| Name: | | Index Number: | | Class: | |
|---|---|---|---|---|---|

# Preliminary Examination 3
# Secondary 4

## PHYSICS

**5059/01**

Paper 1 Multiple Choice

**19 September 2016**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

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

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 Answer Sheet.

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

For examiner's use only:

| Total | / 40 |
|---|---|

| Overall | Marks | % |
|---|---|---|
| Paper 1 | 40 | 37.5% |
| Paper 2A | 50 | 62.5% |
| Paper 2B | 30 | |

1 A plumber measures, as **accurately** as possible, the length and internal diameter of a straight copper pipe. The length is approximately 80 cm and the internal diameter is approximately 2 cm.

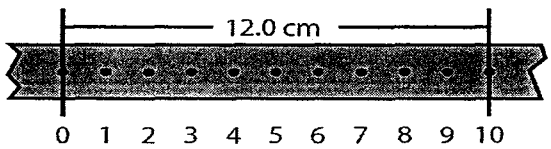
What is the best combination of instruments for the plumber to use?

| | internal diameter | length |
|---|---|---|
| **A** | rule | rule |
| **B** | rule | tape |
| **C** | vernier calipers | rule |
| **D** | vernier calipers | tape |

2 What is the correct unit for the quantity shown?

| | quantity | unit |
|---|---|---|
| **A** | electromotive force (e.m.f) | N |
| **B** | latent heat | J |
| **C** | pressure | kg $m^{-3}$ |
| **D** | weight | kg |

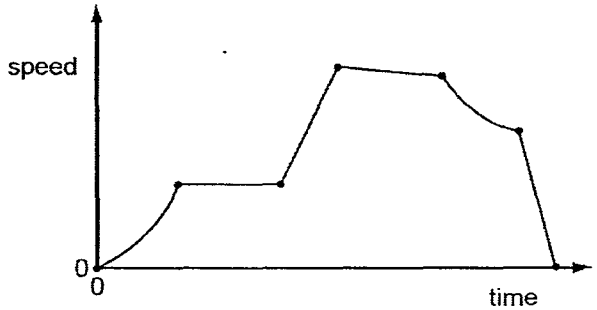
3 A student uses a ticker tape timer to investigate the movement of a trolley. Every second, the ticker tape timer puts 50 dots on the paper.
The tape looks like this.




Estimate the speed of the trolley.

**A** 0.24 cm $s^{-1}$ **B** 55 cm $s^{-1}$ **C** 60 cm $s^{-1}$ **D** 600 cm $s^{-1}$

4 The speed-time graph represents the journey of a car. The dots separate different sections of the journey. There are six different sections.




How many sections represent the car moving with non-uniform acceleration?

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

5 A car of mass 1500 kg is towing a trailer of mass 1100 kg along a level road. The acceleration of the car is 1.30 m $s^{-2}$.

Ignoring friction and air resistance, what is the driving force on the car?

**A** 1430 N **B** 1950 N **C** 2000 N **D** 3380 N

6 A hard stone hits the ground and comes to rest almost immediately.

As the stone hits the ground, what is the direction and the size of the force acting on the ground?

**A** downwards and equal to the weight of the stone
**B** downwards and larger than the weight of the stone
**C** upwards and equal to the weight of the stone
**D** upwards and larger than the weight of the stone

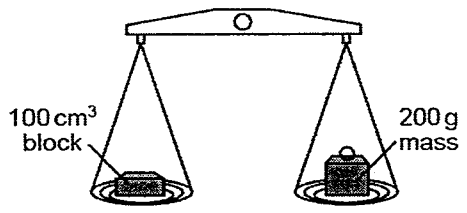
7 Which of the following correctly lists one scalar and one vector quantity?

| | scalar quantity | vector quantity |
|---|---|---|
| **A** | displacement | work |
| **B** | energy | force |
| **C** | force | acceleration |
| **D** | velocity | mass |

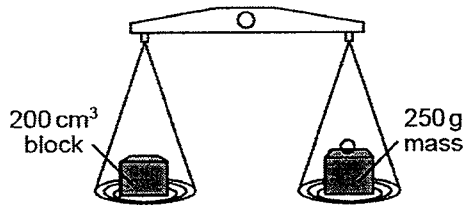
8 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams below.

In which diagram does the block have the greatest density?

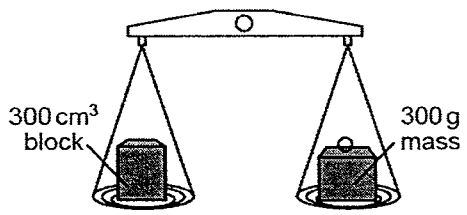
**A**



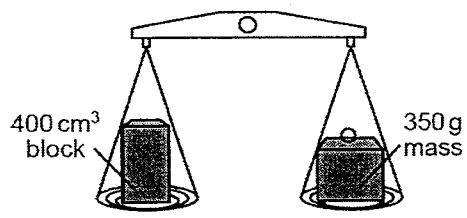

**B**



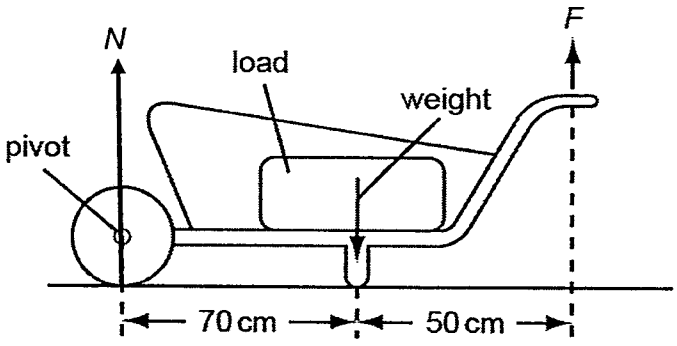

**C**




**D**



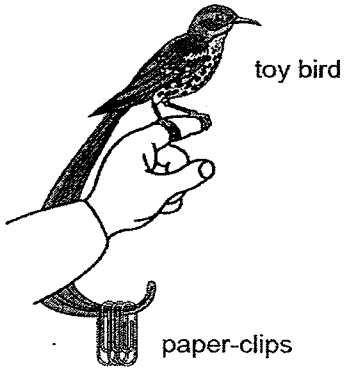
9 A load is to be moved using a wheelbarrow. The total mass of the load and wheelbarrow is 60 kg. The gravitational field strength is 10 N / kg.
The upward force *F* is applied such that the only normal contact force from the ground is acting at the wheel as shown by *N*.




What is the size of the normal force of the ground on the wheel *N*?

**A** 250 N **B** 350 N **C** 429 N **D** 840 N

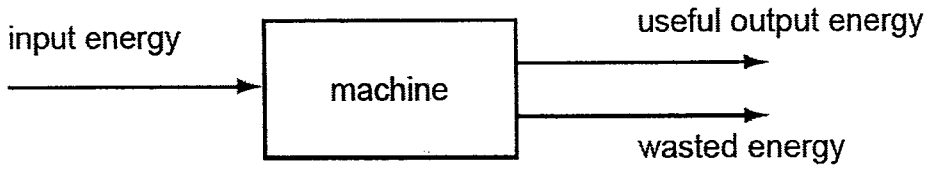
10 A girl uses paper-clips to balance a toy bird on her finger as shown.




What is the effect of the paper-clips?

**A** They help to raise the centre of gravity above her finger.
**B** They help to raise the centre of gravity to her finger.
**C** They help to lower the centre of gravity below her finger.
**D** They do not affect the centre of gravity but increase the weight.

**11** The diagram shows the energy transfer through a machine.




The machine is 50 % efficient.

Which is correct?

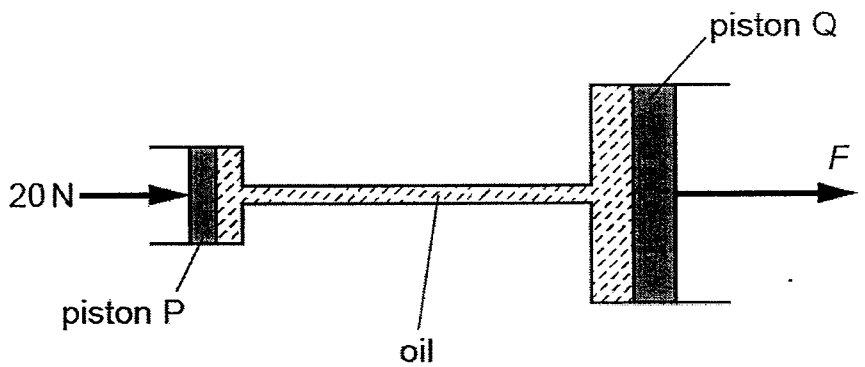
**A** input energy = useful output energy
**B** useful output energy = input energy + wasted energy
**C** wasted energy = input energy + useful output energy
**D** wasted energy = useful output energy

**12** A cyclist travels along a horizontal track at constant speed.

The work done by the cyclist is equal to

**A** the change in kinetic energy.
**B** the force of air resistance.
**C** the force of friction in the bicycle.
**D** the thermal energy (heat) produced.

