Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

Where…… discernment, discipline, daring, determination & duty become a part of life.

PRELIMINARY EXAMINATION 2018

SEC 4 EXPRESS

PHYSICS (REVISED) 6091 PAPER 1

1 hour
0800 – 0900 h

7 August 2018
Tuesday

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighter, glue or correction fluid.
Write your name and index number and class on the Answer Sheet in the spaces provided unless this has been done for you.

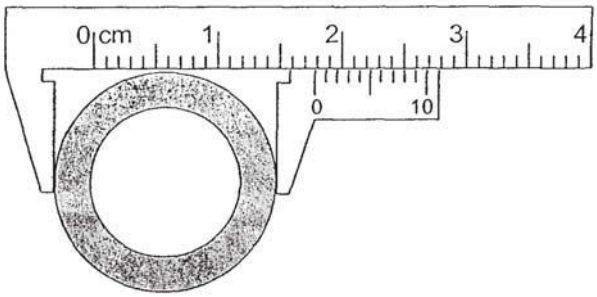
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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.

This question paper consists of **17** printed pages including the cover page.

1 The diagram below shows a pair of vernier calipers set to measure a metal pipe. Given that the pipe has an internal diameter of 10.2 mm, what is the thickness of the wall of the metal pipe?



A 2.8 mm **B** 3.8 mm **C** 5.6 mm **D** 7.6 mm

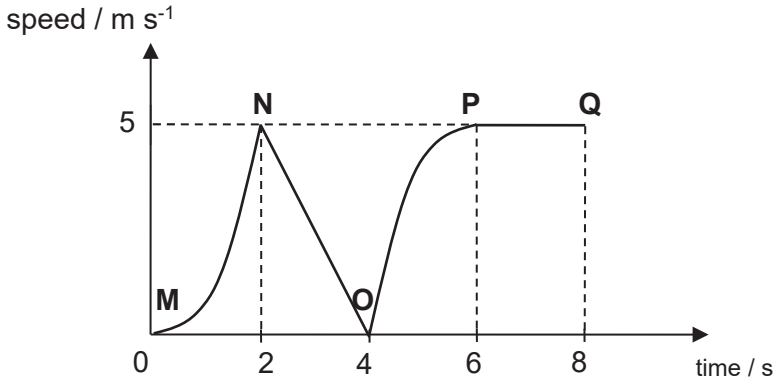
2 The following statements describe various motions.

1. A plane flies due North for 500 km.
2. A tourist travels 100 km on a journey.
3. A snail crawls at 3 mm/s in a straight line towards a carrot.
4. A runner's average speed in a race around a track is 5 m/s.

Which statements describe vector quantities?

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

3 The velocity-time graph for a moving object is shown below.

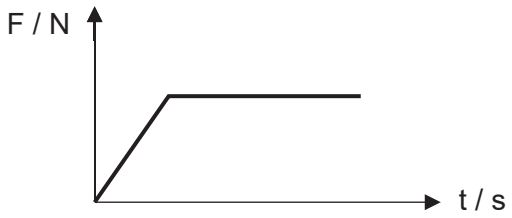


In which region is the acceleration uniform?

A **M** to **N** **B** **N** to **O** **C** **O** to **P** **D** **P** to **Q**

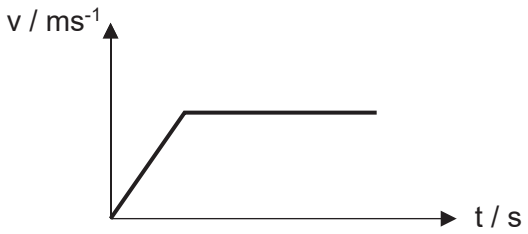
[Turn over

4 A graph of resultant force of a moving car against time is plotted as shown below.

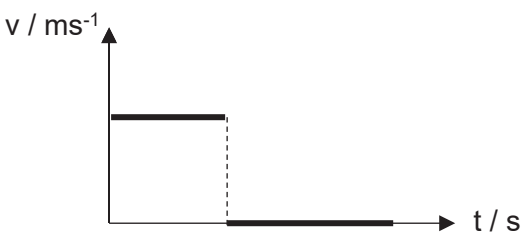


Which of the following velocity-time graphs shows the velocity of the car?

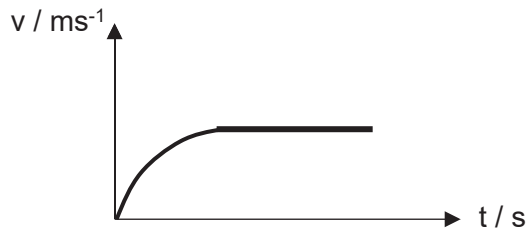
A



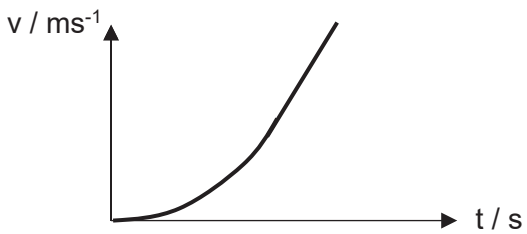
B



C



D



5 Only 2 forces act on an object. If the object is in equilibrium, which of the following condition(s) is/are required?

1 The 2 forces have the same magnitude.
2 The 2 forces are opposite in direction.
3 The 2 forces are in the same direction.
4 The 2 forces are of the same type.

A 1 and 2 only
B 1 and 3 only
C 3 and 4 only
D 1, 2 and 4 only

6 A cyclist is riding at a steady speed on a level road.

According to Newton's Third Law of motion, what is the equal and opposite force to the backward push of the back wheel on the road?

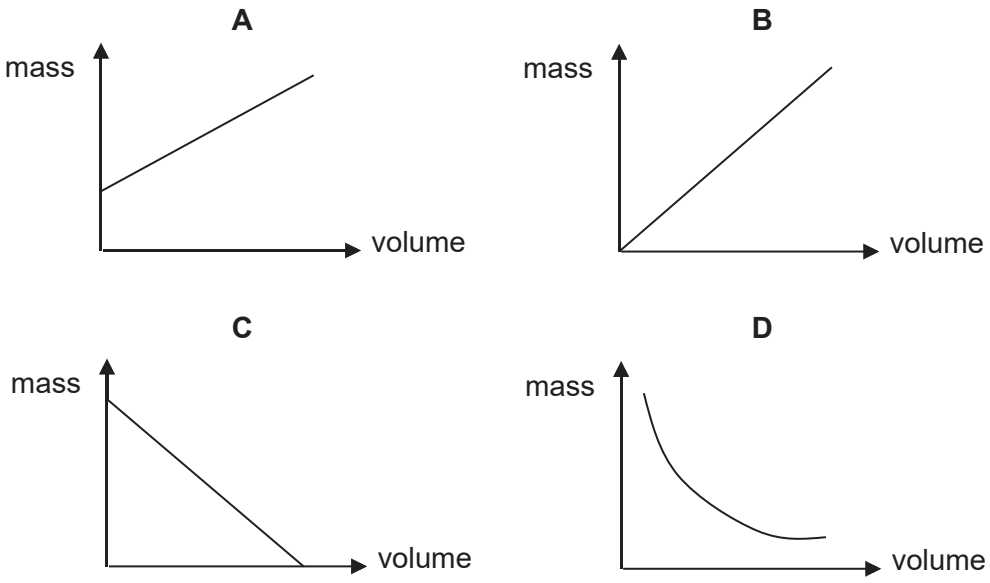
A the tension in the cycle chain

B the total air resistance and frictional force

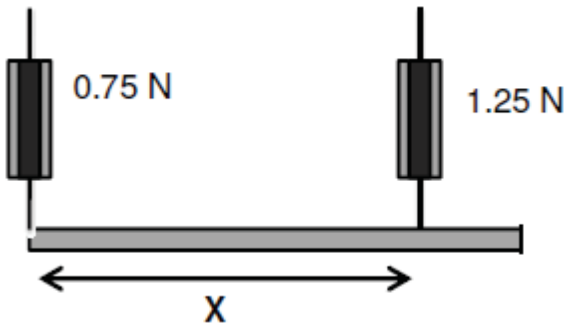
C the force exerted by the cyclist on the pedals

D the forward push of the road on the back wheel

7 Some students measure the masses and volumes of different sized samples of a type of wood. Which graph shows their results?



8 The diagram below shows a uniform metre rule of weight 2.00 N suspended by two spring balances. The tensions on the spring balances are 0.75 N and 1.25 N respectively.

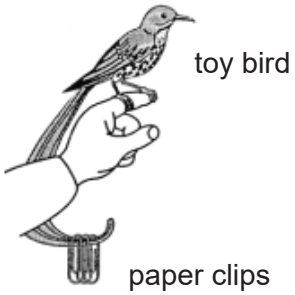


Determine **X**, the distance between the two springs.

A 0.60 m **B** 0.70 m **C** 0.80 m **D** 0.90 m

[Turn over

9 Nathan uses paper clips to balance a toy bird on his finger as shown.



What is the effect of the paper clips?

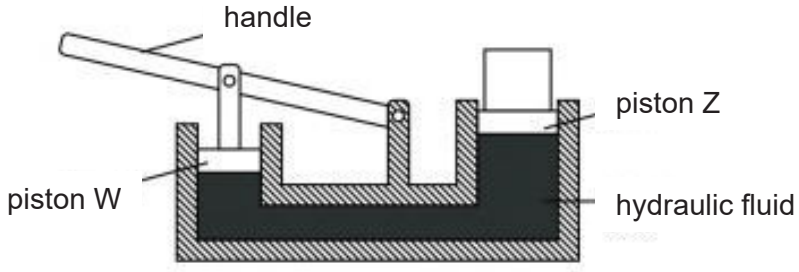
A They help to raise the centre of gravity above his finger.

B They help to raise the centre of gravity to his finger.

C They help to lower the centre of gravity to below his finger.

