinner insulation to reduce heat loss to the surroundings

37. The diagram shows a current-carrying conductor placed in between two magnets.



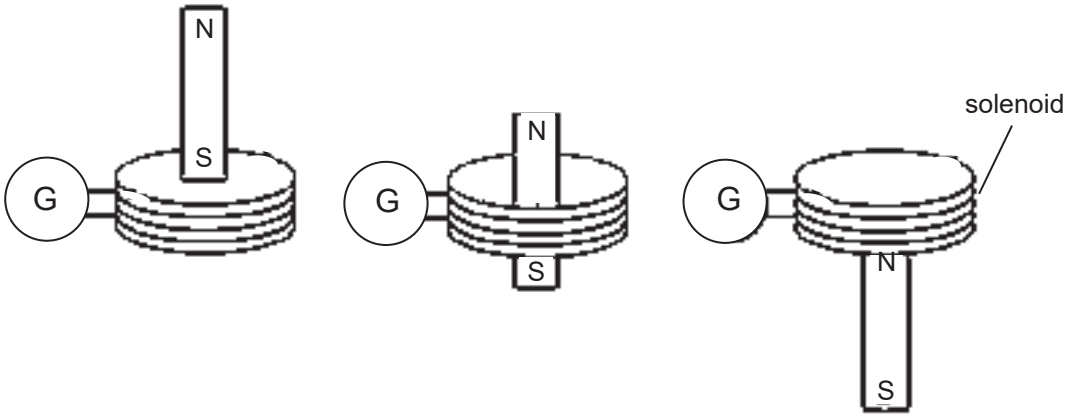
Which magnetic poles at **X** and **Y** will cause the conductor to move into the plane of the paper?

	X	Y
A	north	north
B	north	south
C	south	north
D	south	south

38. What is the function of the soft iron cylinder placed between the curved poles of the magnet in a d.c. motor?

A to control the speed of rotation of the coil
B to enable the coil to turn in one direction only
C to increase the forces acting on the coil
D to increase the magnitude of the induced e.m.f. in the coil

39. A bar magnet is dropped through a solenoid connected to a galvanometer.

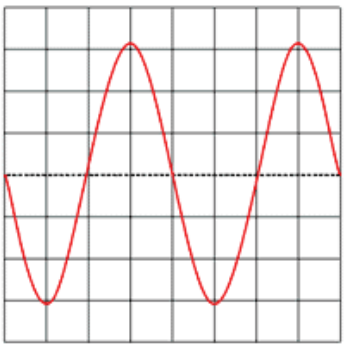


position 1 position 2 position 3

At which position(s) will the galvanometer show a deflection?

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

40. The diagram shows a cathode-ray oscilloscope (c.r.o.) trace for a voltage produced by an a.c. generator. The time base of the c.r.o. is 30 μs/div.



If the coil in the a.c. generator is rotated at three times its current speed, what is the period of the new voltage?

A 10 μs **B** 40 μs **C** 90 μs **D** 360 μs

End of Paper

Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS

PRELIMINARY EXAMINATION 2018

PHYSICS 6091/02

Paper 2 Theory **11 September 2018**

Tuesday 0800 - 0945 **1 hour 45 minutes**

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.

Write in dark blue or black pen. You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid or tape.

Section A [50 marks]

Answer **all** questions.

Section B [30 marks]

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

Candidates are reminded that **all** quantitative answers should include appropriate units.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **17** printed pages, including this cover page.

Setter: **[Turn over**

Section A (50 marks)

Answer all the questions in the spaces provided.

1. A suitcase slides down a conveyer belt from an aeroplane as shown in Fig. 1.1. The suitcase starts from rest at **A**, which is at the top of the belt and slides down the belt until it reaches **B** which is 4.0 m below **A**. The suitcase then decelerates as it moves along the horizontal floor.

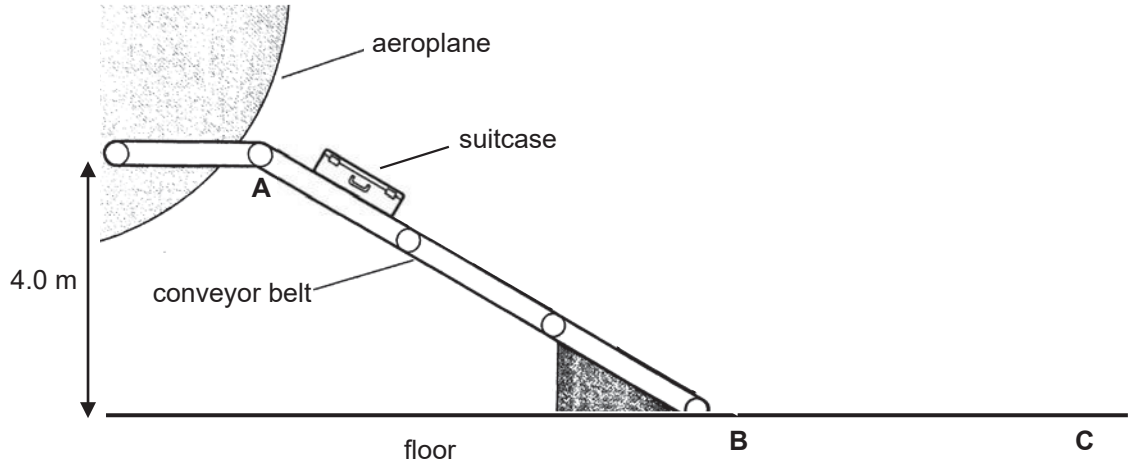


Fig. 1.1

The mass of the suitcase is 20 kg. The suitcase is moving at a horizontal speed of 5.0 m/s at **B**. Take gravitational field strength, g = 10 N/kg.

(a) Describe the energy changes that take place as the suitcase moves from **A** to **B**, and from **B** to **C** in Fig. 1.1. [2]

_____

_____

_____

_____

(b) Calculate the efficiency of the suitcase when it moves from **A** to **B**. [2]

(c) The suitcase comes to a rest at **C** three seconds after passing **B**. Determine the average retarding force exerted by the floor on the suitcase. [2]

2. Fig. 2.1 shows a sky diver falling vertically from an aircraft.

Fig. 2.1

(a) On Fig. 2.1, draw and label the forces experienced by the sky diver as he falls. [1]

(b) Fig. 2.2 shows the velocity-time graph for the sky diver during the first 20 s of his jump.