**13** The diagram shows a simple model of the braking system of a car. A force of 20 N is applied to piston P. As a result, there is a force F on piston Q.

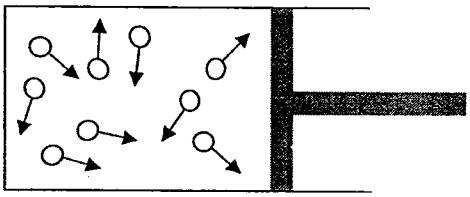



Piston P has an area of 5.0 $cm^2$ and piston Q has an area of 25 $cm^2$.

What is the force *F*?

**A** 4.0 N **B** 20 N **C** 100 N **D** 500 N

**14** Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the gas cylinder remains constant as the piston pushes outwards.



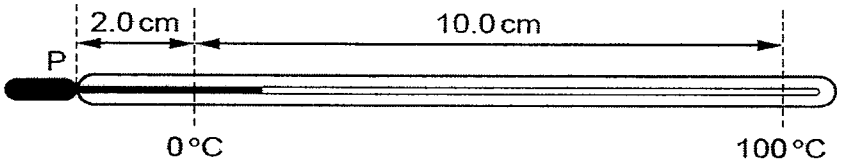
How do the speed of the gas molecules and the rate of collision with the piston compare with their initial values at the lower temperature?

| | Speed of molecules | Rate of Collision |
|---|---|---|
| **A** | greater | greater |
| **B** | greater | reduced |
| **C** | greater | same |
| **D** | same | greater |

**15** Which law or theory does Brownian Motion provide evidence for?

**A** Convection Currents
**B** Principle of Conservation of Energy
**C** Kinetic Model of Matter
**D** Pressure Law

**16** In a liquid-in-glass thermometer, the liquid column is 2.0 cm long at 0 °C and it expands by 10.0 cm when heated to 100 °C.




Measuring from P, how long is the liquid column at 30 °C?

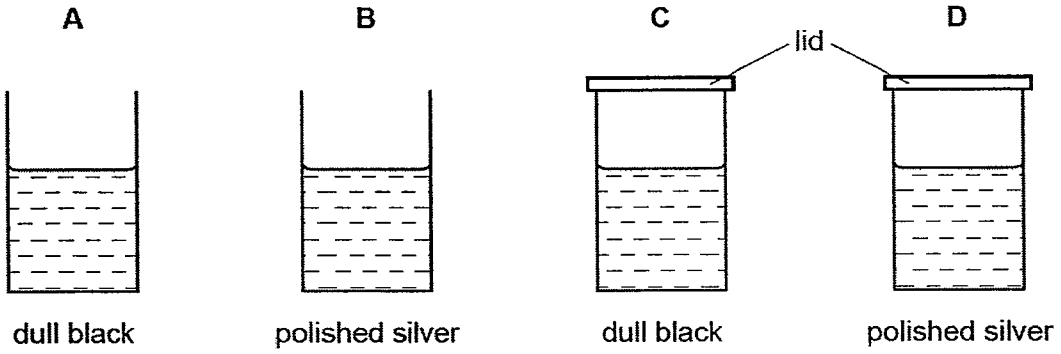
**A** 2.3 cm **B** 3.0 cm **C** 5.0 cm **D** 7.0 cm

**17** When calibrating a liquid-in-glass thermometer, which of the following steps is not needed?

**A** Choosing two fixed points.
**B** Choosing a thermometric property that varies uniformly.
**C** Ensuring that the room temperature is kept constant.
**D** Ensuring that the thermometer is calibrated at one atmospheric pressure.

**18** The diagrams show four identical cans with their outside surfaces painted either dull black or polished silver. Each can contains the same volume of water, initially at 80 °C.

After five minutes in a cool room, which can contains the coolest water?

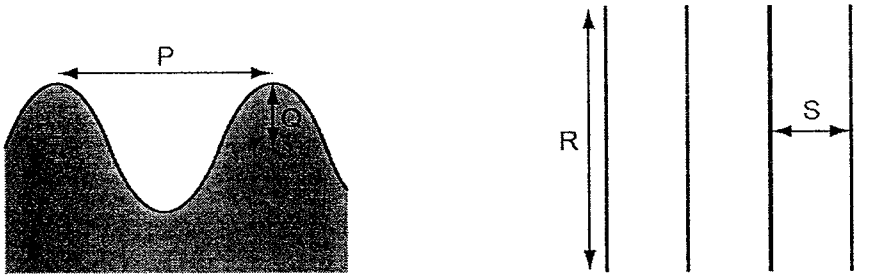



**19** 5 g of steam at 100 °C is passed into a beaker of water with 500 g of water at 10 °C.

Ignoring the heat capacity of the beaker, calculate the rise in temperature of the beaker of water.
(Specific heat capacity of water = 4.2 J $g^{-1}$ $K^{-1}$; specific latent heat of vaporisation of water = 2260 J $g^{-1}$)

**A** 6.2°C **B** 16.2 °C **C** 22.6°C **D** 77.4°C

**20** The diagrams show different views of a water wave in a ripple tank.




cross-section of wave

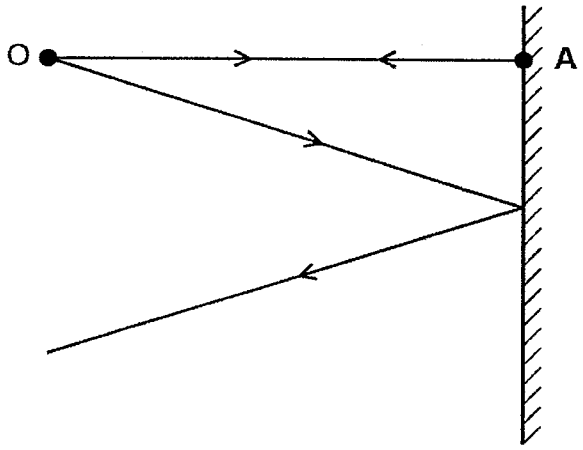
crests seen from above

Which letters represent a wavelength and a wavefront?

| | wavelength | wavefront |
|---|---|---|
| A | P | R |
| B | P | S |
| C | Q | R |
| D | Q | S |

**21** The diagram shows two divergent rays of light from an object O being reflected from a plane mirror.

At which position is the image formed?

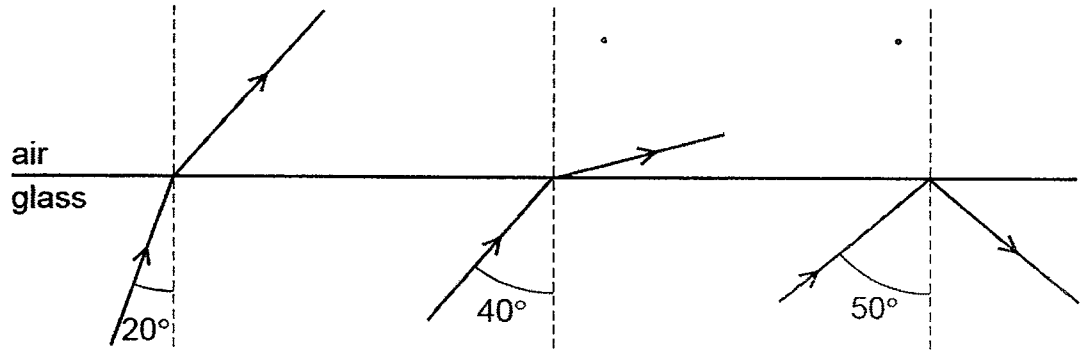



● B

● C

● D

**22** Three rays of light are incident on the boundary between a glass block and air. The angles of incidence are different.




What is a possible critical angle for light in the glass?

**A** 15° **B** 30° **C** 45° **D** 60°

**23** What is true for real images formed by a converging lens?

**A** They are always inverted
**B** They are on the same side of the lens as the object.
**C** They can never be shown on a screen.
**D** They cannot be seen by the human eye.