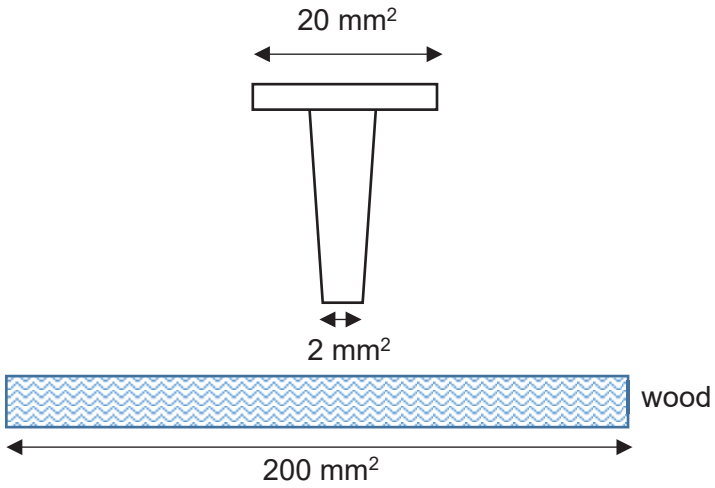
D They do not affect the centre of gravity but increase the weight.

10 The diagram below shows a simple hydraulic jack. Which of the following changes will enable heavier loads to be lifted?



	diameter of W	diameter of Z
A	doubled	remains the same
B	doubled	halved
C	remains the same	halved
D	halved	doubled

11 The diagram shows a nail being knocked into a piece of wood with a force of 60 N.



What is the pressure on the wood?

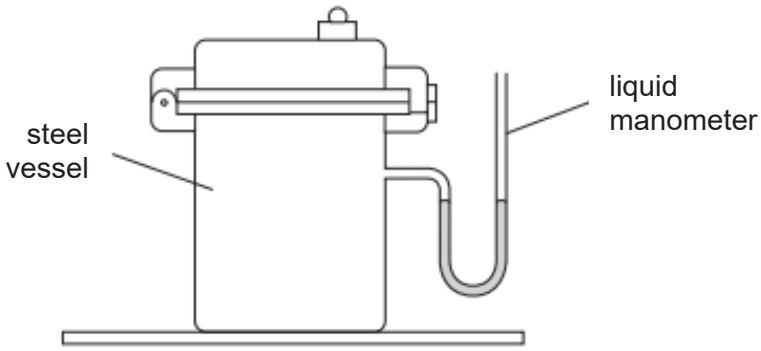
A 30×10 Pa

B 30×10^2 Pa

C 30×10^3 Pa

D 30×10^6 Pa

12 A manometer is used to indicate the pressure in a steel vessel, as shown in the diagram below.



Which option describes the pressure in the vessel as indicated by the liquid manometer?

A It is zero.

B It is between zero and atmospheric pressure.

C It is equal to atmospheric pressure.

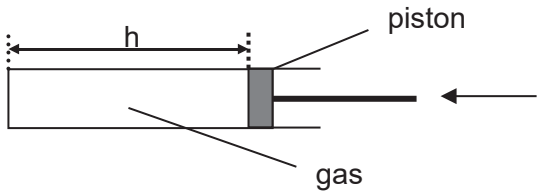
D It is greater than atmospheric pressure.

13 A force of 5.0 N exerted on an object causes it to accelerate from a velocity of 0 m/s to 8 m/s in 10 s.

Determine the power of this force.

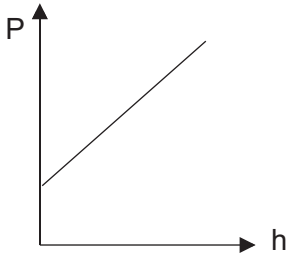
A 0.40 W **B** 2.0 W **C** 20 W **D** 40 W

14 A column of gas is slowly compressed as shown in the diagram.

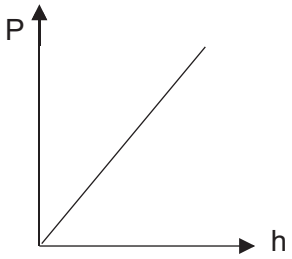


Which of the following graphs correctly shows the relation between the gas pressure P and the length of the gas column h?

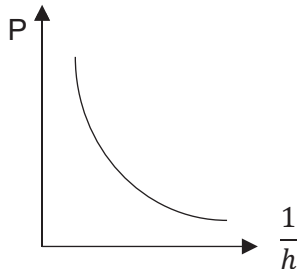
A



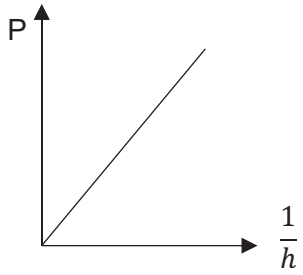
B



C



D



15 The outer surface of an electric kettle is always kept polished and shiny. What is the purpose of this?

A to stop energy loss by conduction

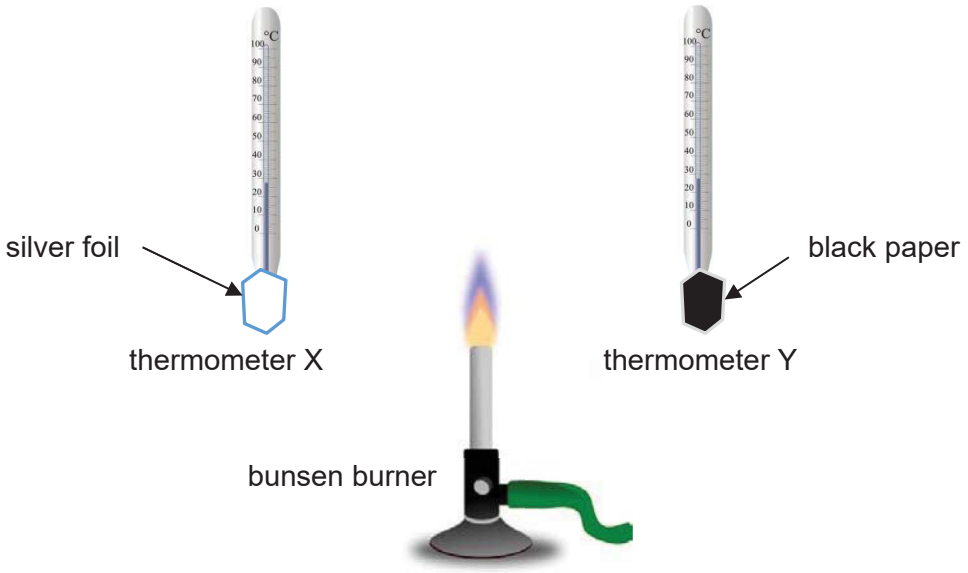
B to be a poor emitter so as to reduce energy loss

C to reduce energy loss by thermal conduction

D to reflect any radiation incident on its outer surface

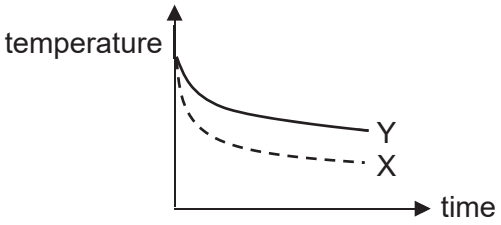
[Turn over

16 The diagram below shows two thermometers, X and Y held at the same distance away from a lighted Bunsen burner. The bulb of thermometer X is wrapped with a silver foil while the bulb of thermometer Y is wrapped with a black paper.

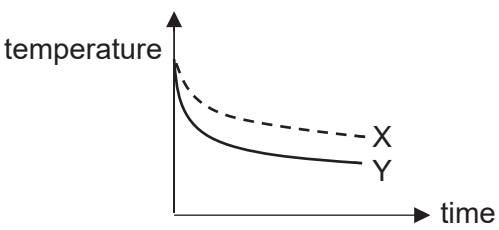


Which of the following graphs show the correct change in temperature of the two thermometers?

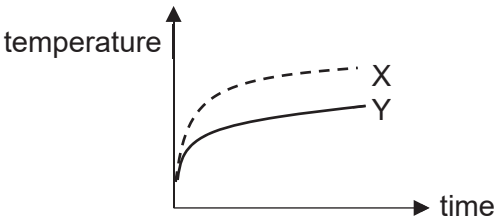
A



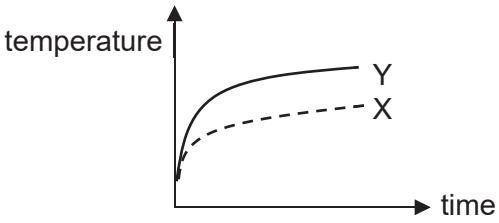
B



C



D



17 When calibrating a thermocouple thermometer, one of its junctions is immersed in melting ice while the other is kept in boiling water. The current reading on the micro-ammeter is 200 μA. If the "hot junction" is immersed in substance X and the reading is 20 μA, what is the temperature of substance X?

A – 20 °C **B** – 10 °C **C** 10 °C **D** 20 °C

[Turn over

18 The same quantity of thermal energy is applied to four different blocks.
The temperature rise produced is shown on each block.
Which block has the highest heat capacity?

A

temperature rise of 3 °C

B

temperature rise of 6 °C

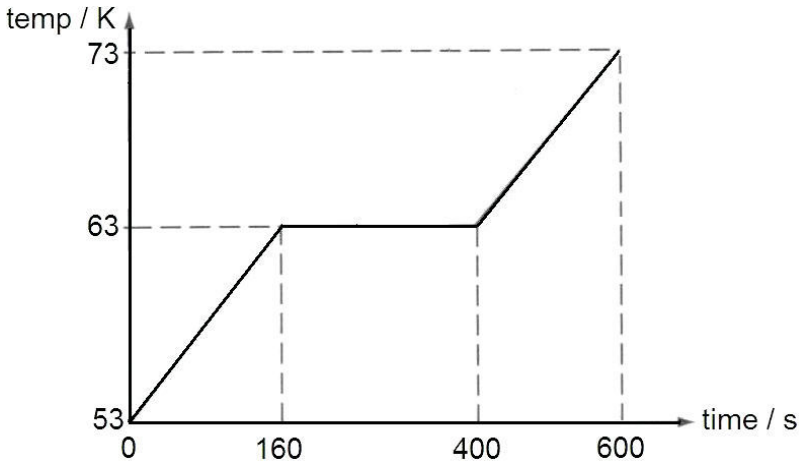
C

temperature rise of 9 °C

D

temperature rise of 18 °C

19 The graph below refers to an experiment in which an initially solid specimen of nitrogen absorbs heat at a constant rate. Solid nitrogen has a specific heat capacity of 1.6×10^3 J / kg K and melts at 63 K.