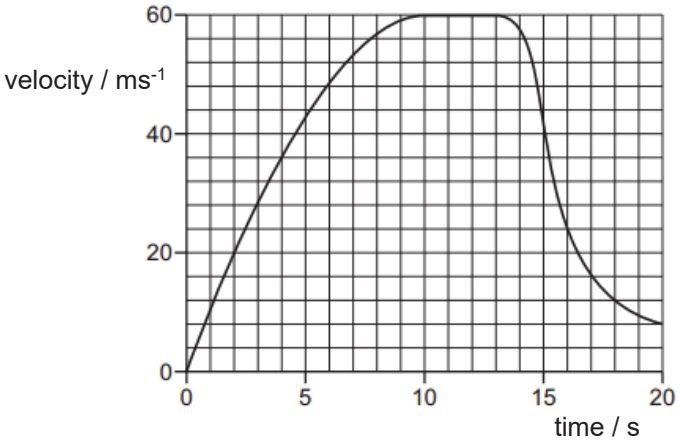


Fig. 2.2

The sky diver falls from rest at time = 0 s and initially accelerates at 10 m/s^2. He reaches a steady velocity after 10 s. At time = 13 s, he opens his parachute.

(i) Explain the motion of the sky diver from 0 to 10 s. [2]

(ii) On Fig. 2.3, sketch the acceleration-time graph for the sky diver from time = 0 s to time = 13 s. [2]

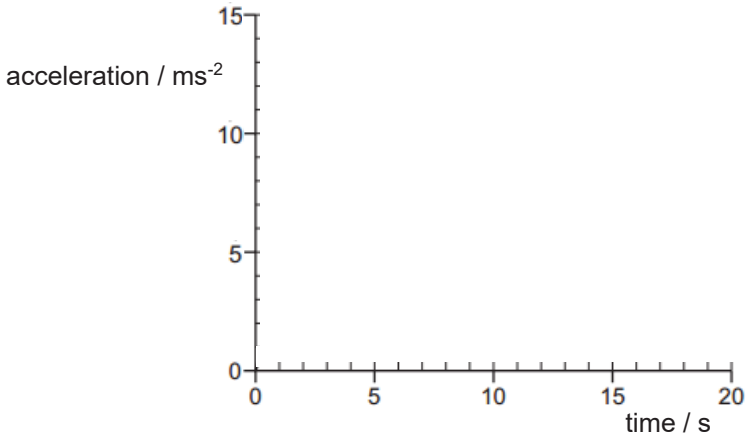


Fig. 2.3

(iii) Explain why the sky diver decelerates after he opens his parachute at time = 13 s. [2]

3. Fig. 3.1 shows the apparatus that could be used to heat up water in a pot. The exterior wall of the pot is covered with a layer of polystyrene foam.

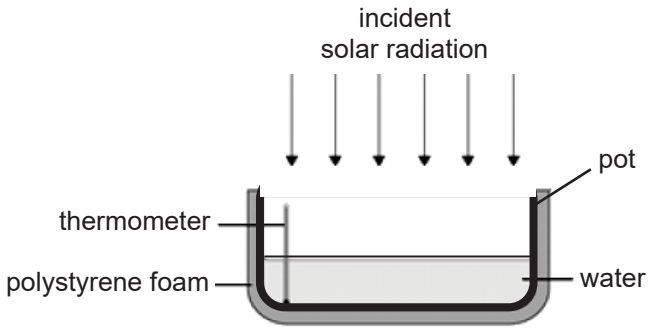


Fig. 3.1

A student puts the pot in direct sunlight and measured the time it took for the temperature of the water to increase. The energy transferred to the water is 5250 J and the time taken for the temperature of the water to increase from 27.0 °C to 29.0 °C is 25 minutes. The temperature of the air outside the pot is 35.0 °C.

(a) Calculate the power supplied by the Sun to the water in the pot. [1]

(b) (i) Other than heat exchange with the surroundings, suggest another reason why the student's results can only be used as an estimate of the power of the Sun. [1]

_____

_____

(ii) Calculate the mass of the water inside the pot. The specific heat capacity of water is 4200 J/(kg°C). [2]

(c) Describe how the polystyrene foam insulates the pot. [2]

_____

_____

_____

(d) Explain why the water reaches a steady temperature after some time. [1]

_____

_____

4. Fig. 4.1 (not drawn to scale) shows part of the path of a ray of light, **PQR**, travelling through an optical fibre. The optical fibre consists of a fibre of denser transparent material, coated with a layer of less dense transparent material. The left side of the fibre is horizontal while the right side of the fibre is bent.

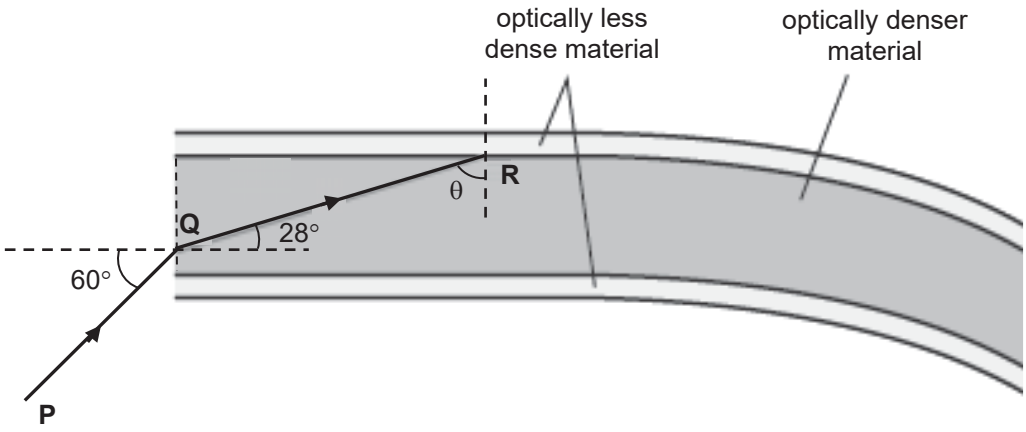


Fig. 4.1

(a) Complete the path of the ray of light until it reaches the end of the optical fibre. [1]

(b) The refractive index of the optically less dense material is assumed to be 1.0.