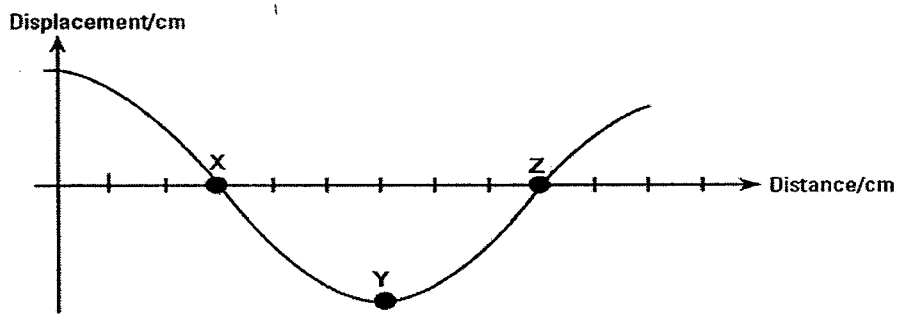
**24** Below are four statements about the use of electromagnetic radiation.

Electromagnetic waves are mechanical waves
Ultra-violet waves are used in sunbeds.
Microwaves are used in satellite TV
Infra-red rays are used in intruder alarms.

How many of the statements are correct?

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

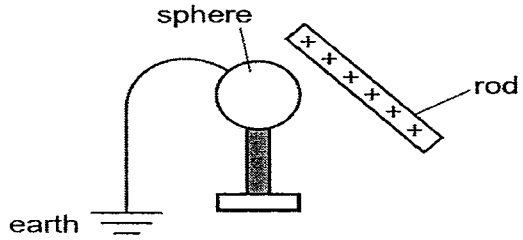
**25** The figure below shows the displacement-distance graph of a sound wave.
The sound wave is travelling to the right.
3 of the particles (X, Y and Z) in the sound wave are marked below.




Which particle(s) in the graph above is a centre of rarefaction?
(You may assume a displacement to the right as positive displacement and a displacement to the left as negative displacement.)

**A** Particle X
**B** Particle Y
**C** Particle Z
**D** Particles X and Z

**26** A positively charged rod is held close to an earthed metal sphere.




What describes the charge on the metal sphere?

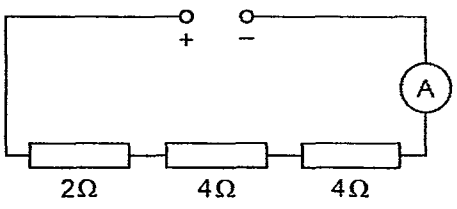
**A** It is negative because electrons are attracted towards the rod.
**B** It is neutral because electrons are attracted towards the rod and protons are repelled.
**C** It is neutral because it is earthed.
**D** It is positive because protons are repelled by the rod.

27 Why are birds able to stand on an overhead transmission line without suffering any harm?

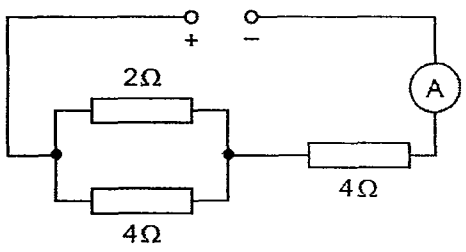
A Their bodies have very high resistance, thus current flowing through them is very small.
B Their feet are good insulators, such that no current can flow through them.
C Their spaces between their feathers act as insulators and, thus, little current flows through them.
D There is little or no potential difference between their feet, thus the current flowing through them is negligible.

28 An ammeter is connected to three resistors and a power supply.
Which arrangement of resistors gives the greatest ammeter reading?

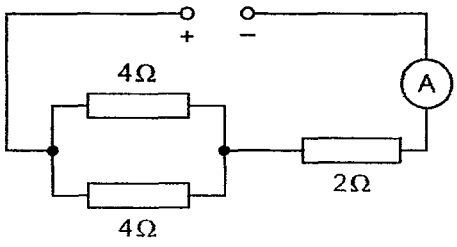
A



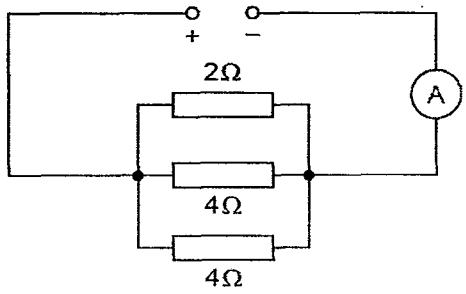

B




C




D




29 Which unit measures the energy input to an electrical appliance?

A ampere
B kilowatt-hour
C volt
D watt

30 What causes the fuse to blow in a mains electrical circuit?

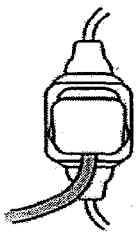
A a person touches the live wire
B a person touches the neutral wire
C the live wire touches the earth wire
D the neutral wire touches the earth wire

31 Voltage-current readings were obtained for different electrical components.

Which readings are for a 3 V, 0.06 A torch bulb?

| | | | | | |
|---|---|---|---|---|---|
| **A** | voltage / V | 0 | 1 | 2 | 3 |
| | current / mA | 0 | 6 | 12 | 18 |
| **B** | voltage / V | 0 | 1 | 2 | 3 |
| | current / mA | 0 | 25 | 45 | 60 |
| **C** | voltage / V | 0 | 1 | 2 | 3 |
| | current / mA | 0 | 20 | 40 | 60 |
| **D** | voltage / V | 0 | 1 | 2 | 3 |
| | current / mA | 0 | 10 | 20 | 30 |

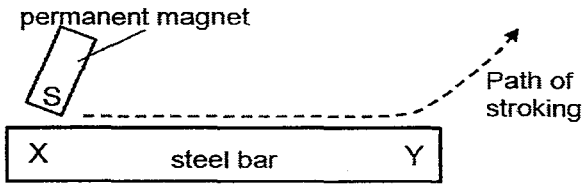
32 The diagram below shows how the plugs of several electric appliances are connected to an adaptor.



Which of the statements is incorrect?

**A** Current drawn is increased
**B** Voltage in the power source is increased
**C** Combined resistance is smaller than the smallest resistance used
**D** Energy consumption is high

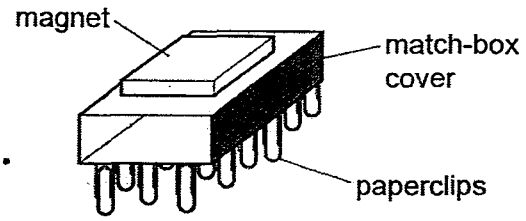
33 A piece of steel bar can be magnetised by stroking it with a piece of permanent magnet as shown.



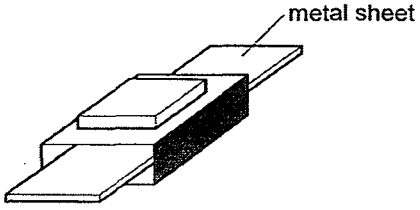

Which of the following shows the poles produced at X and Y?

| | X | Y |
|---|---|---|
| **A** | North | North |
| **B** | North | South |
| **C** | South | South |
| **D** | South | North |

34 A teacher sticks a magnet to the top surface of a match-box cover. The bottom surface is placed in a small tray of iron paperclips. As the match-box cover is lifted up, a large number of paperclips are held on the bottom surface.




Sheets of metal are placed inside the match-box cover, between the magnet and the paperclips.



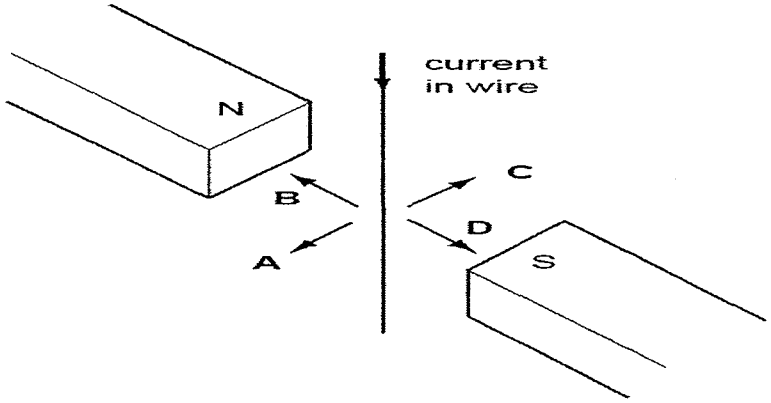

When sheet X is placed inside, the paperclips stay attached. When sheet Y is placed inside, all the paperclips fall off.