Which of the following are the specific latent heat of fusion and specific heat capacity of liquid nitrogen respectively?

	specific latent heat of fusion	specific heat capacity of liquid nitrogen
A	4.0×10^4 J / kg	1.6×10^3 J / kg K
B	2.4×10^4 J / kg	2.0×10^3 J / kg K
C	1.6×10^4 J / kg	1.6×10^3 J / kg K
D	2.4×10^4 J / kg	6.0×10^3 J / kg K

[Turn over

20 Substance K consists of particles that are close together and sliding past each other randomly. The average speed of the particles in substance K is also gradually increasing.

Which of the following best describes the substance?

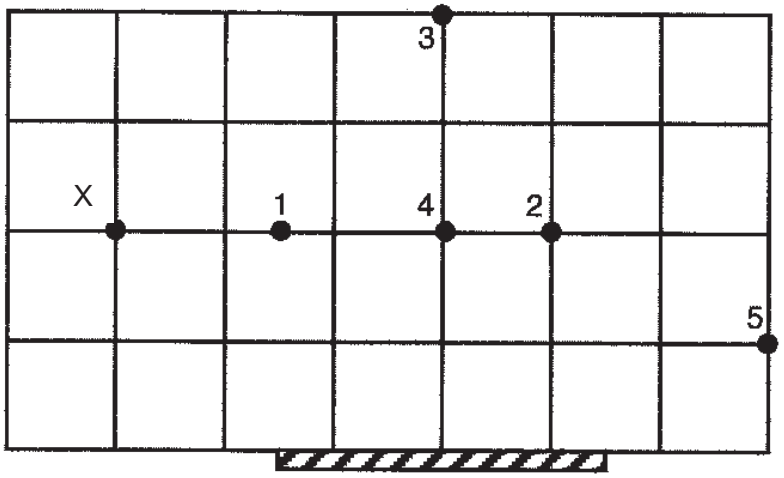
A Substance K is a liquid boiling.

B Substance K is a liquid being heated.

C Substance K is a solid melting.

D Substance K is a solid being heated.

21 A person stands at point X as shown in the diagram below.



Which of the pins (1, 2, 3, 4, 5) will the person be able to see in the mirror?

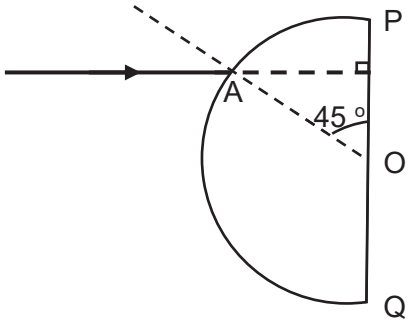
A pins 1 and 3

B pins 2 and 4

C pins 2, 3 and 5

D pins 2, 4 and 5

22 Fig. shows a semicircular glass slab with centre O and critical angle of 45 °.



What happens when a ray of light, perpendicular to the diameter POQ, is incident at A?

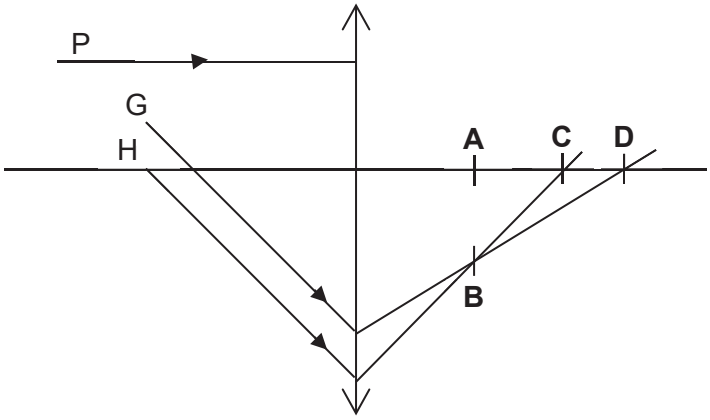
A The light ray emerges as O.

B Total internal reflection occurs at O.

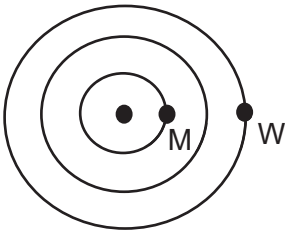
C The light ray emerges at some point between O and P.

D Total internal reflection occurs at some point between O and P.

23 Two parallel rays of light G and H passes through a converging lens as shown below. Which point will ray P pass through?



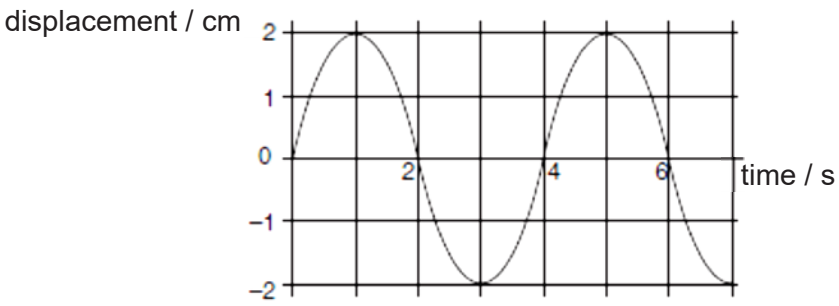
24 A pebble is dropped into still water so that the circular wavefronts are seen to travel outwards with a speed of v. If the wavelength is λ, what is the time taken for the disturbance at M to reach W?



A λ / v **B** λ / 2v **C** 3λ / 2v **D** 2λ / v

[Turn over

25 The graph shows how the displacement of a particle in a wave varies with time.



Which of the following is correct?

A The wave has an amplitude of 2 cm and can be either transverse or longitudinal.

B The wave has an amplitude of 4 cm and can be either transverse or longitudinal.

C The wave has an amplitude of 2 cm and can only be transverse.

D The wave has an amplitude of 4 cm and can only be transverse.

26 The diagram below shows different regions of the electromagnetic spectrum.

radio waves		Z	visible light			gamma rays

Which of the statements below is true of the radiation found in region Z?

A It has a higher speed in glass than in air.

B It has a lower frequency than radio waves.

C It can be used in a remote controller.

D It has a smaller wavelength than gamma rays.

27 Infrared radiation has wavelengths between 700 nm to 1.0 mm.

What is the maximum frequency of infrared radiation in vacuum?

A 3.0×10^{8} Hz

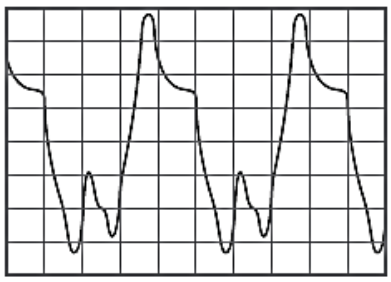
B 3.0×10^{11} Hz

C 4.29×10^{11} Hz

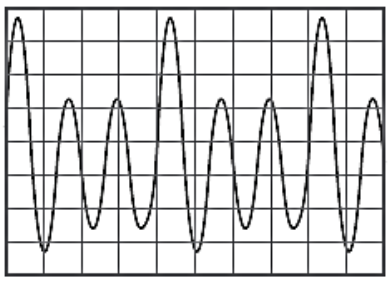
D 4.29×10^{14} Hz

[Turn over

28 Waveforms are shown on a cathode-ray oscilloscope for a flute and a guitar. The oscilloscope settings are the same for both waveforms.



flute



guitar

What is/are the similarities between the two sounds?

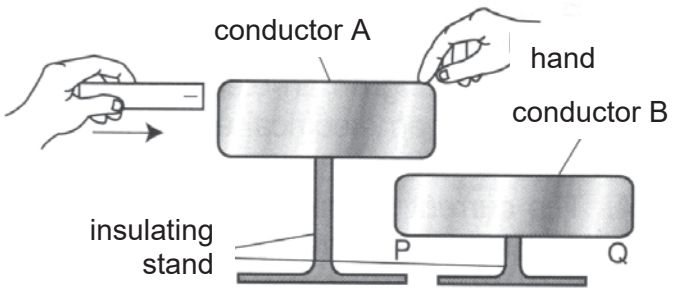
A the loudness only

B the pitch only

C the loudness and the pitch

D they have no similarities

29 A negatively charged rod is brought near conductor A which is earthed momentarily as shown below.



After the rod is removed, what are the resulting charges on conductor B at P and Q?

	P	Q
A	positive	positive
B	positive	negative
C	negative	positive
D	negative	negative

30 A charged cloud carrying a charge of 160 C passes all its charge to the earth through lightning. The lightning lasts for 0.50 ms.

What is the lightning current?

A 80 A **B** 3.2×10^2 A **C** 3.2×10^5 A **D** 0.80×10^5 A

[Turn over

31 Which of the following are correct?

1 An electron will accelerate when placed in an electric field.

2 An electron will always move towards a positively charged object in a straight line.

3 The direction of an electric field at any point is the direction of the force on a small positive charge places at the point.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

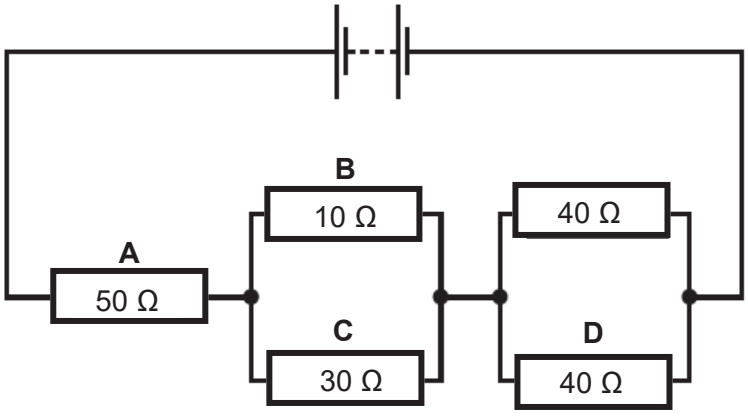
32 A wire of length 8 m has a resistance of 16 Ω. A second wire, made of the same material, has double the resistance and half the cross-sectional radius.

