ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: / INDEX NUMBER:

PHYSICS **5059/01**

Paper 1 (Multiple Choice)

1st September 2015

1 hour

1300 – 1400h

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** the 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 Multiple Choice Answer Sheet.

At the end of the examination, hand in the completed Multiple Choice Answer Sheet and the question paper separately.

INFORMATION FOR CANDIDATES

Take *acceleration due to gravity, g* as 10 m/s^2.

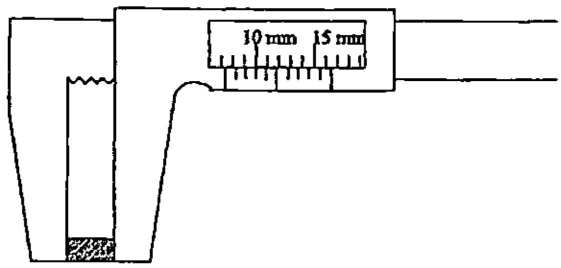
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This document consists of **17** printed pages

Setter: Mrs Hui Ching Hong Christine

1 The diagram below shows a vernier caliper being used to measure the length of a thin glass slide.



glass slide

What is the length of the glass slide?

A 6.3 mm

B 7.3 mm

C 7.6 mm

D 10.5 mm

2 Four physical quantities P, Q, R and S are related by the equation:

$$P = Q - RS$$

Which one of the following statements is certainly **true**?

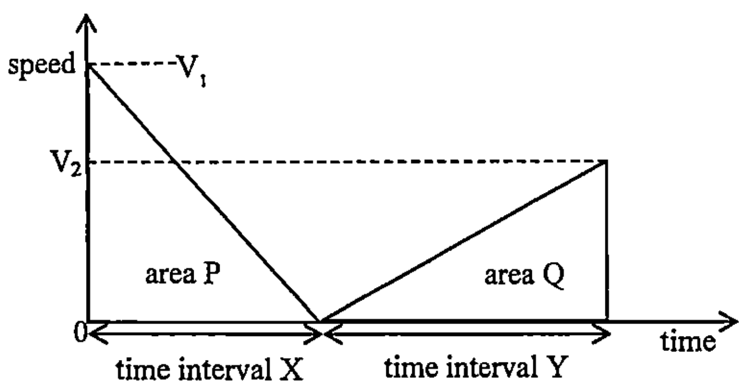
A P, Q, R and S all have the same units.

B P, Q, R and S are all scalar quantities.

C The product of RS has the same units as P/Q.

D The product of RS is numerically equal to (Q-P).

3 The graph below shows the speed-time graph of the motion of a bus.



What is the average speed of the bus throughout the journey?

A $(V_2-V_1) / 2$

B $(P-Q) / (X+Y)$

C $(V_2-V_1) / 2$

D $(P+Q) / (X+Y)$

4 The velocity of a car, which is decelerating uniformly, changes from 30 m/s to 15 m/s in 75 m. After what further distance will it come to a rest?