Which metals are the sheets made from?

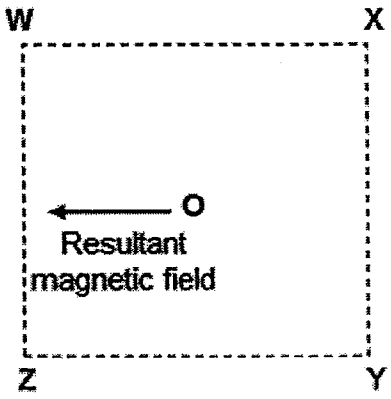
| | sheet X | sheet Y |
|---|---|---|
| **A** | aluminium | copper |
| **B** | copper | iron |
| **C** | iron | aluminium |
| **D** | iron | copper |

35 A wire hangs between the poles of a magnet.

When there is a current in the wire, in which direction does the wire move?



36 Four parallel conductors, carrying equal currents, pass vertically through the four corners of a square WXYZ. In two of the conductors, the current is flowing into the page, and in the other two, out of the page.

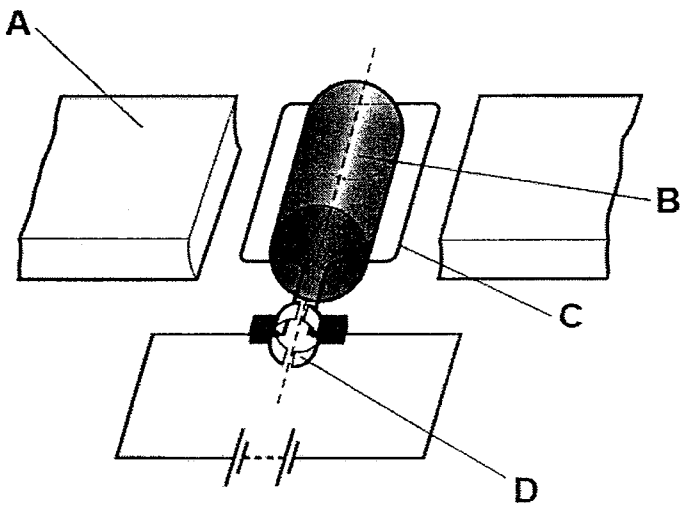



In what directions must the current flow in order to produce a resultant magnetic field in the direction shown at O, the centre of the square?

| | Into the page | Out of the page |
|---|---|---|
| **A** | W and X | Y and Z |
| **B** | W and Y | X and Z |
| **C** | W and Z | X and Y |
| **D** | X and Z | W and Y |

37 The diagram shows a simple d.c. motor.

Which labelled part is the commutator?

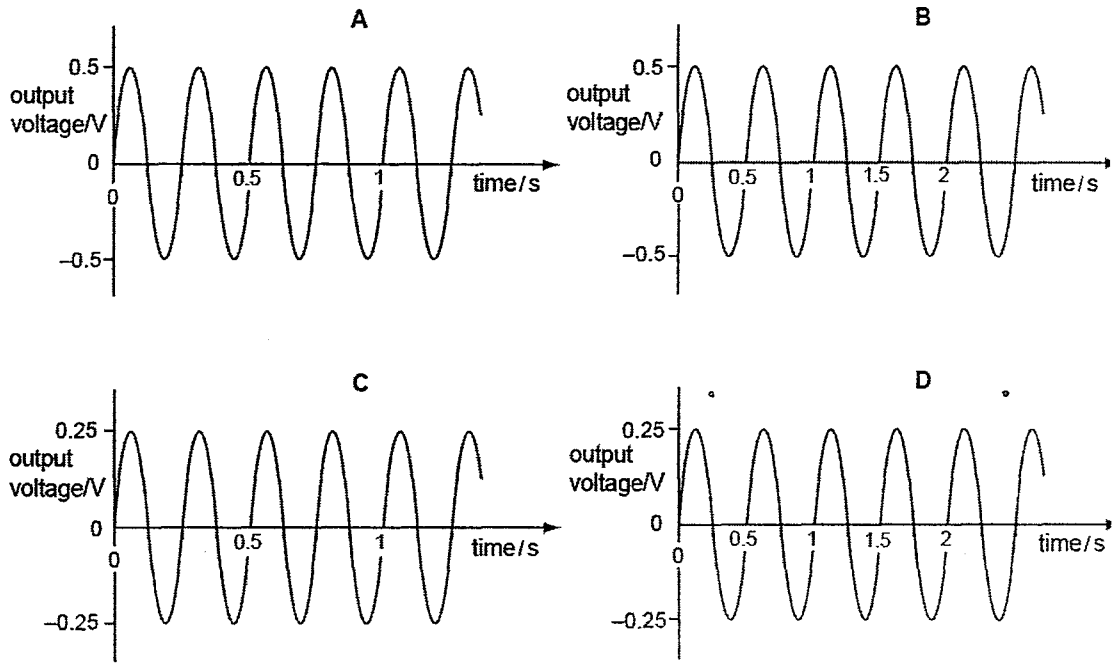


**38** What is used in a cathode-ray oscilloscope to cause the vertical movement of the trace?

**A** a horizontal electric field
**B** a horizontal magnetic field
**C** a vertical electric field
**D** a vertical magnetic field

**39** A girl turns the handle of a small a.c. generator four times each second. The generator produces a maximum output voltage of 0.5 V.

Which of the following graphs best shows this?




**40** Which one of the following does **not** affect the magnitude of induced e.m.f in a simple a.c generator?

**A** speed of rotation of coil
**B** resistance of rectangular coil
**C** distance between magnet and rectangular coil
**D** number of turns of coil per unit length

| Section 2A | ☐ s.f.<br>☐ formula | / 50 |
|---|---|---|

| Name: | | Index Number: | | Class: | |
|---|---|---|---|---|---|

# Preliminary Examination 3
# Secondary 4

## PHYSICS

**5059/02**

Paper 2 Theory

**13 September 2016**
**1 hour 45 minutes**

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

**READ THESE INSTRUCTIONS FIRST**

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

**Section A**
Answer **all** questions.

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

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

For examiner's use only:

| | |
|---|---|
| Section 2A | / 50 |
| Section 2B | / 30 |
| **Total** | **/ 80** |

| Overall weightings | Mark | % |
|---|---|---|
| Paper 1 | 40 | |
| Paper 2A | 50 | |
| Paper 2B | 30 | |

## Section A

For Examiner's Use

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

1 Fig. 1.1 shows a simple pendulum that oscillates between the points A and D with a period of 0.72 s.

Point B is the equilibrium position of the pendulum.

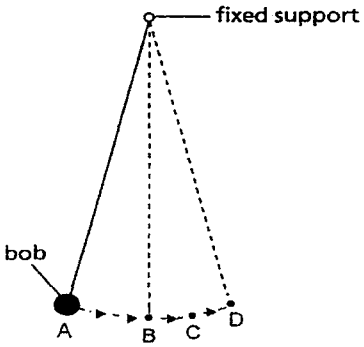



**Fig. 1.1**

**(a)** Explain what is meant by '*the period is 0.72 s*'.

.....

.....

[1]

**(b)** The bob is released from rest at point A. Determine the time required for it to reach point B.

time = .....

[1]

**(c)** Explain why a student measuring the period should start timing when the pendulum bob is at point B, instead of point A or D.

.....

.....

.....

.....

[2]

**(d)** State and explain the effect on the period if the simple pendulum in Fig. 1.1 is replaced with a uniform iron rod of the same length.

.....

.....

[2]

For Examiner's Use

2 A climber of weight 720 N is rappelling down a cliff. At the instant shown in Fig. 2.1, he is stationary and in a state of equilibrium.

The rope makes an angle of $\theta$ with the vertical, and the cliff exerts a force $F$ of 300 N on the feet of the climber. This force $F$ is directed at 22° above the horizontal.

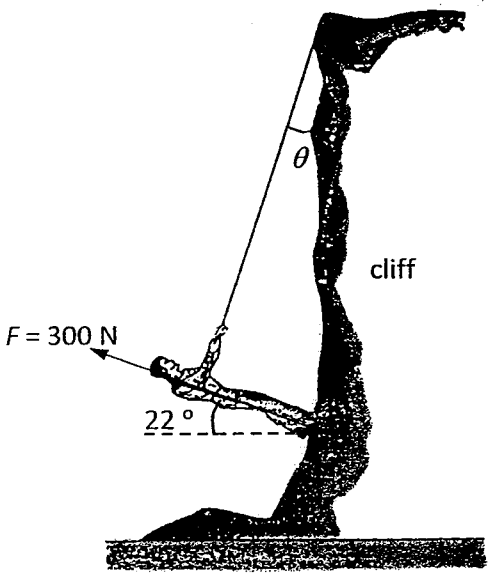



**Fig. 2.1**

**(a)** State the conditions for a body to be in equilibrium.

.....