What is the length of the second wire?

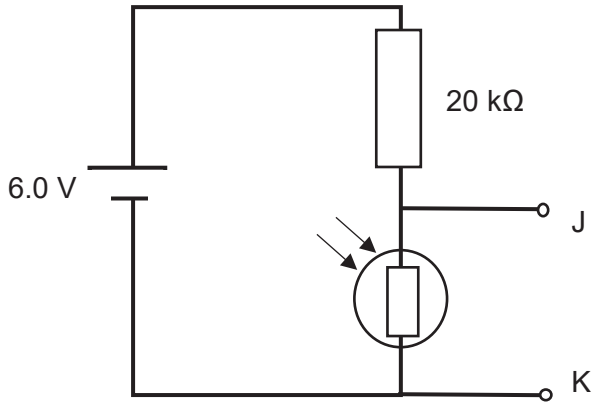
A 4 m **B** 8 m **C** 16 m **D** 64 m

33 The diagram shows a circuit containing five resistors connected to a battery.

In which resistor is the current the smallest?



34 The circuit shows a potential divider, which consists of a fixed resistor and a light-dependent resistor. The potential divider is used to switch on a lamp when it gets dark.



The resistance of the fixed resistor is 20 kΩ. The potential difference across JK is 0.60 V when the lamp is switched on.

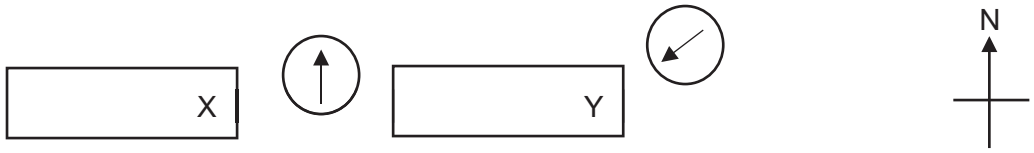
What is the resistance of the light-dependent resistor when the lamp is switched on?

A 1.8 kΩ **B** 2.2 kΩ **C** 160 kΩ **D** 180 kΩ

35 Electrical appliances have voltage and power ratings as listed below. Which has the lowest electrical resistance?

	appliance	voltage	power
A	kettle	240	1500
B	hair dryer	250	20
C	television	240	160
D	washing machine	250	3000

36 The diagram shows the direction of the compass needle when placed near two bar magnets.



What is the likely poles at X and Y?

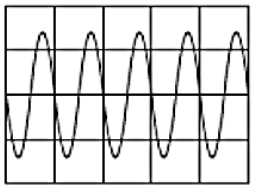
	pole at X	pole at Y
A	North	South
B	North	North
C	South	North
D	South	South

[Turn over

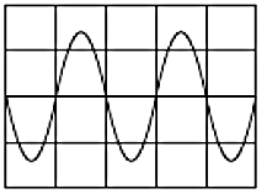
37 The Y-input terminals of a cathode ray oscilloscope are connected to a supply of peak value 5.0 V and of frequency 50 Hz. The time-base is set as 10 ms per division and the Y-gain at 5.0 V per division.

Which trace is obtained?

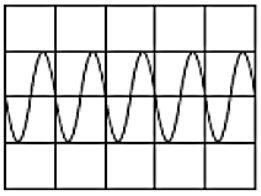
A



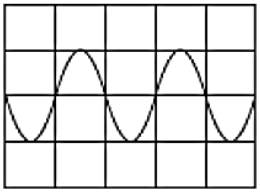
B



C



D



38 Split-ring commutators can be found in a d.c. motor.
What is the purpose of the split-ring commutator?

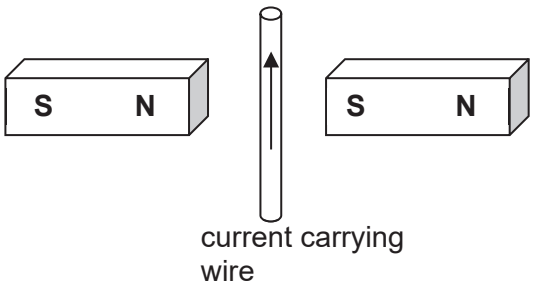
A It allows the coil to rotate in the same direction by keeping the direction of the current through the coil constant every half-cycle.

B It allows the coil to rotate in the same direction by reversing the direction of the current through the coil every half-cycle.

C It allows the coil to change its direction of rotation every half-cycle.

D It produces a greater turning effect by becoming magnetically induced.

39 The diagram below shows a wire carrying a current between two permanent magnets.



What would be the direction of the force acting on the wire?

A to the left

B to the right

C into the page

D out of the page

[Turn over

40 The ratio of number of turns in the secondary coil to that in the primary coil of a transformer is 5 : 2.

Determine the primary voltage if the secondary voltage is 240 V.

A 48 V **B** 96 V **C** 120 V **D** 600 V

- - - End of Paper 1 - - -

Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

Where…… discernment, discipline, daring,
determination & duty become a part of life.

PRELIMINARY EXAMINATION 2018

SEC 4 EXPRESS

PHYSICS (REVISED) 6091 PAPER 2

1 hour 45 minutes **31 July 2018**
1115 – 1300h **Tuesday**

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

READ THESE INSTRUCTIONS FIRST

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

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 10 has a choice of parts to answer.
Write your answers in the spaces provided on the question paper.

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.

This question paper consists of **20** printed pages including the cover page.

[Turn over

Section A

Answer all the questions in this section in the spaces provided.

The total mark for this section is 50.

1 **(a)** Complete the table. Give the missing prefixes, symbols and value.

prefix	symbol	value
milli	m	
kilo		10^3
	G	10^9

[3]

(b) Underline all of the vector quantities in the list below.

force **energy** **distance** **weight** **acceleration** [1]

(c) Fig. 1.1 shows a ring supported by two strings that hang from a beam.

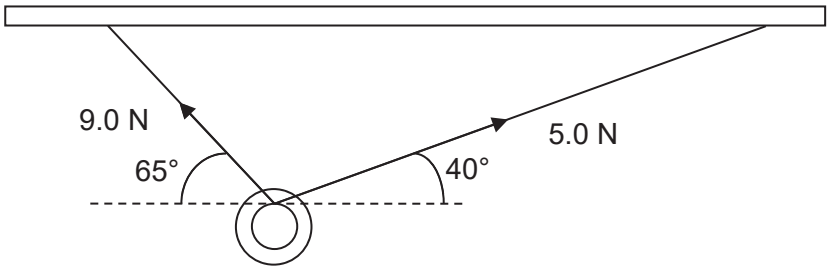


Fig. 1.1

(i) In the space below, draw a labelled diagram to show the resultant of the two tensions in the two strings. Determine the size of the resultant force and the direction between the resultant force and the horizontal.

resultant force = ……

direction = ……[3]

[Turn over

(ii) State the weight of the ring.

weight = ...[1]

2 Fig 2.1 shows a non-uniform plank XY 2.50 m long and weighs 750 N. Spring balances A and B are attached to the plank at a distance of 0.40 m from each end, as shown in Fig. 2.1.

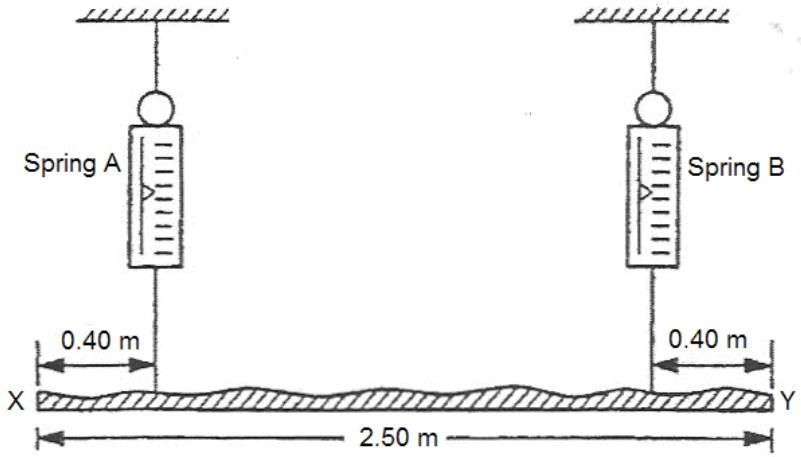


Fig. 2.1

When the plank is horizontal, spring balance A records 400 N.

(a) Calculate the reading on spring balance B.

reading = ...[1]

(b) On Fig. 2.1,

(i) indicate, clearly with a cross (**X**) a likely position for the centre of gravity of the plank. Label it '**C.G**'. [1]

(ii) mark and label all the forces, with suitable force arrows, acting on the plank. [2]

[Turn over

(c) Taking moment about spring B, calculate the distance of the centre of gravity from the end Y of the plank.

distance = ……[3]

(d) Explain why is the tension in spring B not considered for the calculation in part **(c)**?

……

……

……[1]

3 Fig 3.1 shows a water wave in a ripple tank at t = 0 s. The wave has a speed of 4.0 cm/s at **X**. The water waves crosses a boundary **AB** where the distance between crests changes from 5.0 cm to 8.0 cm.