A 15 m

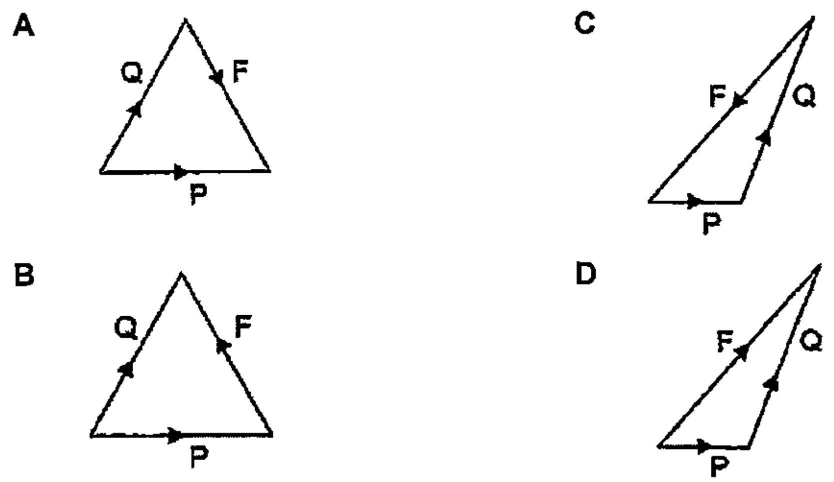
B 25 m

C 20 m

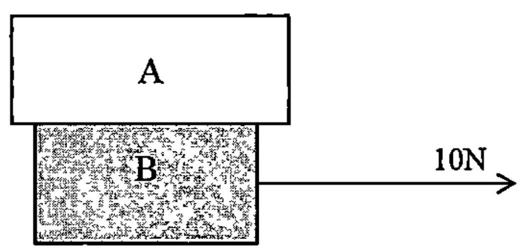
D 50 m

5 A body is acted on by 2 forces, P and Q. A frictional force F holds the body in equilibrium.

Which vector triangle could represent the relationship between these forces?



6 Two objects, A and B of mass 3.0 kg and 2.0 kg respectively, are stacked one on top of the other as shown. B lies on a smooth surface.



Determine the acceleration of A, when B is pulled by a force of 10N.

A $5.0\ ms^{-2}$

B $3.3\ ms^{-2}$

C $2.0\ ms^{-2}$

D $0.0\ ms^{-2}$

7 When a horizontal force of up to 4.0 N is applied to a wooden block of mass 2.0 kg on a horizontal surface, the block moves with a constant velocity. If the applied force is now increased to 12.0 N, determine the acceleration of the block.

A 2.0 ms^{-2} **C** 6.0 ms^{-2}

B 4.0 ms^{-2} **D** 8.0 ms^{-2}

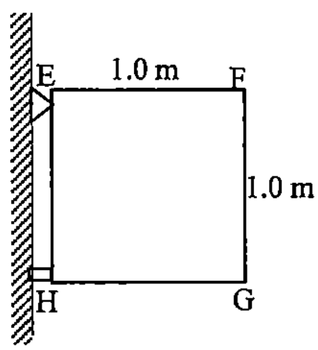
8 A lunar landing module is descending to the Moon's surface at a steady velocity of 10 ms^{-1}. At a height of 120 m, a small object falls from its landing gear.

Taking the Moon's gravitational field strength to be 1.6 N/kg, at what speed does the small object strike the Moon?

A 22 ms^{-1} **C** 17 ms^{-1}

B 20 ms^{-1} **D** 10 ms^{-1}

9 A square shop sign EFGH, of sides 1.0 m, is pivoted on a vertical wall by a hinge at E.



If the mass of the sign is 5.0 kg, determine the force exerted by the wall support at H.

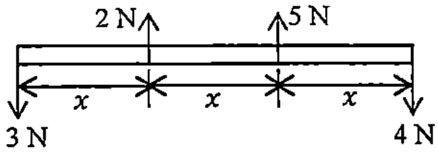
A 25 N **C** 75 N

B 50 N **D** 100 N

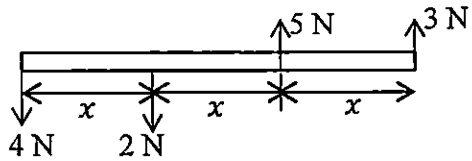
10 The diagrams below show all the forces acting on a beam of length $3x$.

Which of the following causes only rotational motion of the beam without any linear movement?