(i) Determine the minimum angle θ needed for total internal reflection to take place. [3]

(ii) Explain why it is necessary for the denser material to have a refractive index much higher than that of the less dense material. [2]

_____

_____

_____

(c) Other than the cost incurred, state one advantage of using optical fibres rather than copper wires for transmission of information. [1]

_____

_____

5. Fig. 5.1 shows an object **AB** near a thin converging lens. The path of one ray from point **A**, passing through the lens, is drawn.

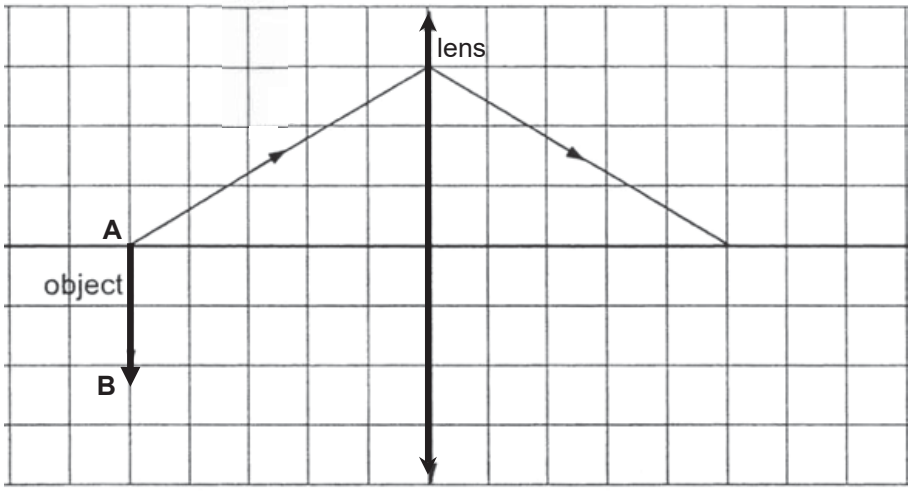


Fig. 5.1

(a) On Fig. 5.1, draw a suitable ray from point **B**, passing through the lens, to locate the position of the image of object **AB**. Label the image **A'B'**. [2]

(b) By drawing another ray from point **B** passing through the lens, mark the focal length of the lens. Label it **f**. [1]

(c) The converging lens may be used to form a virtual image of object **AB**. State where the object is placed, relative to the lens, for a virtual image to be formed. [1]

_____

6. Fig. 6.1 shows a large metal sphere **X** supported on an insulating stand. Sphere **X** is connected to earth through switch **S**. A positively charged sphere **Y** is brought very close to sphere **X** and is held in place by two strings, **A** and **B**.

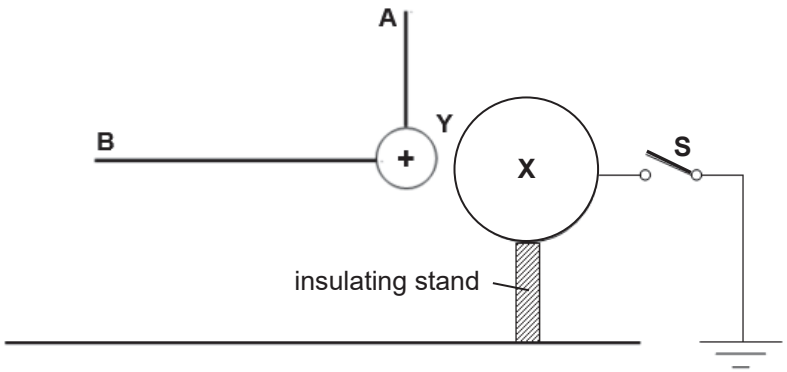


Fig. 6.1

Switch **S** is then closed.

(a) (i) On Fig. 6.1, draw the charge distribution on sphere **X**. [1]

(ii) Explain your answer to (a)(i). [2]

_____

_____

_____

(b) String **B** is now cut with switch **S** remaining closed.

(i) Describe and explain the subsequent motion of **Y** until it comes to a rest. [3]

_____

_____

_____

_____

_____

(ii) On Fig. 6.2, draw the final position of rest of **Y**. [1]

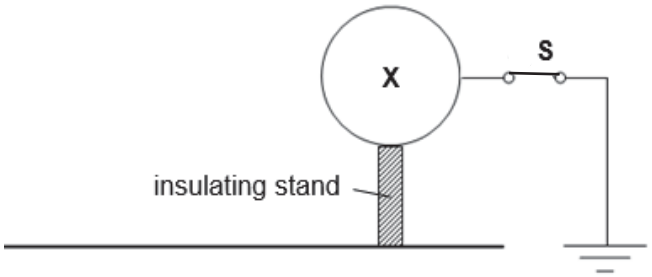


Fig. 6.2

7. Fig. 7.1 shows an electric circuit. **E** is a 1.5 V cell and **T** is a thermistor whose variation of resistance with temperature is shown in Fig. 7.2.