.....

.....

..... [2]

**(b)** In the space below, draw a scaled diagram to show the forces acting on the climber.

Determine the magnitude of the tension in the rope, and the angle $\theta$ it makes with the vertical.

*For Examiner's Use*

tension = .....

$\theta$ = .....

[3]

**(c)** The force $F$ can be said to be the resultant of two forces acting on the climber. One of them is the normal contact force by the cliff on him.

State the other force that acts on the climber, and state its direction.

.....

..... [2]

For Examiner's Use

3 Fig. 3.1 shows a glass tube dipped into mercury. A vacuum pump is connected to the top of the tube and switched on. The mercury rises up the tube and stops.

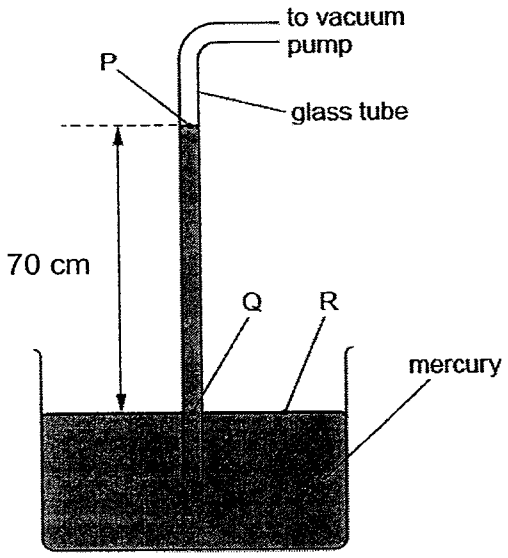



**Fig. 3.1**

**(a)** Three points on Fig. 3.1 are labelled P, Q and R.

State which of these point(s) is/are at atmospheric pressure.

..... [1]

**(b)** The density of mercury is 13 600 kg $m^{-3}$ and the gravitational field strength is 10 N $kg^{-1}$.

Calculate the pressure due to the 70 cm long column of mercury.

pressure = ..... [2]

**(c)** A student observes that the pressure calculated in **(b)** is lower than the atmospheric pressure. Suggest a reason for this.

..... [1]

**(d)** State and explain what happens if the mercury is replaced with water.

.....

.....

..... [2]

4 Fig. 4.1 below shows the structure of a simple periscope used at sporting events to see over the heads of the crowd.

For Examiner's Use

The critical angle of the material used in the prisms must be less than 45°.

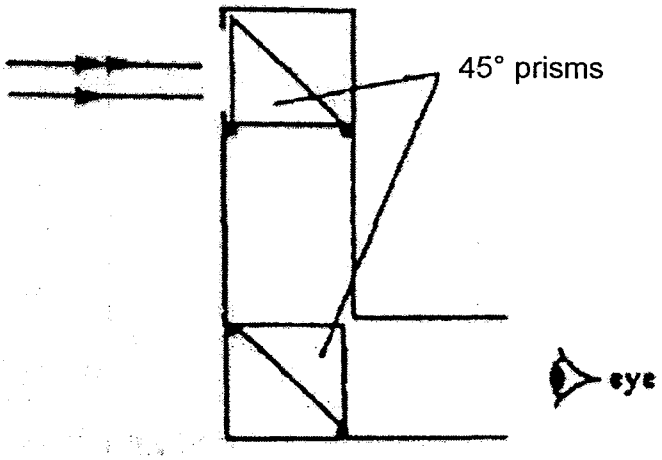



**Fig. 4.1**

**(a)** On Fig. 4.1, complete the paths of the two light rays through the periscope to the eye.

[2]

**(b)** Given that dispersion of light can occur in a prism, explain why light of different colours will take the same paths through the prism.

.....

.....

..... [2]

**(c)** Is the image right way up or inverted? Explain your answer.

.....

.....

..... [2]

**(d)** Determine the smallest possible refractive index for the material of the prisms.

smallest refractive index = ..... [2]

For Examiner's Use

5 Two identical large shallow dishes are filled with water at 30 °C as shown in Fig. 5.1.

Dish K is **covered** while dish L is not. A steady stream of air is blown over both dishes.

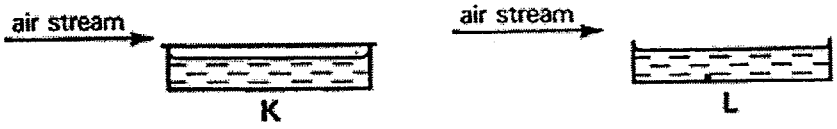



**Fig. 5.1**

**(a)** Using ideas about molecules, explain why

**(i)** the water in dish L cools down,

.....

.....

.....

..... [2]

**(ii)** the volume of water in dish L decreases more rapidly than that in dish K.

.....

.....

.....

..... [2]

**(b)** The water in dish L reaches 25 °C and is found to have a mass of 1.5 kg. Dish L is then placed in the freezer.

**(i)** The water cools from 25 °C to 0 °C in a time of 60 minutes. The specific heat capacity of water is 4.2 J $g^{-1}$ $°C^{-1}$.

Calculate the thermal energy removed from the water as it cools from 25 °C to 0 °C.

energy removed = ..... [2]

**(ii)** After the water has reached 0 °C, thermal energy is removed from the water at the same rate in **(b)(i)**.

The specific latent heat of fusion of water is $3.3 \times 10^5$ J $kg^{-1}$.

Calculate the mass of water at 0 °C that becomes ice in 60 minutes.

mass = ..... [2]

For Examiner's Use

6 Fig. 6.1 shows the wavefronts of a water wave in deep water in a ripple tank. The frequency of the water wave in deep water is 5.0 Hz.

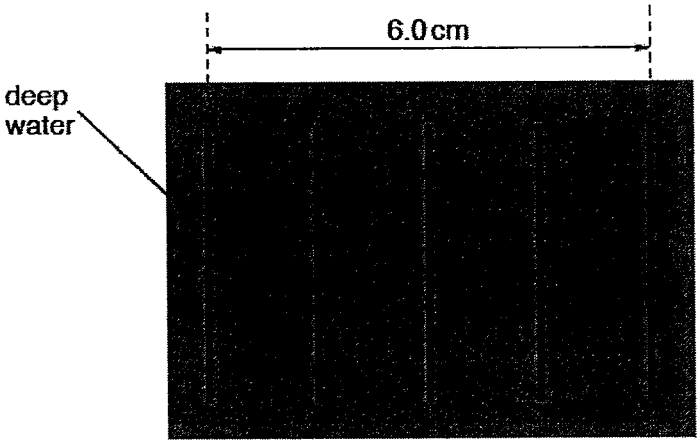



**Fig. 6.1**

**(a)** Explain what is meant by *wavefronts*.

.....

..... [1]

**(b)** Calculate the speed of the wave in deep water.

speed = ..... [3]

**(c)** The water wave passes from deep water into shallow water.

State and explain how this affects the wavelength of the wave.

.....

.....

.....

..... [2]

7 Fig. 7.1 shows two horizontal plates X and Y connected to a high potential difference source. An uncharged conducting sphere is introduced into the region between the plates as shown.

For Examiner's Use

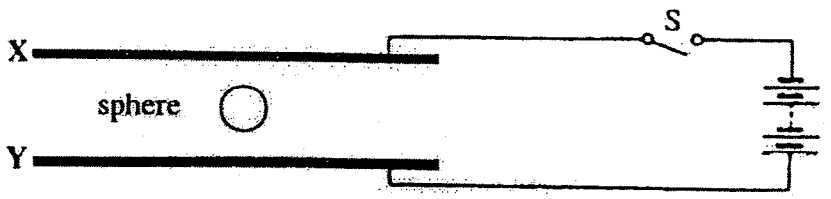



**Fig. 7.1**

**(a)** State the sign of the charges on each plate when the switch S is closed.

Plate X .....

Plate Y .....

[1]

**(b)** Indicate on Fig. 7.1 the charges induced on the conducting sphere.

[1]

**(c)** The sphere falls towards plate Y.

Explain why the fall takes place and state what happens to the charges on the sphere as it makes contact with plate Y.

.....

.....

.....

.....