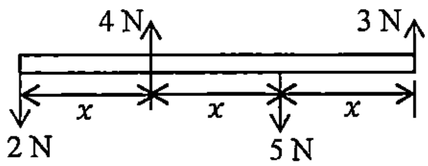
A



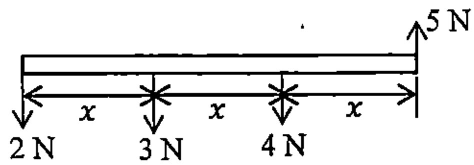
C



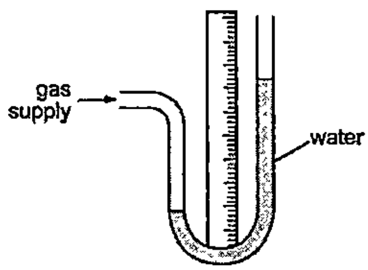
B



D



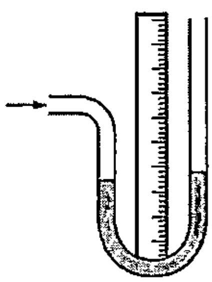
11 A water manometer is connected to a gas supply. The figure below showsthe water levels.



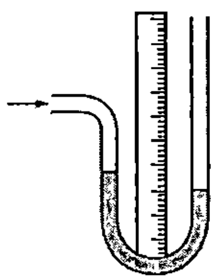
The water is replaced by mercury, which is denser than water.

Which diagram shows the mercury levels when the manometer is connected to the same gas supply?

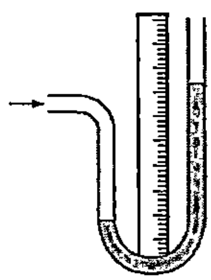
A



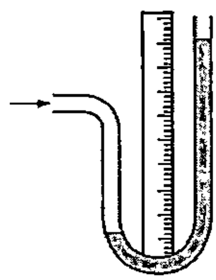
B



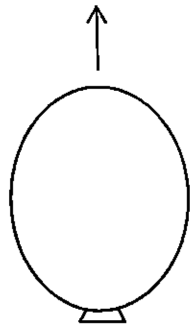
C



D



12 A hydrogen balloon rises from the ground level to an altitude of 300 m. Its volume increases as it rises.



Which pressure changes have occurred within the balloon and the air outside the balloon?

	Pressure change in the balloon	Pressure change of air outside
A	Decrease	Decrease
B	Decrease	Increase
C	Increase	Decrease
D	Increase	Increase

13 A man of mass 80 kg is raised by a lift of 500 kg at a constant speed of 2.0 ms^{-1}. What is the power of the lift's motor?

(Acceleration due to gravity = 10 ms^{-2})

A 160 W

B 320 W

C 1 160 W

D 11 600 W

14 A motorcar of mass 500 kg generates a power of 10 000W. How much time does the motorcar need to accelerate from a speed of 10 ms^{-1} to 20 ms^{-1}?

A 2.5 s

B 5.0 s

C 7.5 s

D 10 s

15 In a Brownian motion experiment involving smoke particles in air, heavy smoke particles settle quickly but very small smoke particles remain suspended for long periods of time.

Which one of the following statements explains why the small smoke particles do not settle?

A Air pressure has greater effect on smaller particles.

B The small smoke particles have the same density as the air.

C The Earth's gravitational field does not act on very small particles

D Random molecular bombardment by air molecules keeps the particles suspended.

16 House owners are being urged to reduce heat loss from roofs by laying a matting of fibre-glass, which consists of a very large number of intertwined fine glass fibres with trapped air in between, on the floor of the roof space. Which of the following is the main reason why fibreglass is effective as a heat insulator?

A Fibre-glass are good reflectors of thermal radiation and so the heat loss is greatly reduced.

B Fibre-glass will not absorb much heat and its low heat capacity results in good insulation.

C Fibre-glass prevents the faster moving air molecules escaping into the roof from the room below.

D Fibre-glass reduces air movement within the fibreglass matting and stationary air is a very good insulator.