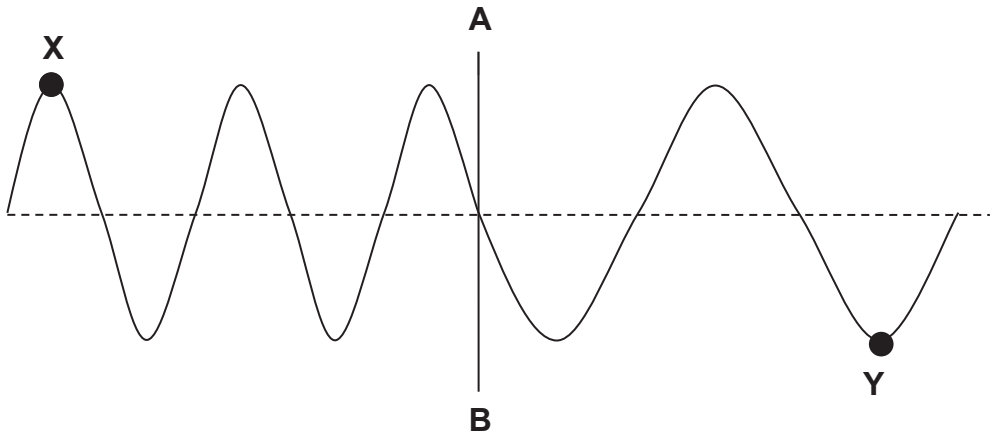


Fig. 3.1 (not drawn to scale)

(a) Calculate the period, T, of the wave before it crosses the boundary **AB**.

period of wave, T = ……[2]

[Turn over

(b) Calculate the speed of the wave at point **Y**.

speed of wave = …..……[2]

(c) The amplitude of the wave remains constant at 10.0 cm.

(i) Calculate the average speed of the particle at Y.

average speed of the particle at Y = …..……[2]

(ii) State the instantaneous speed of the particle at X.

instantaneous speed of the particle at X = …..……[1]

(iii) In Fig. 3.1, draw the wave for time t = 0.5T, where T is the period of the wave. [1]

[Turn over

4 (a) Fig. 4.1 shows a ray of light, from the top of an object PQ, passing through two glass prisms.

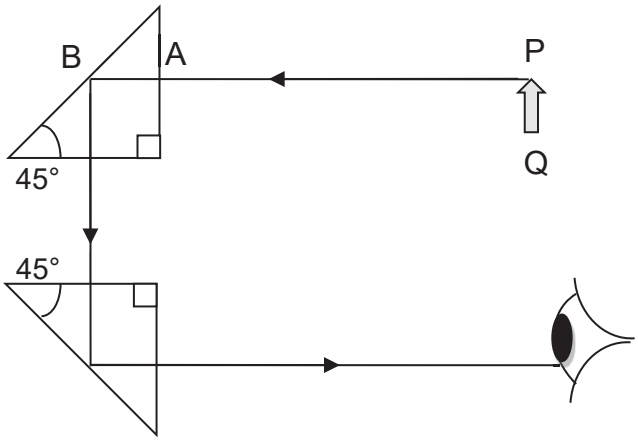


Fig. 4.1

(i) The speed of light as it travels from P to A is 3.0×10^8 m/s and the refractive index of the prism glass is 1.6. Calculate the speed of light in the prism.

speed = ……[2]

(ii) Calculate the critical angle.

critical angle = ……[1]

(iii) Explain why the ray AB reflects through 90° at B and does not pass out of the prism at B.

……

……

……...[1]

[Turn over

(iv) Draw a second light ray from Q of the object PQ to show that the image seen by the eye is upright. [1]

(b) Fig. 4.2 shows ray of light from the top of an object passing through a lens.

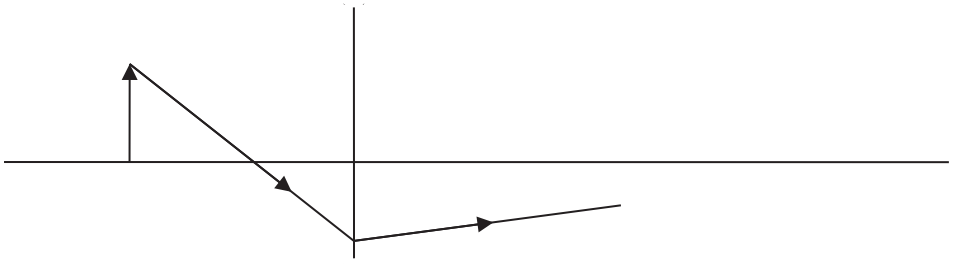


Fig. 4.2

(i) State whether the lens is converging or diverging.

……[1]

(ii) Draw another light ray from the object so that the image of the object can be located. Label the image **I**. [1]

(iii) Locate the principal focus of the lens by drawing another light ray from the object. Label the principal focus **F**. [1]

[Turn over

5 Fig. 5.1 is a graph of current against potential difference (p.d.) for a length of metal wire.

Fig. 5.1

(a) The metal wire obeys Ohm's law. State Ohm's law in words.

……..….

……..….

……..[2]

(b) Calculate the resistance of the metal wire.

resistance = …..……[1]

(c) A new wire is made from the same metal as the original wire. The new wire is half the length of the original wire. The diameter of the new wire is half that of the original wire.

(i) Calculate the resistance of the new wire.

resistance = …..……[2]

[Turn over

(ii) On Fig. 5.1 draw a line to show how the current varies with p.d. for the new wire. [1]

6 Fig. 6.1 shows an iron ring suspended by a thread. There is a bar magnet close to the ring. The iron ring is attracted to the magnet.

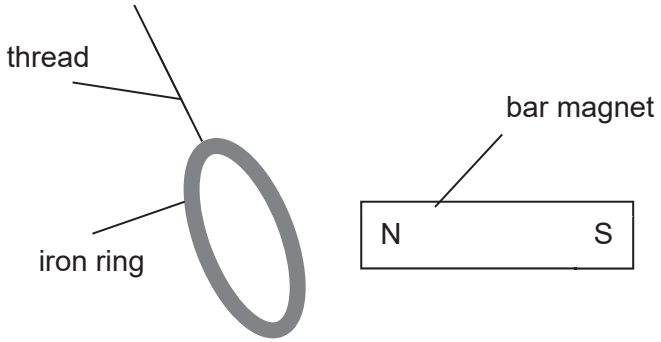


Fig. 6.1

Fig. 6.2 shows a brass ring suspended by a thread, close to a bar magnet.

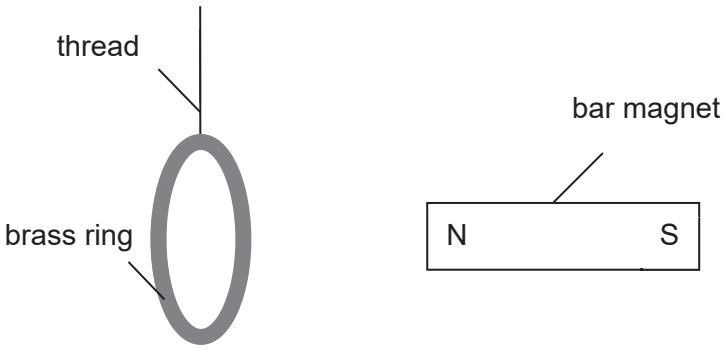


Fig. 6.2

(a) Explain why the brass ring is **not** attracted to the magnet, while the iron ring is attracted to the magnet.

……

……

……

……[2]

[Turn over

(b) When the N-pole of the bar magnet in Fig. 6.2 is moved quickly towards the brass 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 brass ring.

……

……

……

……[2]

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

……

……

……

……[2]

7 Fig. 7.1 represents the basic structure of a transformer.

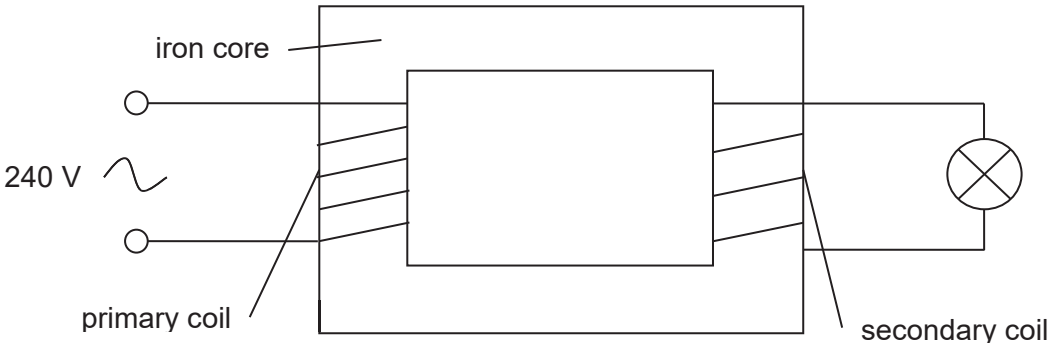


Fig. 7.1

An alternating voltage of 240 V is applied to the primary coil and a voltage is induced in the secondary coil.

(a) **(i)** Describe what is meant by an *alternating* voltage.

……

……

……

……[1]

[Turn over

(ii) Explain why an iron core is used instead of a steel core.

……

……

……

……[1]

(b) The primary coil has 360 turns.

Calculate the smallest number of complete turn in the secondary coil that would give an induced voltage of at least 6.0 V in the secondary coil.

number of turns = ……[2]

(c) The current in the primary coil is 0.040 A. The current in the secondary coil is 0.6 A and the output voltage is 6.0 V.

Calculate the efficiency of the transformer.

efficiency = ……[2]

End of Section A

[Turn over

Candidate Name:	Class:	Index No:

Section B

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

Answer only one of the two alternative questions in **Q10**.

The total mark for this section is 30.

8 Read the article below and answer the questions.

Undersea cable systems transport telephone conversations

Telephone conversations are carried across the oceans of the world as brief pulses of light in cable that contain hair-thin fibre optic strands. These strands are made from glass covered by a cladding that is protected by an outer casing, as shown in Fig. 8.1. If the speed of light in cladding is greater than in the core, total internal reflection occurs and all the light is then confined to the core.