..... [2]

For Examiner's Use

8 Fig. 8.1 shows the variation of the output voltage of an ideal transformer with time. The transformer has 100 turns on the primary coil and 200 turns on the secondary coil.

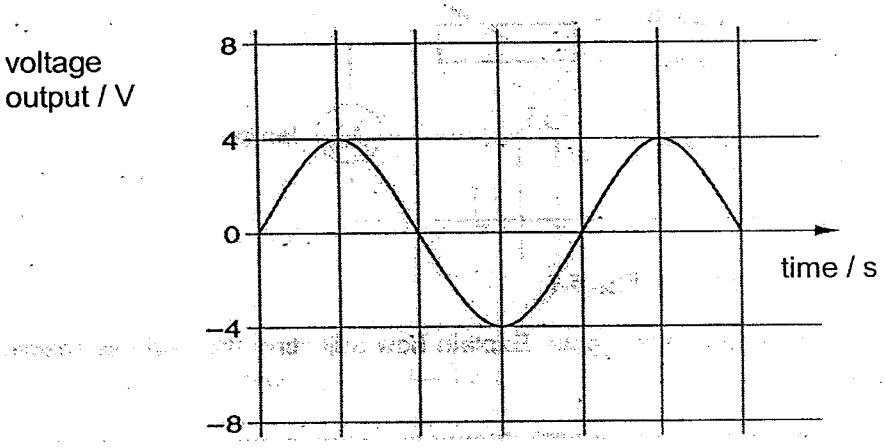



**Fig. 8.1**

**(a)** Explain what is meant by the transformer is *ideal*.

.....

..... [1]

**(b)** Draw on Fig. 8.1 the new output voltage, if the number of turns on the secondary coil is increased to 300 while that of the primary coil remains unchanged.

[2]

**(c)** The transformer is used to step up the voltage at the power station before the electrical power is supplied to homes and factories.

Explain why electrical power is transmitted at high voltage.

.....

.....

.....

..... [2]

**End of Section A**

| Name: | | Index Number: | | Class: | |
|---|---|---|---|---|---|

# Preliminary Examination 3
# Secondary 4

**PHYSICS** **5059/02**

Paper 2 Theory

**13 September 2016**
**1 hour 45 minutes**

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

## Section B

*For Examiner's Use*

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

Answer only one of the two alternative questions in **Question 11**.

**9** A bungee jumper falls from a bridge above a river, as shown in Fig. 9.1.

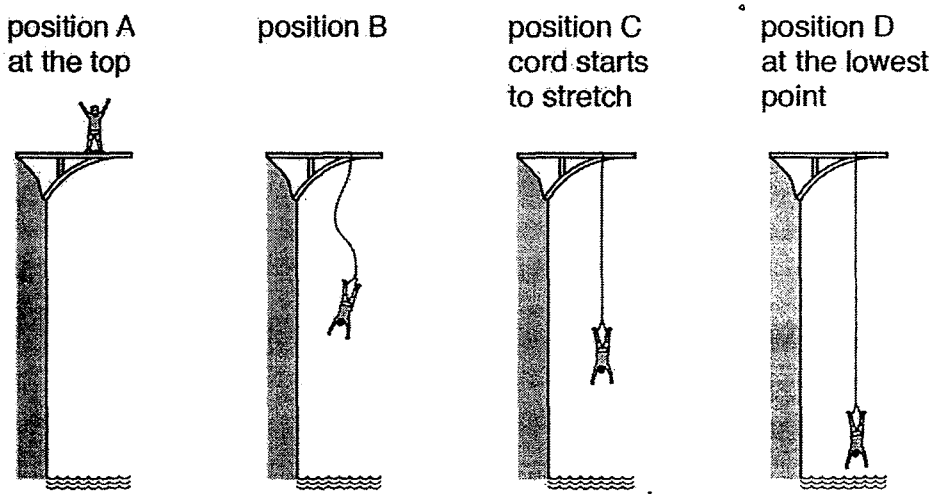



**Fig. 9.1 (not drawn to scale)**

The man starts from position A. The elastic cord starts to stretch at position C and he stops for the first time at position D. He continues to rise and fall after that.

For Examiner's Use

Fig. 9.2 shows how the velocity of the man varies with time $t$.

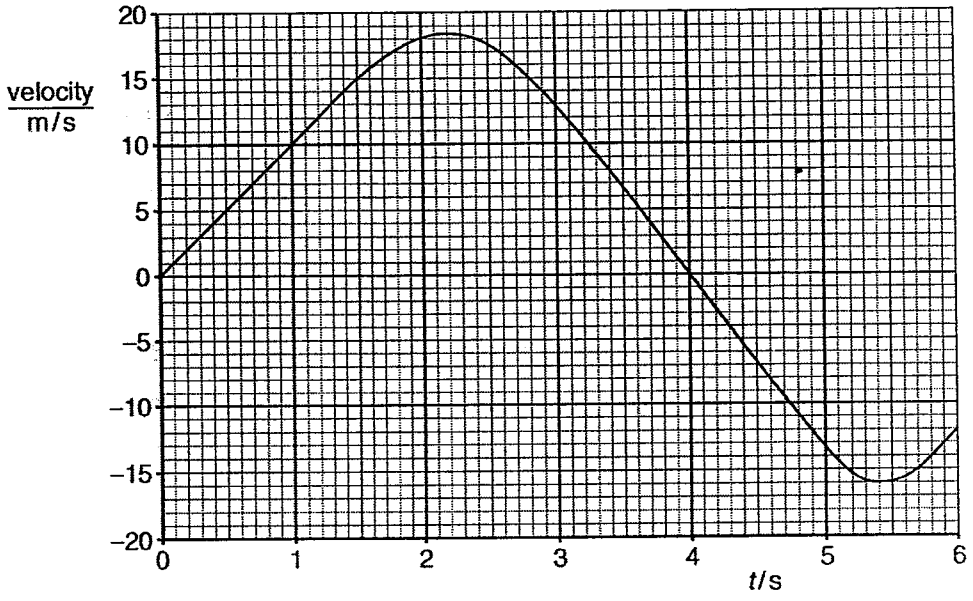



**Fig. 9.2**

**(a)** **(i)** State what is meant by *velocity*.

.....

..... [1]

**(ii)** State the difference between a positive velocity and a negative velocity.

..... [1]

**(b)** **(i)** State the **first** time interval for which the acceleration is uniform.

..... [1]

**(ii)** Using values from Fig. 9.2, determine the acceleration of the man for the time interval mentioned in **(b)(i)**.

acceleration = ..... [2]

**(iii)** Comment on your value of acceleration.

.....

..... [1]

**(c)** **(i)** State the value of $t$ when the man is at position D.

..... [1]

**(ii)** State and explain, in terms of the forces acting, the direction which the man is accelerating at position D.

.....

.....

.....

..... [3]

For Examiner's Use

**10** **(a)** State the *Principle of Conservation of Energy*.

.....

.....

..... [2]

**(b)** A worker needs to move a box of mass 40 kg from the ground to the back of a truck as shown in Fig. 10.1.

The box moves 5.0 m along the ramp, which is inclined at an angle of 20 ° to the horizontal. The ramp is assumed to be frictionless.

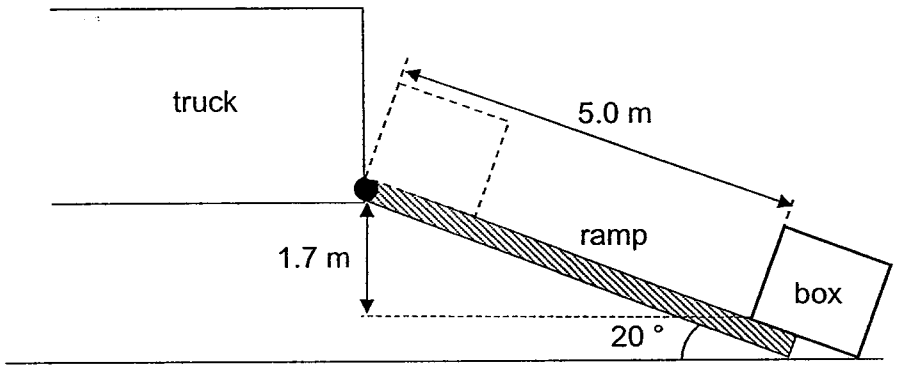



**Fig. 10.1**

**(i)** The worker gives a ***momentary*** push to the box to move it up the ramp.

Calculate the initial speed that the worker must impart to the box for it to reach the back of the truck. Take the gravitational field strength to be 10 N $kg^{-1}$.

speed = ..... [3]

**(ii)** State the advantage of pushing the box up the ramp with a constant force, instead of lifting it up directly onto the truck.