17 The distance between the 20 ^{o}C and the 100 ^{o}C mark on a mercury thermometer is 25.0 cm. When the mercury level is 5.0 cm below the 100 ^{o}C mark, the temperature is approximately

A 64 ^{o}C

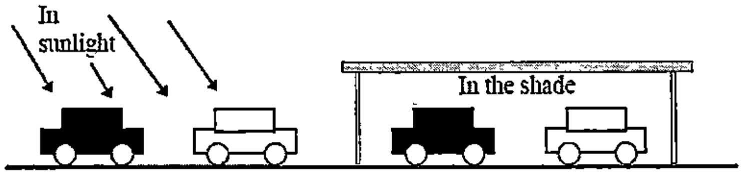
B 80 ^{o}C

C 84 ^{o}C

D 90 ^{o}C

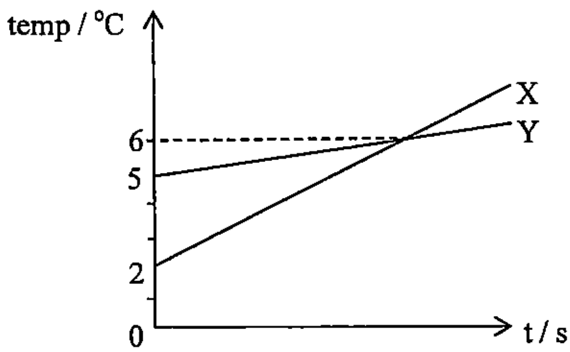
18 Two cars, one painted dull black and another white, were left in the sun. Which car will heat up faster?

When the two cars reached a surface temperature of 40 ^{0}C, they were driven into the shade. Which of the following will be observed?



	In the sun	In the shade
A	White car heats up faster.	White car cools down faster.
B	White car heats up faster.	Black car cools down faster.
C	Black car heats up faster.	White car cools down faster.
D	Black car heats up faster.	Black car cools down faster.

19 Two blocks, X and Y, which are made of the same metal, are heated by heaters of the same power rating. The variations of temperature with time are given in the figure below.



What is the ratio of the mass of X to the mass of Y?

A 1 : 3 **C** 3 : 4

B 1 : 4 **D** 3 : 1

20 An immersion heater rated at 150 W is fitted into a large block of ice at 0 °C. The specific latent heat of fusion is 300 J/g. How long does it take to melt 10 g of ice?

A 2 s　　　**C** 5 s

B 20 s　　　**D** 150 s

21 A brass block of mass 50 g was heated to 100 °C in boiling water and immersed in m grams of "cold" water at 30 °C. The final temperature of the "mixture", θ, was recorded.

The specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1}. The results obtained were used to calculate the specific heat capacity, c, of brass using the equation.

$$50\,c\,(100-\theta) = 4.2m(\theta - 30)$$

The actual value of specific heat capacity of brass compared to the calculated value is

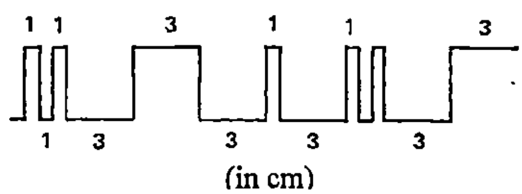
A higher because of heat loss to surrounding air.

B lower because heat is absorbed by the calorimeter.

C higher as droplets of boiling water may have been transferred to the cold water.

D lower because of heat loss to surrounding air.

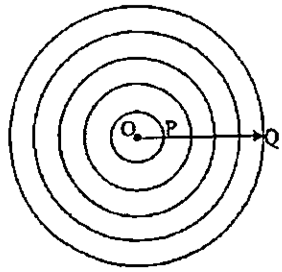
22 The figure below shows a waveform. Determine its wavelength, in cm.



A 7 cm　　　**C** 13 cm

B 10 cm　　　**D** 16 cm

23 The figure below illustrates circular wavefronts radiating from a point source O.



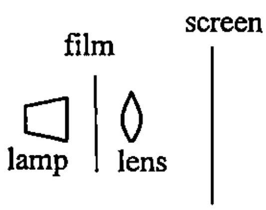
Given that the time taken for the wave to travel from P to Q is 10 s, and the wavelength of the waves is 200 cm, determine the speed of the wave.