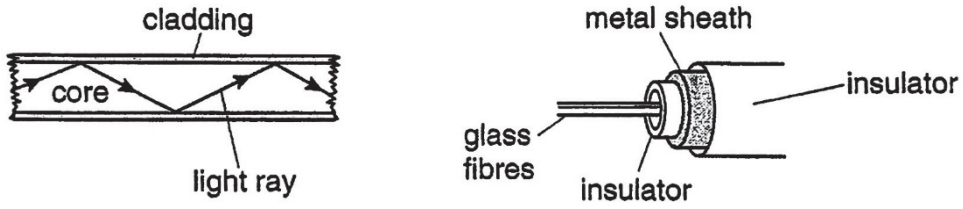


Fig. 8.1

The transmission of light is not 100% efficient as it passes down the fibre since light is absorbed by impurities in the glass. If light travels through 75 km of glass, then only 10% of the signal arrives at the other end. Over long distances, the light signal has to be boosted at underwater repeaters that are powered by an electric current sent along a metal sheath inside the cable. The repeaters connected in series with the same current of 0.80 A through each and a potential difference of 40 V across each repeater. In a typical 7500 km undersea cable there are 100 repeaters. Each kilometer of the metal sheath has a resistance of 0.70 Ω and some of the energy provided by the supply is lost as thermal energy (heat) in the sheath.

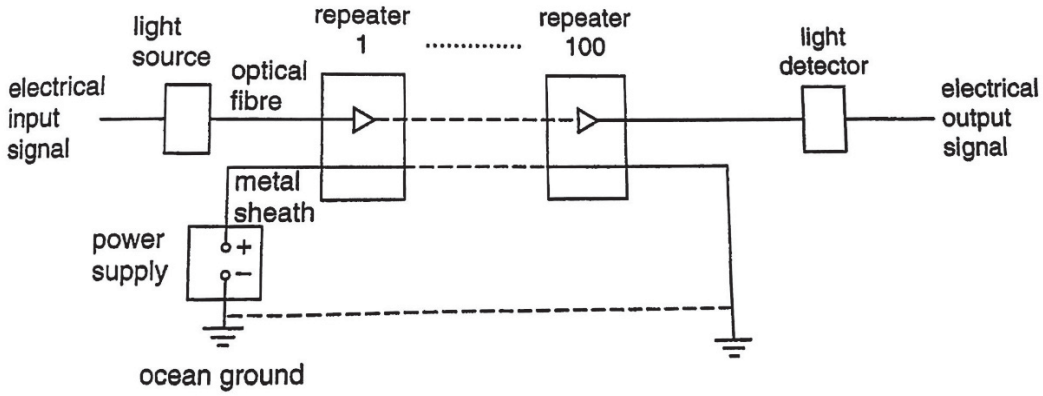


Fig. 8.2

(a) State why repeaters are necessary along an undersea cable.

……

……[1]

(b) Define *critical angle*.

……

……[1]

(c) Explain why the glass strands have to be covered with a cladding as shown in Fig. 8.1.

……

……

……

……[2]

(d) Determine, for a 7500 km undersea cable,

(i) the total potential difference across all the repeaters,

total potential difference = ……[1]

(ii) the total potential difference across the resistance of the metal sheath,

total potential difference = ……[2]

[Turn over

(iii) the potential difference provided by the power supply,

total potential difference = …..……[1]

(iv) the thermal energy (heat) lost from each kilometer of the metal sheath in one day.

thermal energy loss = …..……[2]

9 **(a)** A nuclear bomb test has been conducted on a remote island and observed from a ship which is 100 km away. The nuclear bomb emits both light and sound when exploded.

(i) Given that the speed of sound and light are 340 ms^{-1} and 3.00×10^8 ms^{-1} respectively, calculate the time taken (in seconds) for the light and sound to travel from the bomb to the ship.

time taken for sound = …..……[1]

time taken for light = …..……[1]

(ii) Hence, or otherwise, calculate the time interval between the observer seeing and hearing the explosion.

time interval = …..……[1]

(iii) Explain any changes to your answer to the time interval in **(ii)** if the bomb exploded in the sea and observed from a submarine. Assume that the distance from the bomb and observer is still 100 km.

……

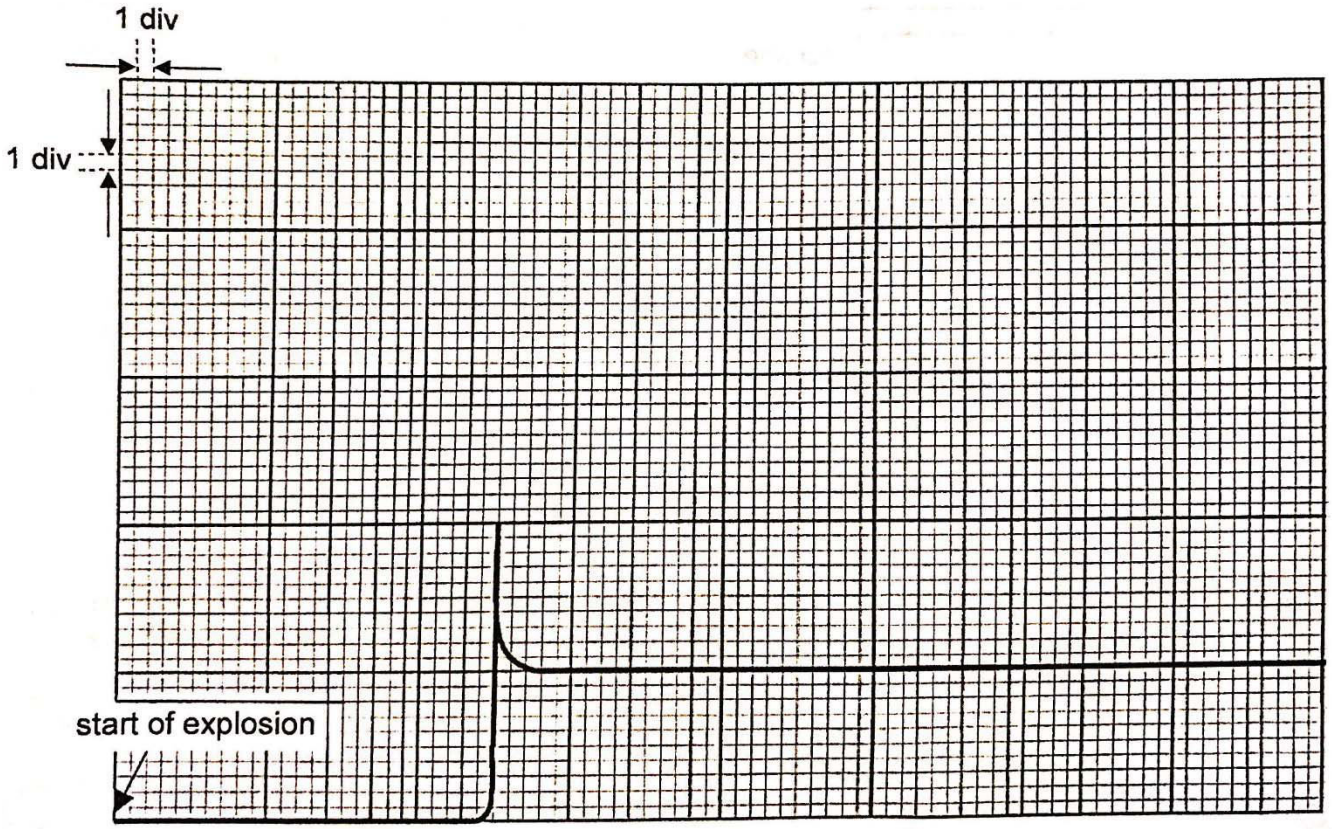
……

……

……[2]

[Turn over

(b) A nuclear-proof sensor is placed at 1 km away from the bomb site. The sensor detects the amount of light in the environment and sends the signal to an oscilloscope. The display of the oscilloscope is as shown below.



The amount of light is measured in lux. Given that the y-gain scale is 50,000 lux/div and time base scale is 120 ns/div,

(i) calculate the speed of light emitted by the nuclear bomb based on the display in the oscilloscope and,

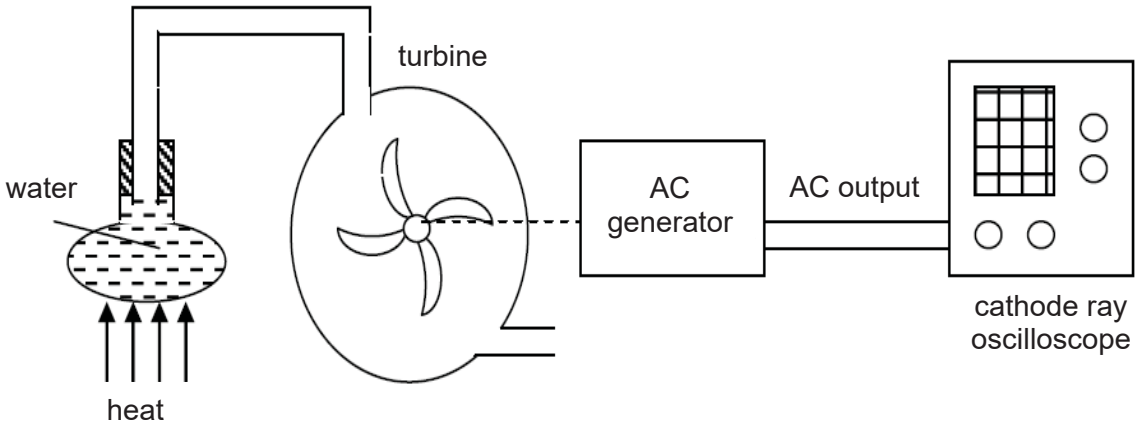
speed of light = …..……[2]

(ii) On the grids above, sketch the display if the y-gain and time base scales are adjusted to 25,000 lux/div and 60 ns/div respectively. [3]

[Turn over

10 EITHER

The diagram below shows an experiment to observe how steam can be used to generate power.



An oscilloscope is used to determine the efficiency of the steam generator.