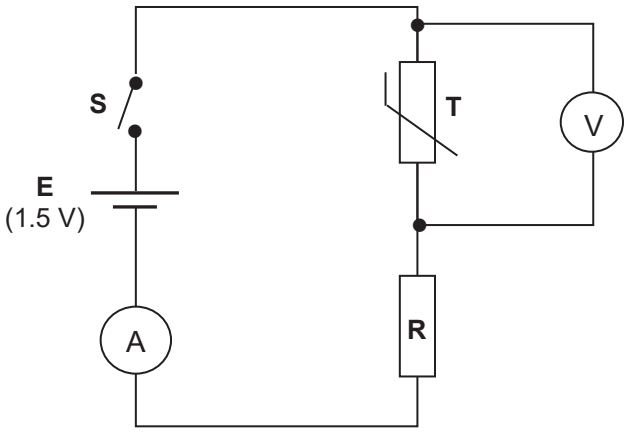


Fig. 7.1

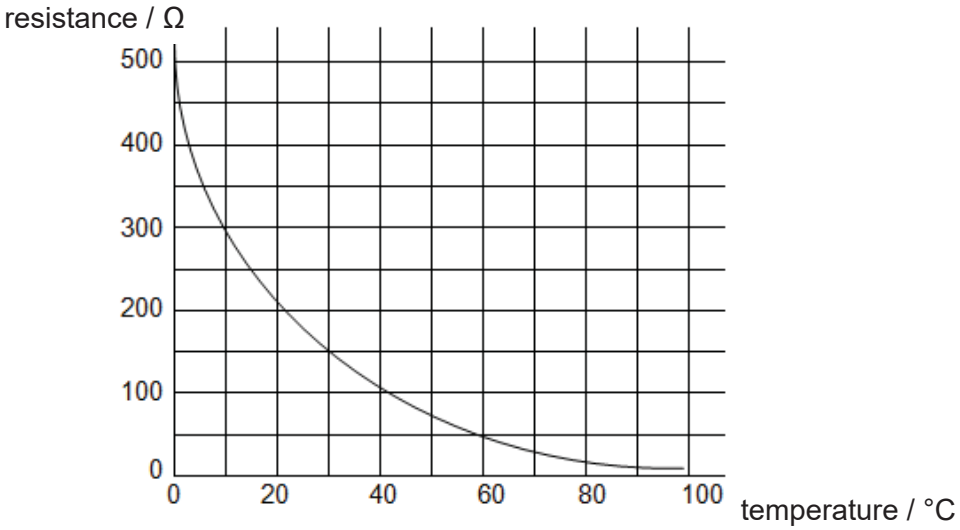


Fig. 7.2

(a) When the thermistor is at 30 °C and switch **S** is closed, the reading on the ammeter is 6 mA. Determine the resistance of resistor **R**. [3]

(b) The temperature of the thermistor increases from 30 °C to 60 °C.

(i) Calculate the reading on the ammeter at 60 °C. [1]

(ii) Explain the change in the potential difference across **T**, if any, when the temperature of the thermistor increases. [2]

8. Fig. 8.1 shows how power cables are used to transmit electrical energy from a power station to the consumers in a village. The power station produces electricity at an alternating voltage of 20 kV. The output voltage of transformer **J** is 285 kV, while the voltage supplied to the consumers is 240 V. Assume that transformers **J** and **K** are ideal.

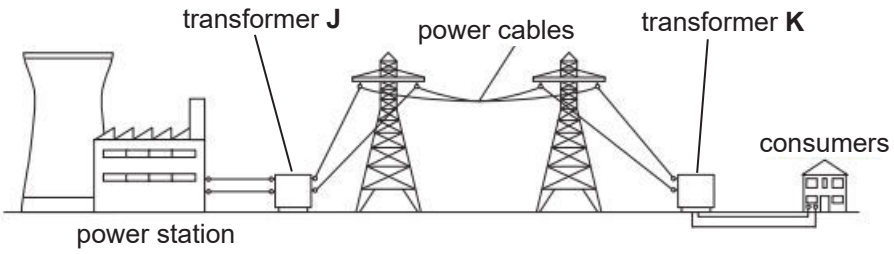


Fig. 8.1

(a) Explain why transformer **J** is not able to transform the voltage of a direct current. [2]

(b) Calculate the number of turns in the primary coil of transformer **J** if there are 48 000 turns in the secondary coil. [2]

(c) Explain why the voltage of power station was stepped up from 20 kV to 285 kV before being transmitted over the power cables. [2]

Section B (30 marks)

Answer all the questions in the spaces provided.
Question 11 has a choice of parts to answer.

9. A student investigated how current varies with potential difference for two different lamps **X** and **Y**. Fig. 9.1 shows the readings obtained.

potential difference / V	current in lamp **X** / A	current in lamp **Y** / A
0.0	0.00	0.00
1.0	0.15	0.07
2.0	0.30	0.14
3.0	0.40	0.21
4.0	0.48	0.28
5.0	0.55	0.34
6.0	0.60	0.39
7.0	0.64	0.43
8.0	0.67	0.46

Fig. 9.1

(a) In the space below, draw the diagram of a circuit that the student could use to obtain the results in Fig. 9.1. The current in lamp **X** must be obtained at the same time as the current in lamp **Y**. [2]

(b) State the values of potential difference for which **both** lamp **X** and lamp **Y** behave like ohmic conductors. Explain your answer. [2]

(c) Using Fig. 9.1, explain which lamp has a higher resistance. [2]

(d) Using your answer from (c), explain which lamp is brighter at any potential difference. [2]

(e) The student repeats his investigation with a strong wind blowing over the lamps. Fig. 9.2 shows the readings obtained at a potential difference of 4.0 V.

potential difference / V	current in lamp **X** / A	current in lamp **Y** / A
4.0	0.50	0.31

Fig. 9.2

Explain why the values of current in Fig. 9.2 are different from that in Fig. 9.1 for the same potential difference across the lamps. [2]

10. Fig. 10.1 shows a loudspeaker made by a student. A coil of wire is fixed to one end of the paper cone. When the switch is closed, the paper cone moves to the right.

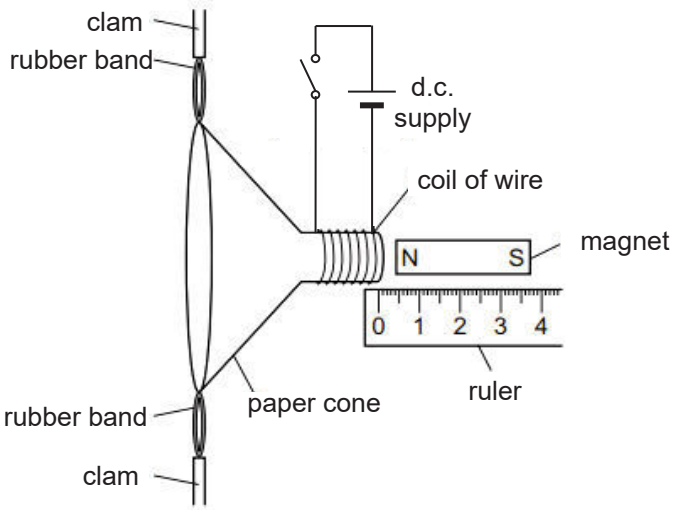


Fig. 10.1

(a) Explain why the paper cone moves to the right when the switch is closed. [3]

_____

_____

_____

_____

_____

(b) The student investigates how changing the size of the current in the coil of wire affects the horizontal distance moved by the paper cone. The results of the student's investigation are shown in Fig. 10.2.