.....

..... [1]

For Examiner's Use

**(iii)** Another worker proposes using a longer ramp inclined at a smaller angle of 15 ° to the horizontal. He claims that less work need to be done to get the box into the truck.

Comment on his claim.

.....

.....

.....

..... [2]

**(c)** The truck in **(b)** accelerates uniformly, from a velocity of 2.0 m $s^{-1}$ to 5.0 m $s^{-1}$ in 3.0 s.

If the total mass of the truck and its contents is 2500 kg, calculate the additional work done by the engine in this time.

work done = ..... [2]

For Examiner's Use

**11 EITHER**

Fig. 11.1 shows an electromagnetic relay connected to a cell and a switch.

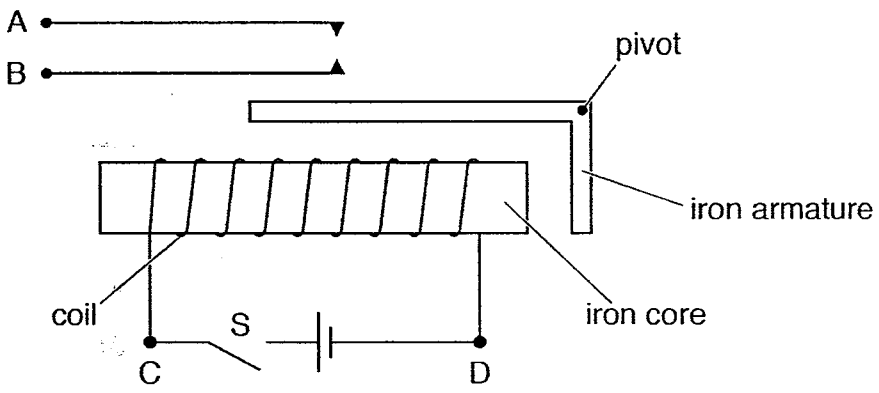



**Fig. 11.1**

**(a)** On Fig. 11.1, mark the north and south poles of the iron core when the switch S is closed.

[1]

**(b)** Explain how the relay is used to close the contacts between A and B.

.....

.....

.....

..... [2]

**(c)** Explain why the core is made of iron and not steel.

.....

.....

..... [2]

For Examiner's Use

**(d)** Fig. 11.2 shows the relay with its switch S and cell removed and connected to a circuit with a 12 V battery. The resistance of the thermistor, X decreases with temperature.

The coil has to close the contacts A and B for the bell to ring. The bell is not ringing at the instant shown.

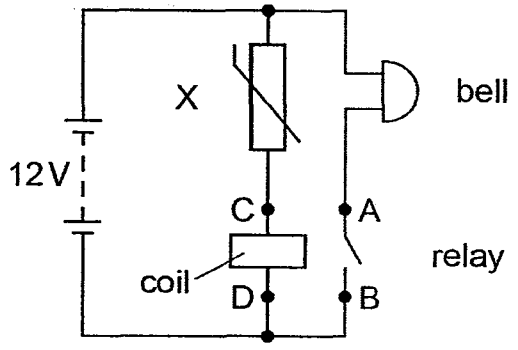



**Fig. 11.2**

**(i)** Explain why the bell rings when the temperature of the thermistor, X rises.

.....

.....

.....

..... [2]

**(ii)** When the resistance of X is 2000 Ω, the current flowing in the coil is 1.5 mA. This causes the contacts between A and B to close. The resistance of the bell is 200 Ω. Calculate

**1.** the potential difference across X,

potential difference = ..... [2]

**2.** the current in the battery.

current = ..... [1]

For Examiner's Use

**11 OR**

The vibrations of a guitar string are picked up by a small coil of wire wound round a cylindrical magnet as shown in Fig. 11.3.

The string is made from steel. When it vibrates, an electrical signal is generated between the terminals of the coil.

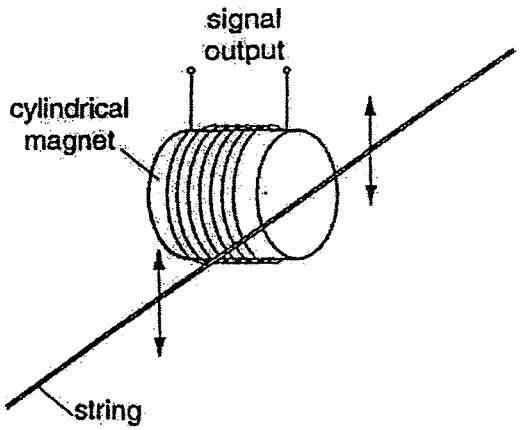



**Fig. 11.3**

**(a) (i)** State *Faraday's Law of Electromagnetic Induction.*

.....

.....

..... [2]

**(ii)** Use Faraday's Law to explain why an electrical signal is generated.

.....

.....

.....

..... [2]

**(iii)** Explain why no signal will be picked up if the guitar string is made from nylon.

.....

.....

..... [2]

**(b)** Fig. 11.4 shows the display on the C.R.O. screen when a signal from the guitar is fed into it. The time base on the screen is set to 2.0 ms/cm.

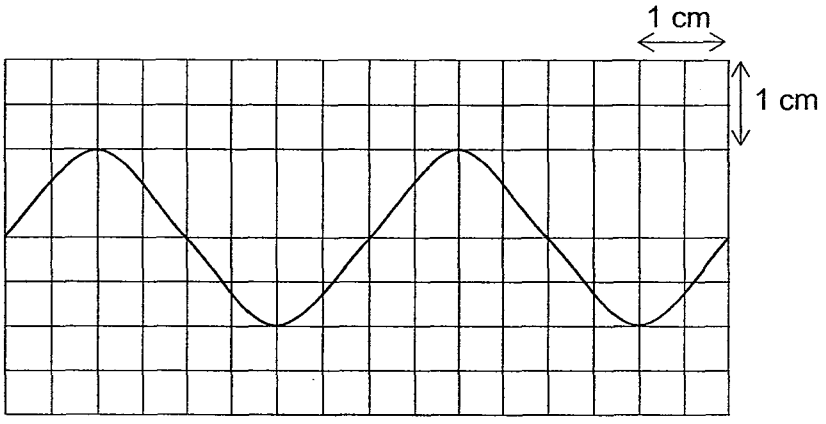



**Fig. 11.4**

**(i)** Calculate the frequency of the sound produced.

frequency = ..... [2]

**(ii)** Draw on Fig. 11.4 the signal displayed on the C.R.O. screen when the frequency of the sound is doubled and its loudness is halved.

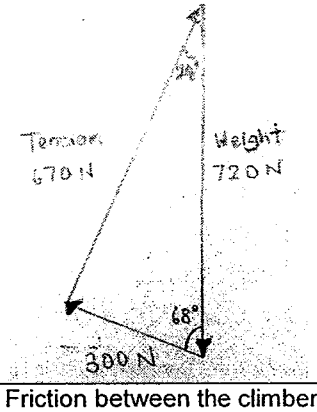
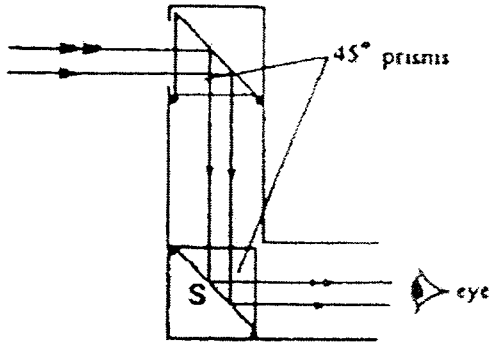
[2]