(a) The heat source is an electric heater that requires 20 W of power. Determine the energy consumed by the heater if it is turned on for 5 hours to support the experiment.

energy consumed = …..……[2]

(b) Steam produced by the water is able to oscillate the turbine at 50 revolutions per second. Given that the generator can produce a peak voltage of 0.05 V per revolution every second and a peak current of 2 A, determine,

(i) the peak voltage the generator can produce in 1 second with the turbine connected. (Assume there is no loss in energy at this stage.)

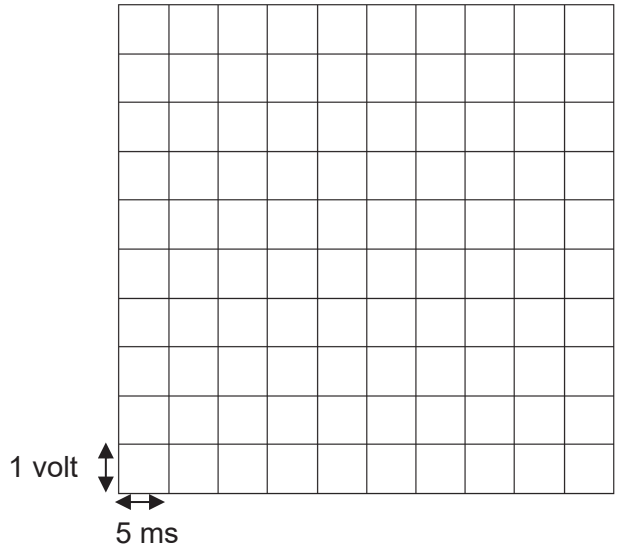
peak voltage = …..……[1]

[Turn over

(ii) the maximum power the generator can produce in 1 second.

maximum power = ……[1]

(c) Using the grid provided, sketch the waveform produced by the AC generator as observed from the oscilloscope.



(d) Determine the maximum energy in kWh, the generator can produce in 4 hours 20 minutes.

maximum energy = ……[2]

(e) Determine the efficiency of the generator in %.

efficiency = ……[2]

[Turn over

OR

A student investigates the effects of temperature on the volume of a gas used by a column of air sealed in a capillary tube of cross sectional area of 2.00 mm^2 by a short column of mercury as shown in Fig. 10.1.

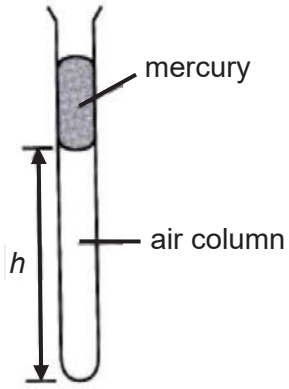


Fig. 10.1

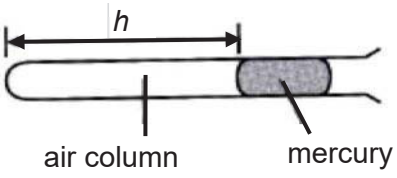


Fig. 10.2

At 20 °C, the length of the air column, *h*, was 15.0 cm, the atmospheric pressure is 1.02×10^5 Pa, the length of the mercury column is 2.5 cm and the density of mercury is 13600 kg/m^3.

(a) Calculate the pressure of the air column.

pressure = …..……[2]

(b) Calculate the weight of the mercury column.

weight = …..……[2]

[Turn over

(c) Boyle's Law states that PV = constant, where P is the pressure of the gas and V is the volume of the gas. Sketch the graph of P against $\frac{1}{V}$ for the air column in the capillary tube.

[2]

(d) The capillary tube is not heated. In terms of kinetic theory, state and explain the changes to the length of the air column, if any, that will be observed.

……

……

……

……

……

……

……

……[3]

(e) The capillary tube is allowed to cool back to 20 °C and placed horizontally as shown in Fig. 10.2. State the new pressure of the air column.

new pressure = ……[1]

- END OF PAPER -

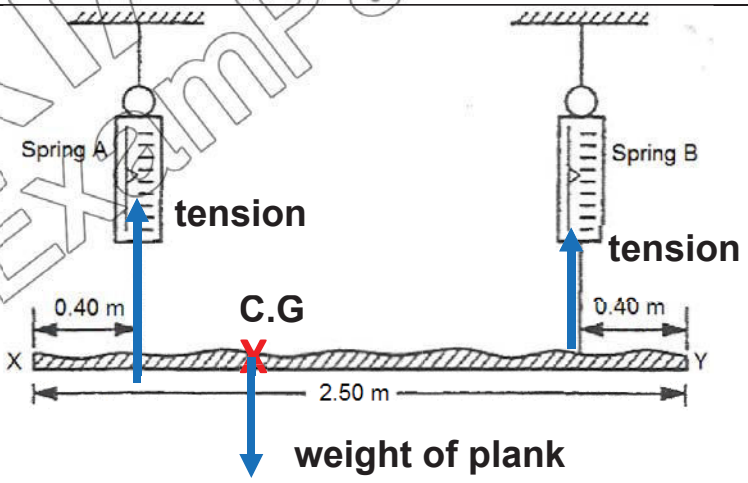
[Turn over

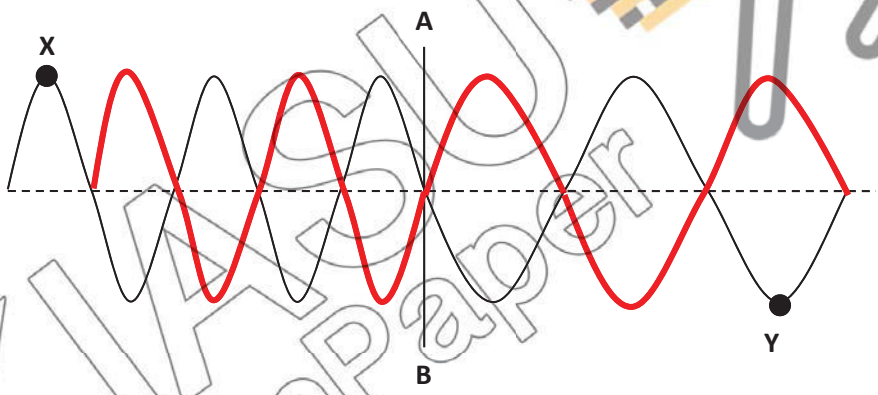
DUNMAN SECONDARY SCHOOL
PRELIMINARY EXAMS 2018
SEC 4 PHYSICS 6091 ANSWER SCHEME

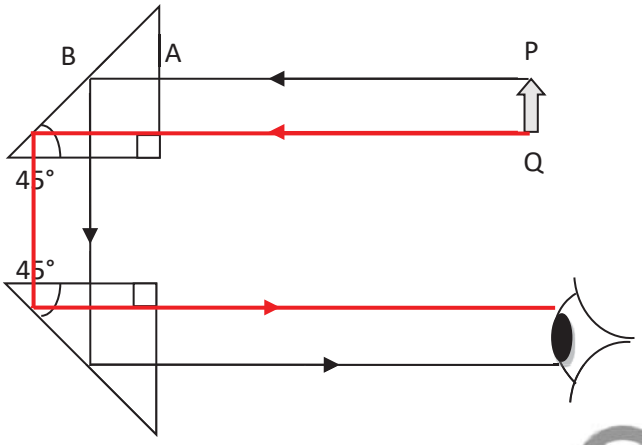
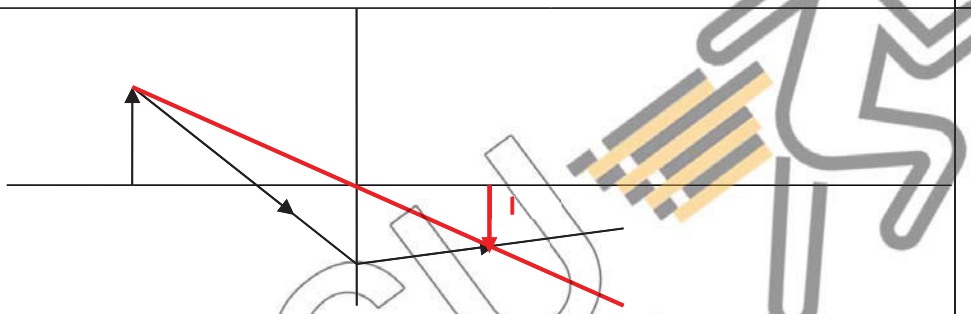
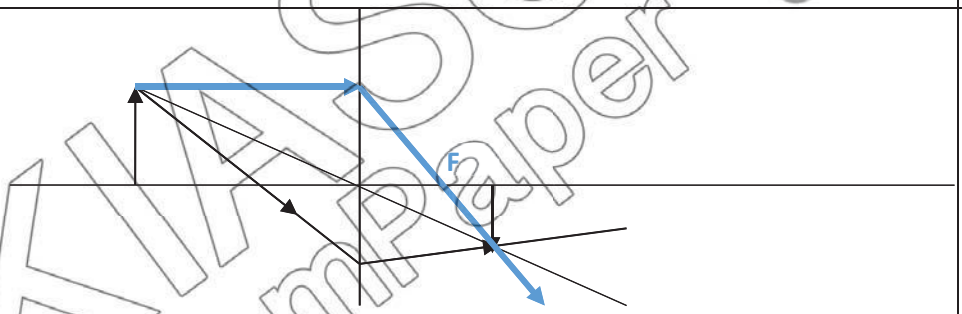
PAPER 1 [40M]