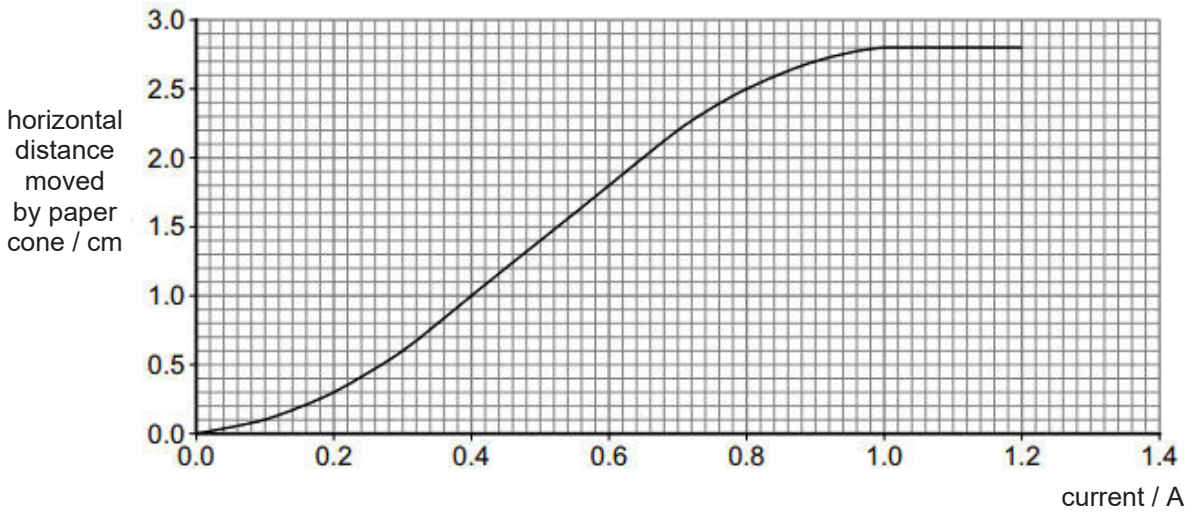


Fig. 10.2

State and explain the results of the student's investigation when the current increases from 0.0 A to 1.0 A. [2]

(c) Sound is produced when there is an alternating current in the coil.

(i) Explain how sound is produced when there is an alternating current in the coil. [2]

(ii) Describe how the particles of the cone provides an example of longitudinal wave motion. [1]

(iii) Explain the difference in the sound heard when the size of the alternating current is increased. [2]

EITHER

11. Fig. 11.1 shows a manometer attached to a tyre to measure the pressure difference between the air inside the tyre and the atmosphere outside. The atmospheric pressure outside the tyre is 100 000 Pa.

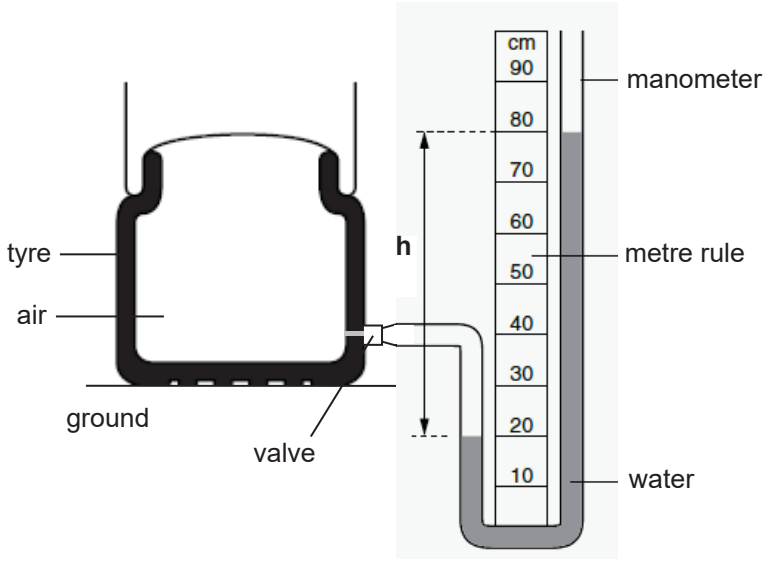


Fig. 11.1

(a) (i) Mark on the manometer, a point **P** where the pressure is 20 cm of water higher than atmospheric pressure. [1]

(ii) Calculate the pressure of the air inside the tyre. The density of water is 1000 kg/m^3 and the gravitational field strength, g = 10 N/kg. [2]

(iii) State what change, if any, will occur to the height **h** if a liquid denser than water is used in the manometer. [1]

_____

(b) Describe the motion of air molecules inside the tyre and explain how this results in a pressure exerted by air on the walls of the tyre. [2]

_____

_____

_____

(c) The tyre goes over a stone as shown in Fig. 11.2.

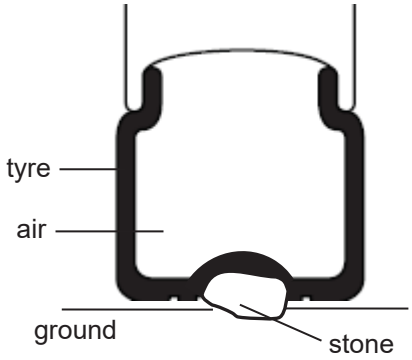


Fig. 11.2

State and explain

(i) how the pressure exerted on the ground changes. [1]

(ii) how the pressure inside the tyre changes. [3]

OR

11. The weight of a rock, which is more than 20 N, cannot be measured directly using a spring balance with a maximum reading of 20 N. Fig. 11.3 shows a setup that could be used to determine the weight of the rock.

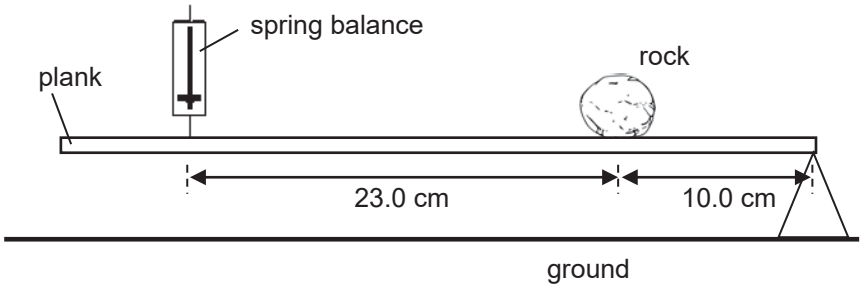


Fig. 11.3

A weightless plank is pivoted with the rock placed 10.0 cm from the pivot. The plank is suspended by a spring balance at a point 23.0 cm from the rock. The plank balances horizontally and the reading on the spring balance is 6.5 N.