A $0.08\ ms^{-1}$ **C** $0.80\ ms^{-1}$

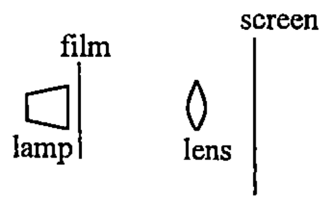
B $1.0\ ms^{-1}$ **D** $8.0\ ms^{-1}$

24 Which of the following diagrams correctly shows the arrangement of a lamp, lens and film in a photographic enlarger?

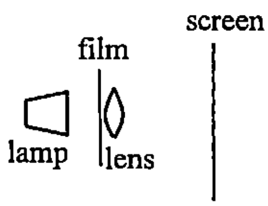
A



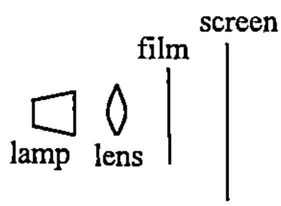
C



B

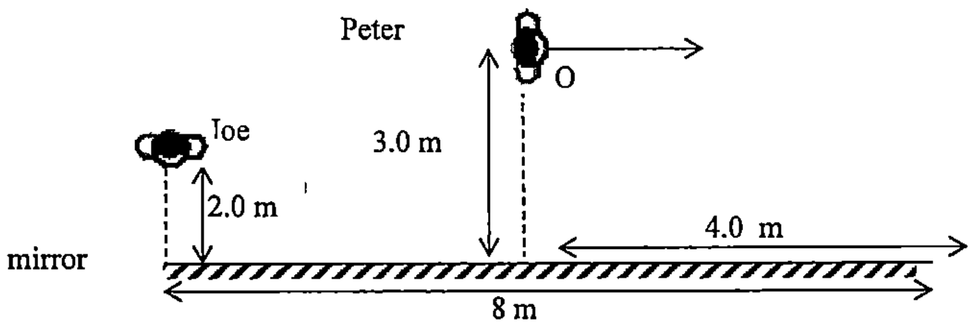


D



25 The figure below shows Joe and Peter standing in front of a 8.0 m long mirror. Joe stands 2.0 m away from the left edge of the mirror, facing it. Peter stands 3.0 m from the mirror at point O, but faces the direction towards the right.

What is the furthest distance that Peter can walk away to the right of O just before Joe loses sight of his image in the mirror?



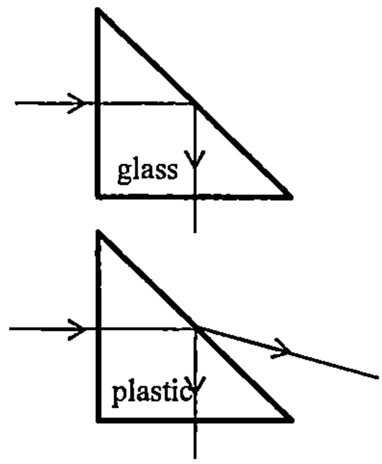
A	4 m	**C**	12 m
B	8 m	**D**	16 m

26 **X** and **Y** are different waves. In air, **X** travels much faster than **Y** but has a much shorter wavelength.

Which of the following correctly describes **X** and **Y**?

	X	**Y**
A	Microwaves	Red light
B	Sound	Ultraviolet
C	Ultraviolet	Sound
D	Red light	Gamma rays

27 A ray of light is incident on 2 prisms of identical shape and size, as shown in the figure below. One prism is made of glass and the other is made of plastic.



State a reason for the difference in the paths of the ray?

A Glass is more transparent than plastic.

B Plastic cannot totally reflect light.

C The plastic surface disperses the light.

D The critical angle for plastic is greater than that for glass.

28 P and Q are the displays on a C.R.O. as two musical instruments are sounded together. Which of the following statements is **NOT** correct?

A The waves have different amplitudes.

B The frequency of P is lower than that of Q.

C The wavelength of P is longer than that of Q.