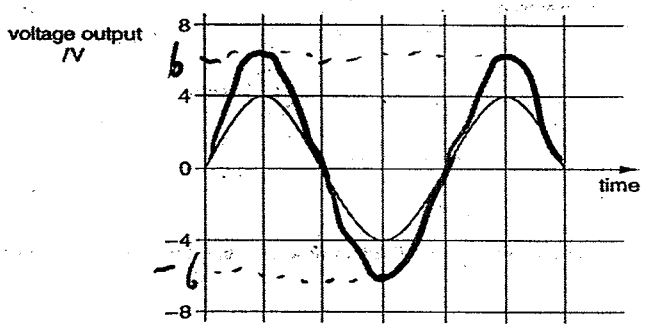
**End of Section B**

ANSWERS

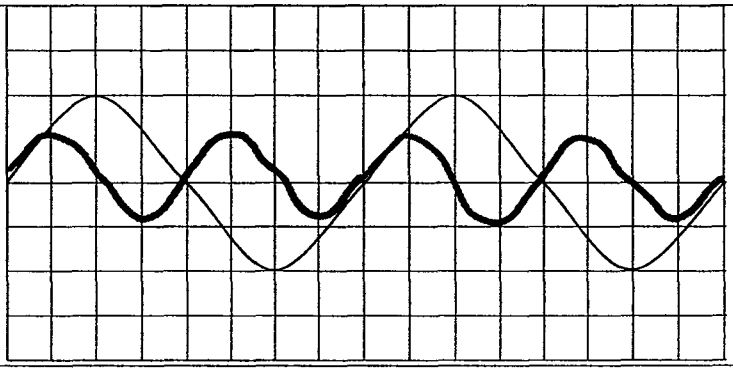
# 2016 – Physics Sec 4 Preliminary Examination 3

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

| | | | | |
|---|---|---|---|---|
| 1 | (a) | | The time for one complete oscillation is 0.72 s. | 1 |
| | (b) | | $\text{time} = \frac{0.72}{4} = 0.18\,\text{s}$ | 1 |
| | (c) | | The pendulum is momentarily at rest at points A and D. So the student will not know when exactly to start his stopwatch.<br>The pendulum bob moves with a non-zero speed at point B so the moment to start timing is more clearly defined. | 2 |
| | (d) | | The period will be shorter.<br>The mass distribution of the pendulum is changed with a uniform rod and its centre of gravity shifts nearer to the fixed support. | 2 |
| | | | | |
| 2 | (a) | | Resultant force on the body is zero.<br>Resultant moment about any point on the body is zero. | 2 |
| | (b) | |  <br>Scale<br>1.0 cm : 100 N<br><br>Tension = 670 N<br>$\Theta = 24°$ | 3 |
| | (c) | | Friction between the climber's feet and the cliff.<br>It is acting in the direction up the cliff. | 2 |
| | | | | |
| 3 | (a) | | Q and R | 1 |
| | (b) | | $P = h\rho g$<br>$= 0.70 \times 10 \times 13600$<br>$= 95200\,\text{Pa}$ | 2 |
| | (c) | | The vacuum pump cannot create a perfect vacuum in the glass tube. | 1 |
| | (d) | | The water column will be longer as water has a lower density so a longer column is required to exert the same pressure as mercury. | 2 |
| | | | | |
| 4 | (a) | |  | 2 |

| | | | | |
|---|---|---|---|---|
| | (b) | | There is no refraction as the light enters and leaves each prism. At the surfaces where total internal reflection occurs, the angle of incidence equals angle of reflection for all colours of light. So there is no dispersion of light. | 2 |
| | (c) | | Right way up. The first prism inverts and the second prism reinverts the image. | 2 |
| | (d) | | $c$ must be lesser than 45°.<br>$n > \frac{1}{\sin 45°}$<br>$n > 1.41$ | 2 |
| | | | | |
| 5 | (a) | (i) | The more energetic water molecules are able to escape from the water surface into the atmosphere. This causes the average kinetic energy of the remaining water molecules to decrease, leading to a decrease in temperature. | 2 |
| | | (ii) | In dish K, some of the escaped water molecules return back to the water due to collision with air particles. For dish L, the escaped water molecules are quickly swept away by the air stream. | 2 |
| | (b) | (i) | $Q = mc\Delta\theta$<br>$= 1.5 \times 4200 \times (25 - 0)$<br>$= 15800\ \text{J}$ | 2 |
| | | (ii) | $Pt = ml_f$<br>$m = \frac{157500}{60 \times 60} \times \frac{60 \times 60}{330000}$<br>$= 0.477\ \text{kg}$ | 2 |
| | | | | |
| 6 | (a) | | Imaginary lines joining adjacent points on the wave with the same phase. | 1 |
| | (b) | | $\lambda = \frac{0.060}{4} = 0.015\ \text{m}$<br>$v = f\lambda$<br>$= 5.0 \times 0.015$<br>$= 0.075\ \text{m s}^{-1}$ | 3 |
| | (c) | | The wavelength decreases. The wave speed slows down in shallow water and since the frequency of the wave remains unchanged, the wavelength of the waves must have decreased (as $v = f\lambda$). | 2 |
| | | | | |
| 7 | (a) | | Plate X: Negative, Plate Y: Positive | 1 |
| | (b) | |  | 1 |
| | (c) | | The sum of the weight of the sphere and the downward electrostatic force on the negatively charged region of the sphere is greater than the upward force on the positively charged region of the sphere.<br>The negative charges will flow from the sphere to Y on contact. | 2 |
| | | | | |
| 8 | (a) | | No power loss between the primary and secondary coils of the transformer. | 1 |
| | (b) | |  | 2 |

| | | | | |
|---|---|---|---|---|
| | (c) | | Transmitting at high voltage causes the current in the cables to be small (as $P = VI$). This reduces the power loss due to heating in the cables ($P_{Loss} = I^2R$). | 2 |
| | | | | |
| 9 | (a) | (i) | Rate of change of displacement. | 1 |
| | | (ii) | They are in opposite directions. | 1 |
| | (b) | (i) | 0 to 1.5 s | 1 |
| | | (ii) | $a = \frac{v-u}{t}$<br>$= \frac{15-0}{1.5}$<br>$= 10\ \text{m s}^{-2}$ | 2 |
| | | (iii) | Equal to acceleration of free fall as the man's velocity is low so air resistance is negligible. | 1 |
| | (c) | (i) | 4.0 s | 1 |
| | | (ii) | The tension in the cord causes an upward force to act on him and this force increases as he is moving downwards. At D, this upward force is greater than his weight which is acting downwards, thus his acceleration is upwards. | 3 |
| | | | | |
| 10 | (a) | | Energy can neither be created nor destroyed. It can be transformed or transferred but the total amount in any (isolated) system must remain constant. | 2 |
| | (b) | (i) | By Principle of Conservation of Energy<br>$\frac{1}{2}mv^2 = mgh$<br>$v = \sqrt{2gh}$<br>$= \sqrt{2 \times 10 \times 1.7}$<br>$= 5.8\ \text{m s}^{-1}$ | 3 |
| | | (ii) | Less force is required to push the box up the ramp. | 1 |
| | | (iii) | Not true as the smaller force required to push the box up the ramp has to be applied over a larger distance (longer ramp). The work done should be the same by the principle of conservation of energy. | 2 |
| | (c) | | $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$<br>$= \frac{1}{2}(2500)(5.0^2 - 2.0^2)$<br>$= 26300\ \text{J}$ | 2 |
| | | | | |
| 11 | Either | | | |
| | (a) | | N S | 1 |
| | (b) | | The iron core attracts the iron armature towards its S-pole when the switch is closed. This causes the armature to turn clockwise about its pivot and push the contacts A and B together. | 2 |
| | (c) | | Iron retains its magnetism so the iron armature will still be attracted to the core even when the switch is opened. Thus the contacts A and B will not be apart. | 2 |
| | (d) | (i) | As the temperature of X (thermistor) rises, its resistance decreases, which causes the current through the coil to increase. This strongly magnetises the coil and closes the contacts A and B. | 2 |
| | | (ii) | $V = IR$<br>$= 0.0015 \times 2000$<br>$= 3.0\ \text{V}$ | 2 |

| | | | | |
|---|---|---|---|---|
| | | (iii) | $I = \text{sum of currents through the two branches}$<br>$= 0.0015 + \frac{V}{R_{bell}}$<br>$= 0.0015 + \frac{12}{200} = 0.062\ \text{A}$ | 1 |
| | | | | |
| 11 | OR | | | |
| | (a) | (i) | The magnitude of the induced emf in a circuit is directly proportional to the rate of change of magnetic flux linkage in the circuit. | 2 |
| | | (ii) | The cylindrical magnet magnetises the steel string. When the steel string vibrates, its magnetic field cuts the coil of wire, producing a continuously changing magnetic flux linkage in the coil. By Faraday's law, an emf which causes the signal is induced. | 2 |
| | | (iii) | Nylon is not a magnetic material so it cannot be magnetised.<br>There is no changing magnetic field to cause a change in magnetic flux linkage in the coil. | 2 |
| | (b) | (i) | $\text{Period} = 4 \times 0.002$<br>$= 0.0080\ \text{ms}$<br>$f = \frac{1}{T}$<br>$= \frac{1}{0.0080}$<br>$= 125\ \text{Hz}$ | 2 |
| | | (ii) |  | 2 |
| | | | | |