(a) (i) State the *principle of moments*. [1]

_____

_____

_____

(ii) Explain why this setup can enable the weight of the rock to be determined. [2]

_____

_____

_____

_____

(iii) Calculate the weight of the rock. [2]

(b) The rock falls off the plank and hits the ground with a speed of 7.0 m/s. The vertical distance of the plank from the ground is 2.5 m.

(i) Calculate the time taken for the rock to hit the ground. State two assumptions that you have made during your calculations. [3]

assumption 1: _____

assumption 2: _____

(ii) Calculate the work done on the rock by the force of gravity. [2]

End of Paper

Answers to PRSS Prelim 2018 4E Pure Physics Paper 1

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

Answers to PRSS 4E Physics Prelim 2018

Section A

1. (a) From **A** to **B**, gravitational potential energy of the suitcase is converted to kinetic energy and thermal (and sound) energy. [1]
From **B** to **C**, the kinetic energy of the suitcase is converted to thermal (and sound) energy. [1]

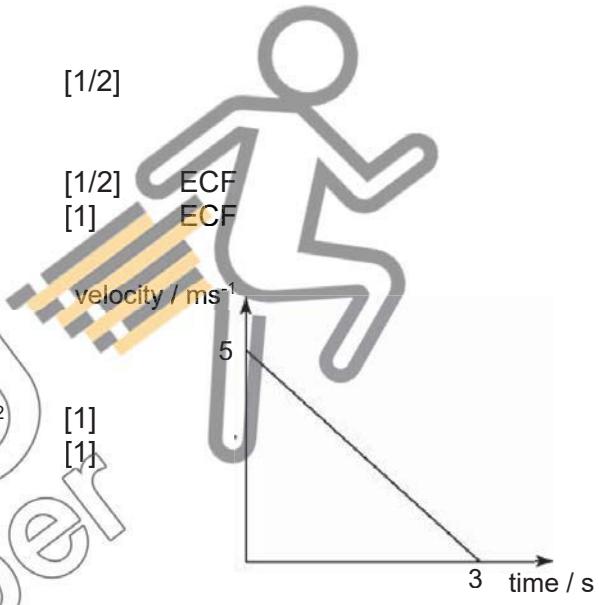
(b) Efficiency = (useful energy output / input energy) x 100%
= (KE at **B** / GPE at **A**) x 100%
= (½ x 20 x 5.0^2 / 20 x 10 x 4) x 100% [1]
= 31% [1]

(c) Acceleration of suitcase, a = (v - u) / t
= (0 - 5.0) / 3
= - 1.67 m/s^2 [1/2]

F = ma
0 - retarding force = 20 x (- 1.67) [1/2] ECF
Retarding force = 33.4 N [1] ECF

OR

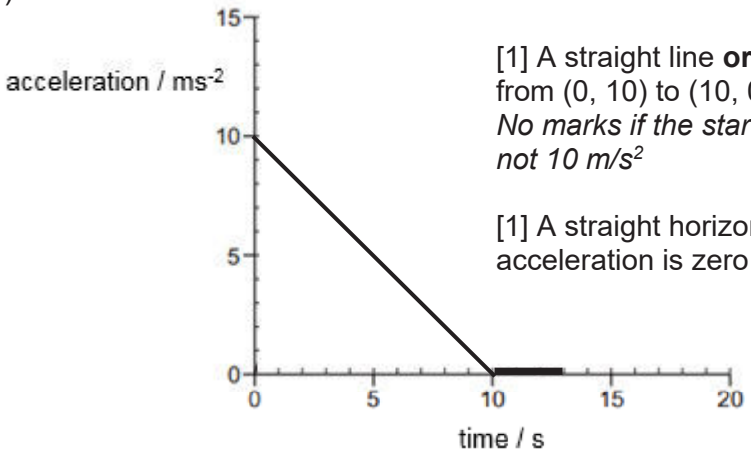
Work done by retarding force = Loss in KE
F x (1/2 x 3 x 5.0) = ½ x 20 x 5.0^2 [1]
F = 33.3 N [1]



2. (a)

(b) (i) As he falls, his velocity increases [1/2] and this causes the air resistance to increase [1/2].
The (downward) resultant force decreases [1/2], hence his acceleration is decreases [1/2].

(ii)



[1] A straight line **or** curve with negative gradient from (0, 10) to (10, 0).
No marks if the starting value of acceleration is not 10 m/s²

[1] A straight horizontal line showing that acceleration is zero from 10 to 13 s.

(iii) After the sky diver opens the parachute, the resistive force or air resistance acting on him becomes greater than his weight. [1]
Resultant force on him becomes negative / resultant force acts in a direction opposite (upwards) to his motion [1] and hence he decelerates.

3. (a) Power, P = E / t
= 5250 / (25 x 60)
= 3.5 W [1]

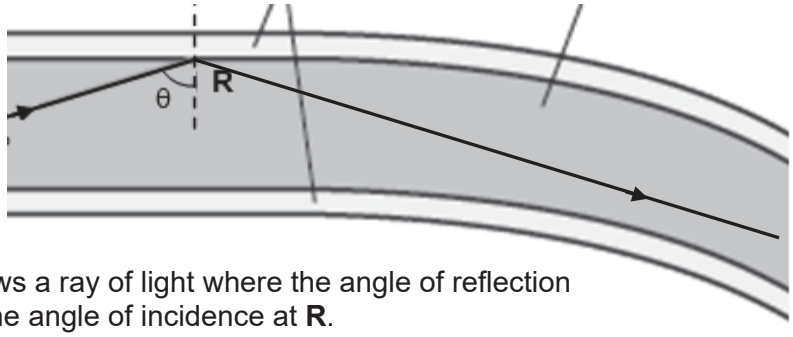
(b) (i) Some of the energy from the Sun is used to heat the pot (as well as the water).
OR
The intensity of solar radiation on the apparatus changed during the 25 minutes.
OR
The thermometer is touching the base of the pot and is not exactly measuring the temperature of the water
OR
Clouds block sun rays from reaching the pot.
OR
The distance of the pot from the Sun is large and some of the Sun's energy is lost before reaching the water.
Any one [1]

(ii) $Q = mc\Delta\theta$
$5250 = m \times 4200 \times (29.0 - 27.0)$ [1]
$m = 0.625$
= 0.63 kg or 630 g [1]

(c) The air trapped in polystyrene [1] is a poor conductor of thermal energy [1/2].
Convection is restricted as air is trapped [1/2].
Hence heat transfer by conduction and convection is reduced.