D The speeds of the waves produced by P and Q are different.

29 A car, which is travelling normally towards a cliff at a speed of 50 ms^{-1}, sounds its horn when it is 0.7 km away. Taking speed of sound to be 300 ms^{-1} in air, find the time taken for the driver to hear its echo.

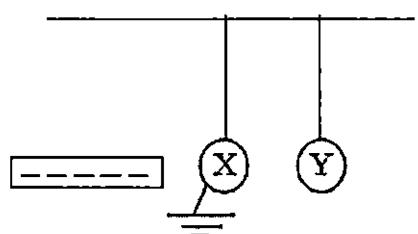
A 0.0040 s **C** 4.7 s

B 4.0 s **D** 28.0 s

30 During a thunderstorm, the clouds formed have negative charges at their bottom. Which of the following is correct about a lightning forming between the clouds and a building on the ground?

	Lightning direction	Electron flow
A	From building to clouds	Upwards
B	From building to clouds	Downwards
C	From clouds to building	Upwards
D	From clouds to building	Downwards

31 A negatively charged rod is brought near two isolated metals balls **X** and **Y**. **X** is then earthed momentarily as shown in the diagram. If the rod is then removed, what charge would the balls possess?



	X	Y
A	Positive	Negative
B	Positive	Neutral
C	Negative	Positive
D	Negative	Neutral

32 Which of the following will cause a fuse to melt?

- i Short circuiting
- ii Over-loading
- iii Open circuit

A i only

B ii only

C i & ii

D i, ii & iii

33 Amy turned on her Hi-Fi system for 8 hours. If the Hi-Fi is operating at 200 W and the unit cost of electricity is 85 cents, what is the cost of using the system for 8 hours?

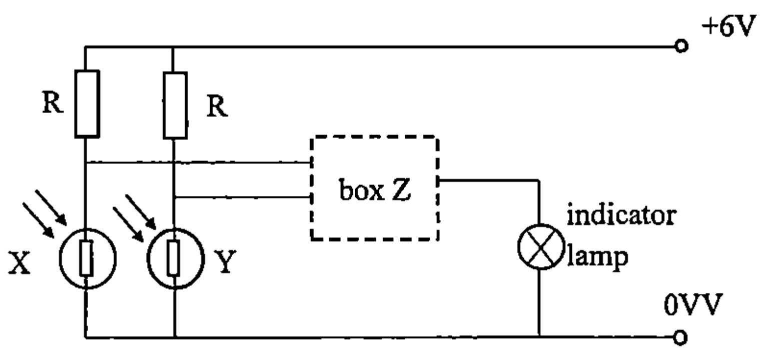
A \$1.36

B \$21.25

C \$13.60

D \$48.96

34 The diagram below shows a circuit with 2 LDRs, namely X and Y. What is the potential difference across X if the resistance of resistors R is 500 Ω each and the resistance of X is 1500 Ω?



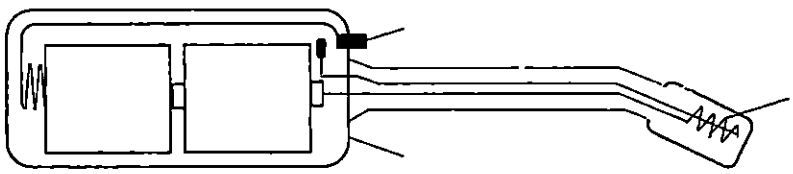
A 0.0 V

B 1.5 V

C 2.0 V

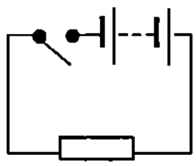
D 4.5 V

35 The figure below shows the components of a lighter for a gas cooker.

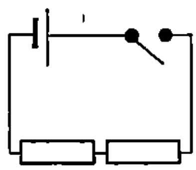


Which of the following circuit diagrams is correct for this lighter?