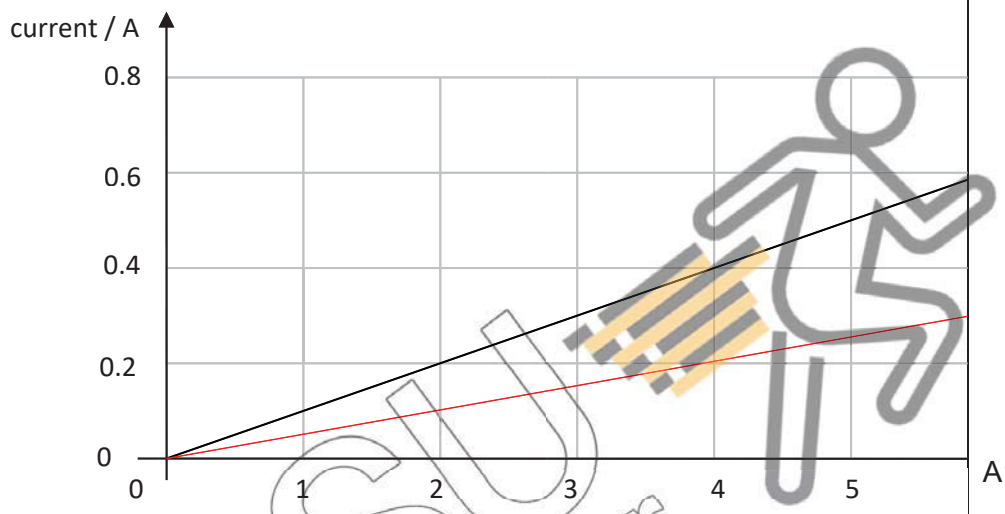
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	B	D	A	D	B	C	C	D
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	C	C	D	B	D	C	A	B	B
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
D	C	A	D	A	C	D	C	C	C
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
B	A	C	B	D	A	D	B	C	B

PAPER 2 – SECTION A

1(a)	10^{-3} k giga	B1 B1 B1
1(b)	force, weight and acceleration only (all 3 must be correctly underlined)	B1
1(c)(i)	correctly labelled diagram using tip-to-tail method or parallelogram method (resultant force should have double arrows) resultant force = 11.4 N *(range 11.0 to 11.8 N)* direction = 50 degree to the 5.0 N force OR 25 degree to the 9.0N force or 90° from horizontal	 B1 B1 B1
1(c)(i)	11.4 N (answer should be the same as resultant force in c(i))	B1
2(a)	750 – 400 = 350 N	B1
2(b)	 Correct labelling of 'X' and 'C.G' (towards spring A) Correct drawing of 3 arrows representing the 3 forces Correct labelling of the 3 forces (tension A must be longer than tension B)	 B1 B1 B1

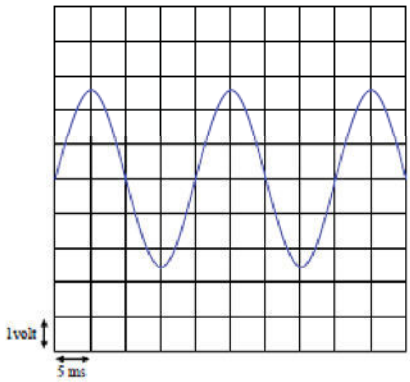
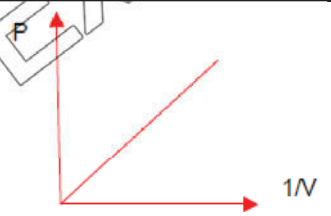
2(c)	By Principle of Moment / OR Taking Spring B to be the pivot, Clockwise moment = anti-clockwise moment 400 x (2.50 – 0.40 – 0.40) = 750 x K K = 0.907 m Distance = 0.907 + 0.40 = 1.31 m	 B1 B1 B1
2(d)	The line of action of the tension in spring B cuts the pivot, hence **<u>perpendicular distance</u>** between the line of action of the force and pivot **<u>is zero</u>**. Hence, as moment = force x perpendicular distance, moment due to the tension in spring B about B will be zero.	B1
3(a)	speed = wavelength / period 4.0 = 5.0 / period period = 1.25 s	 M1 A1
3(b)	frequency = speed / wavelength = 4.0 / 5.0 = 0.80 Hz speed = frequency x wavelength = 0.80 x 0.08 = 0.064 m/s (OR 6.40 cm/s)	 M1 A1
3(c)(i)	At Y, period is also 1.25 s. Average speed = (4 x 10.0) / 1.25 = 32 cm/s (OR 0.32 m/s)	 M1 A1
3(c)(ii)	0.00cm/s (check for 2 or 3 sf)	A1
3(c)(iii)		A1
4(a)(i)	n = 3.0 x 10^8 / speed of light in prism speed of light in prism = 3.0 x 10^8 / 1.6 = 1.88 x 10^8 m/s	 M1 A1
4(a)(ii)	n = 1 / sin c c = sin-1 (1/1.6) = 38.7°	 A1
4(a)(iii)	**Incident angle is 45° which is more than the critical angle 38.7°** **Total internal reflection** occurs hence the ray AB did not pass out of prism at B *reject if students cited incident angle as 90°.	B1

4(a) (iv)	 Correct ray with at least an arrow drawn.	B1
4(b) (i)	Converging lens	B1
4(b) (i)		B1
4(b) (i)	 *no arrows deduct 1m	B1
5(a)	Current is directly proportional to the potential difference across the circuit in a metallic conductor if temperature/physical conditions are constant	B1 B1
5(b)	R = V / I = 6 / 0.6 (using any value of V and I from graph) = 10.0 Ω	 A1
5(c) (i)	half the length = 5.0 Ω half the diameter means ¼ of the original area = 5.0 x 4 = 20.0 Ω OR R = ρ(1/2 x L) / (1/4 x A) = 2 x (ρL / A) = 2 x 10.0 = 20.0 Ω	M1 A1

5(c) (ii)		A1
6(a)	Brass is not a ferromagnetic material while iron is. Hence, bar magnet cannot **induce magnetism** in brass. Or hence brass cannot be magnetised to become a magnet.	B1 B1
6(b)	When the N-pole of the bar magnet is moved quickly towards the ring, there is a **change in magnetic flux linking the ring**. Hence, by Faraday's Law, an e.m.f is induced in the ring. As the ring is a **closed loop, a current is hence induced.** Or There is cutting of the magnetic flux linkage in the brass ring, this change in magnetic flux induces an emf and an induced current in the brass ring due to Faraday's Law of EMI.	B1 B1
6(c)	By Lenz.s Law, the direction of the induced current in the ring and hence the **induced magnetic flux will oppose the original change in magnetic flux** due to the bar magnet approaching. Hence, an **induced N-Pole will be created in the brass ring on the side facing the bar magnet** and repel the away from the approaching bar magnet.	B1 B1
7(a) (i)	An alternating voltage is a voltage that changes the direction of its **polarity** periodically.	B1
7(a) (ii)	Iron core is used as it is a soft magnet that can easily be magnetised or demagnetised. While steel cannot be easily magnetised or demagnetised.	B1
7(b)	Ns / Np = Vs / Vp Ns = (6.0 / 240) x 360 = 9.0 turns	 M1 A1
7(c)	Pp = 0.040 x 240 = 9.60 W Ps = 0.6 x 6.0 = 3.60 W Efficiency = (3.6 / 9.6) x 100% = 37.5%	 M1 A1

PAPER 2 – SECTION B

8(a)	Light may be absorbed by the impurities of the glass under the seabed. Hence, light has to be boosted at the repeaters to sure light will **arrive at the output**. or This is to ensure that light signals **will arrive at the output end** given that the transmission of light is not 100% efficient.	B1
8(b)	Critical angle is defined as the **angle of incidence in the optically denser medium** which makes **an angle of refraction of 90°** in the optically **less dense medium**.	B1
8(c)	The cladding acts as a layer of **optically less dense medium** as compared to the glass core. This is to ensure that **total internal reflection is able to occur** in the glass core.	B1 B1
8(di)	(in series) Total potential difference = 40 V x 100 = 4000V	 B1
8(dii)	Total resistance in metal sheath = 0.70 Ω/km x 7500 km = 5250 Ω Total potential difference = IR = 0.80 x 5250 = 4200 V	 B1 B1
8(diii)	Total potential difference = 4200 V + 4000 V = 8200 V	 B1
8(div)	Thermal energy loss = I^2Rt = $(0.80)^2$ x 0.70 x (24 x 60 x 60) = 38707.2 J = 38700 (3 sf) or 39000 J (2 sf)	 M1 A1
9(a)(i)	Time taken for sound = 294 s Time taken for light 3.33 x 10^{-4} m/s	B1 B1
9(a)(ii)	294 s	B1
9(a)(iii)	The time interval will be shorter. The speed of light in water is slower and the speed of sound in water is faster, hence the time interval will be shorter.	B1 B1
9(b)(i)	Time taken = 25 div x 120 ns = 3000 ns Speed of light = 1000 ÷ 3000 x 10^{-9} = 3.33 x 10^8 m/s	 B1 A1
9(b)(ii)	Time base at 50 div Peak of lux is twice the original The equilibrium line at twice the original and the shape of the graph	B1 B1 B1
10 Either		
(a)	E = Pt = 20 x 5 x 60 x 60 = 360 kJ	 M1 A1
(bi)	Peak voltage = 0.05 V x 50 rev/s = 2.5 V	B1
(bii)	Maximum power = IV = 2 x 2.5 = 5.0 W	B1

(c)		B2
(d)	Maximum E = Pt = 0.005 kW x $4\frac{1}{3}$ h = 0.0217 kWh	M1 A1
(e)	Efficiency = [output / input] x 100% = (5 W / 20 W) x 100% = 25%	M1 A1
10 OR		
(a)	Pressure of air = Pressure of Hg + Pressure of Atmosphere = 0.025 x 13600 x 10 + 1.02 x 10^5 Pa = 105 000 Pa (3sf)	M1 A1
(b)	P = F/A 3400 = F/ 2 x 10^{-6} F = 6.8 x 10^{-3} N Or Mass = 13600 x (0.025) x (2 x 10^{-6}) = 6.8 x 10^{-4} kg Weight = (6.8 x 10^{-4}) x 10 = 6.8 x 10^{-3} N	M1 A1 M1 A1
(c)	 B1 – straight line graph from original B1 – correct axes label **(only when graph shape is correct)**	
(d)	When heated, the air molecules **gain energy and moves faster. Rate of collision against the walls of the tube as well as the mercury column increases**. This will **raise the pressure** in the tube to increase **pushing the mercury column upwards**, **increasing the length of the air column**.	B1 B1 B1
(e)	Pressure of air = Pressure of Atmosphere = 1.02 x 10^5 Pa	B1