(d) The rate at which the water gains heat from the Sun is equal to the rate of heat loss to the surroundings.
OR
There is no net heat transfer between the water and the surroundings.
Any one [1]

4. (a)



[1] Correctly draws a ray of light where the angle of reflection is equals to the angle of incidence at **R**.

(b) (i) Refractive index, n = sin i / sin r
= sin 60° / sin 28°
= 1.84 [1]

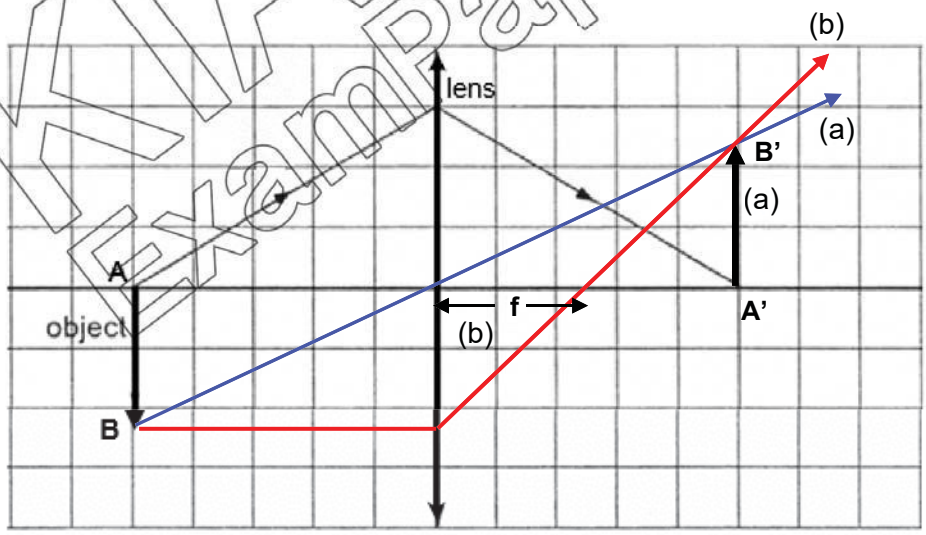
sin c = 1 / n
= 1 / 1.84 [1/2] ECF
c = 32.9° [1] ECF

Minimum angle θ = 32.9° [1/2]

(ii) This will ensure a small critical angle. [1]
Total internal reflection will take place more easily / more rays can undergo total internal reflection. [1]

(c) Optical fibres can carry more information than copper wires.
OR
Transmission of information is faster.
OR
There will be lower energy loss / signal loss during transmission.
OR
Information can be transmitted over a longer distance. Any one [1]

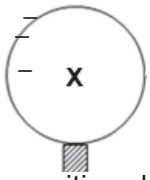
5. (a)
(b)



[1] Draws a ray from **B** passing through the optical centre of the lens.
[1] Draws and label the image **A'B'** correctly.
[1/2] Draws a ray parallel to principal axis and passing through the lens to reach point **B'**.
[1/2] Indicates and label the focal length **f** correctly.

(c) The object must be placed less than the focal length from the lens. [1]

6. (a) (i)

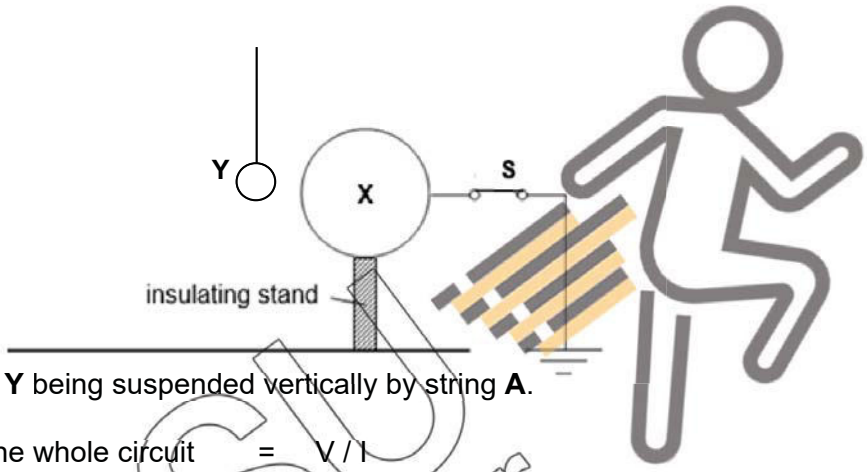


[1] Draws negative charges on the left side of **X** and no positive charges on the right side.

(ii) The positive charges in **Y** attracts electrons from earth [1] as unlike charges attract [1/2].
This induces a negative charge on the left side of **X**. [1/2]

(b) (i) **Y** moves towards **X** [1/2] as unlike charges attract [1/2].
When **Y** touches **X** [1/2], **Y** is discharged / neutralised [1/2] by the earth.
Y then moves away from **X** [1/2] due to gravitational force [1/2] and oscillates before coming to a rest.

(ii)



[1] Draws **Y** being suspended vertically by string **A**.

7. (a) Resistance of the whole circuit = V / I
= 1.50 / (6 x 10^{-3})
= 250 Ω [1]

Resistance of thermistor at 30°C = 150 Ω [1]

Resistance of resistor **R** = 250 - 150
= 100 Ω [1] ECF

OR

Resistance of thermistor at 30°C = 150 Ω [1]

Pd across thermistor = RI
= 150 x 6 x 10^{-3}
= 0.9 V [1/2]

Pd across resistor = 1.5 - 0.9
= 0.6 V [1/2]

Resistance of resistor **R** = 0.6 / 6 x 10^{-3}
= 100 Ω [1]

(b) (i) Resistance of **T** at 60°C = 50 Ω

Current on ammeter at 60°C = V / R
= 1.5 / (50 + 100)
= 10 mA [1] ECF

(ii) When temperature increases, resistance of thermistor decreases [1/2].
This decreases the ratio of resistance of **T** to the total resistance of the whole circuit.
OR
This decreases the ratio of resistance **T** to the resistance of **R**. [1]
The potential difference across **T** decreases. [1/2]

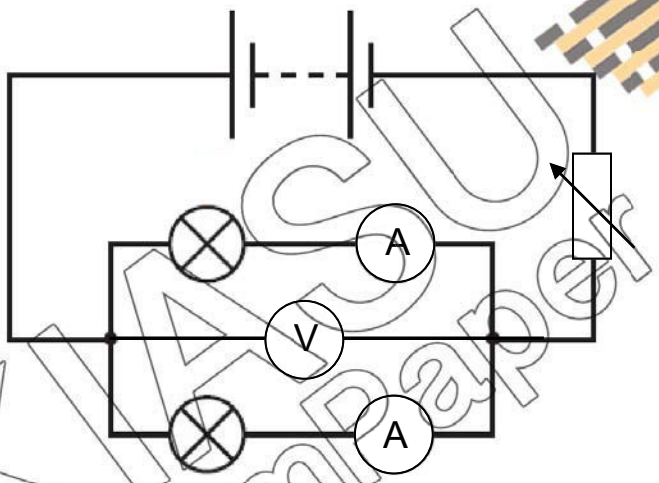
8. (a) A direct current does not produce a continuously changing magnetic field [1/2] in the primary coil of transformer **J** [1/2].
This will not result in electromagnetic induction or no emf will be induced [1/2] in the secondary coil [1/2].

(b) Np / Ns = Vp / Vs
Np / 48 000 = 20 / 285 [1]
Np = 3370 [1] Accept 3368

(c) Stepping up the voltage will reduce the transmission current [1].
As power loss, $P = I^2R$ [1/2], this will reduce power loss as heat [1/2] in the cables.

Section B

9. (a)



Lamps in parallel [1/2] with voltmeter connected in parallel with the lamps [1/2].
An ammeter on each branch to measure the current through lamps. [1/2]
A variable resistor or potentiometer is used to vary the potential difference across the lamps. [1/2]
Deduct ½ mark if battery / power source missing

(b) Values of potential difference is from 0.0 V to 2.0 V. [1/2]
The ratio of potential difference to current is constant / current is proportional potential difference [1] showing that resistance is constant [1/2].

(c) Lamp **Y** has a lower current than lamp **X** [1] for any value of potential difference [1/2].
Lamp **Y** has a higher resistance than lamp **X** [1/2].
*No marks for a simple answer e.g. 'the resistance of **Y** is higher'.*

(d) As power output $P = V^2 / R$ [1/2], **X** has a higher power output as its resistance is lower [1]. Hence **X** is brighter [1/2].
*No marks for a simple answer e.g. '**X** is brighter'.*

(e) Wind removes heat from the lamps [1/2] and lowers their temperature. [1/2]
As temperature lowers, the resistance of the lamps decreases [1/2] and hence current is higher [1/2].

10. (a) When switch is closed, current flows through the coil [1/2] and produces a magnetic field in the coil [1/2]
The right side of the coil is magnetised with a south polarity [1/2]. The magnet attracts the coil [1] as unlike poles attract [1/2] causing the cone to move to the right.

(b) The horizontal distance moved by the cone increases [1/2] non-linearly [1/2] with current.
The strength of magnetic field in the coil increases with current or the coil becomes a stronger electromagnet [1/2] and results in a greater attractive force between the coil and the magnet [1/2].

(c) (i) An alternating current causes the coil to be continuously attracted and repelled by the magnet. [1]
This causes the cone to vibrate [1] and a sound wave is produced.

(ii) The sound produced travel in a direction parallel to the vibration of the particles of the cone. [1]

(iii) The sound heard is louder. [1]
As current increases, the amplitude of vibration [1] of the cone increases.

EITHER

11. (a) (i) Point **P** marked at 60 cm mark on the manometer tube. [1]

(ii) Pressure of air = Atmospheric pressure + ρhg
= 100000 + (1000 x 0.6 x 10) [1]
= 106000 Pa (1.06×10^5 Pa) [1]

(iii) **h** decreases. [1]

(b) The air molecules are moving randomly / continuously [1/2] at high speeds [1/2].
When the air molecules hit the walls of the tyre, a force is exerted [1/2] and this since pressure is force per unit area [1/2], a pressure is exerted on the walls.

(c) (i) There is less surface area in contact with the ground [1/2]. Hence pressure increases [1/2].

(ii) The air inside the tyre is compressed or volume of air inside the tyre decreases [1]. The number of air molecules per unit volume inside the tyre increases [1/2] and this increases the frequency of collision between the air molecules and the tyre [1]. Pressure inside the tyre increases [1/2].

OR

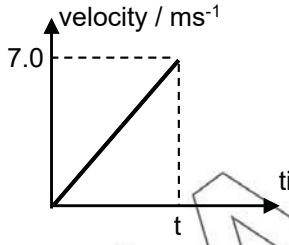
11. (a) (i) For an object in equilibrium, the sum of clockwise moment about a pivot is equal to the sum of anticlockwise moment about the same pivot. [1]

(ii) The clockwise moment due to spring balance is equal to the anticlockwise moment due to rock about pivot [1/2].

As moment = force x perpendicular distance [1/2], a larger perpendicular distance of spring balance from pivot enables a reading less than 20 N / smaller reading [1] to be recorded on the spring balance.

(iii) Clockwise moment about pivot = Anticlockwise moment about pivot
6.5 x 33.0 = W x 10.0 [1]
W = 21.45
= 21.5 N [1] 2 or 3 sf

(b)



Distance travelled = Area under the graph
2.5 = ½ x 7.0 x t [1]
t = 0.714 s [1] 2 or 3 sf

Assumption 1: The rock falls from rest / The initial velocity of the rock is 0 m/s. [1/2]
Assumption 2: The rock is experiencing free fall / accelerates constantly / there is no air resistance acting on the rock. [1/2]

(c) Work done on the rock = F x d
= 21.5 x 2.5 [1] ECF
= 53.8 J [1] 2 or 3 sf ECF