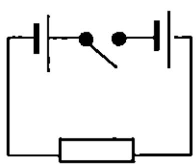
A



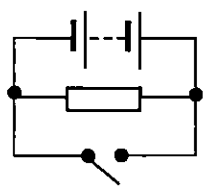
C



B



D



36 A student tries to magnetise a short steel rod. Which one of these tests will show that he has been successful?

A Both poles of a permanent magnet attract the rod.

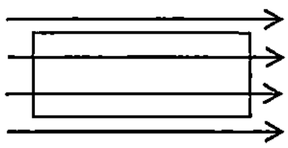
B One pole of a permanent magnet repels the rod.

C The rod picks up a small piece of paper.

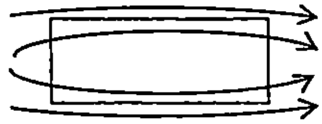
D When freely suspended, the rod points in a random direction.

37 A uniform magnetic field (parallel to the plane of paper) exists in space initially in a direction from left to right. Which of the following diagrams A, B, C or D shows the change in the magnetic field when a piece of soft iron bar is placed in the region of the field?

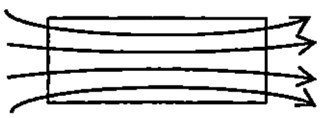
A



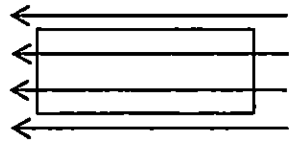
C



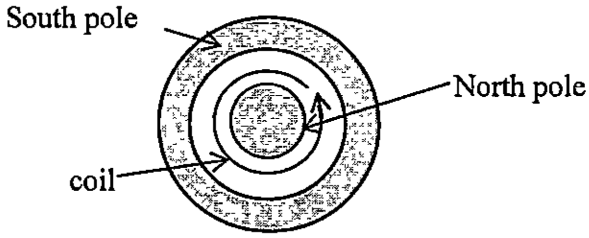
B



D



38 The diagram shows the front view of a loudspeaker, which consists of magnets and a coil amongst other items.



If the current is flowing in the speaker's coil in an anticlockwise direction as shown, determine the direction the coil will move.

A To the right.

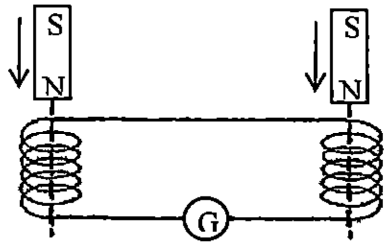
B To the left.

C Out of the page.

D Into the page.

39 Two small coils are connected in series to a sensitive galvanometer. A magnet is held above each coil as shown in the figure below.

When only the magnet in the left coil is dropped, the ammeter needle deflects towards the right.



Both magnets are now dropped at the same time. Determine the motion of the galvanometer needle?

A The needle deflects towards the left and with a greater magnitude.

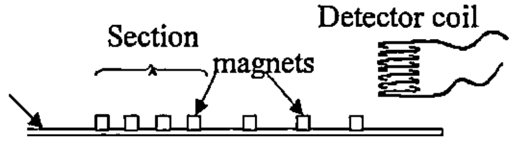
B The needle deflects towards the right and with a greater magnitude.

C The needle deflects towards the right and with the same magnitude.

D The needle does not move.

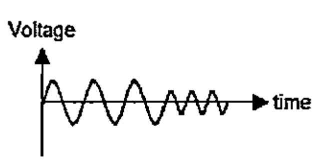
40 The diagram shows a detector coil placed above a conveyor belt carrying magnets from left to right. The belt is moving at a constant speed and the magnets are expected to be spaced out evenly along the belt.

However, the magnets in section A have been spaced closer together due to a programming fault.

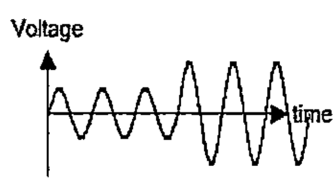


Which graph best represents the voltage signal generated in the detector coil?

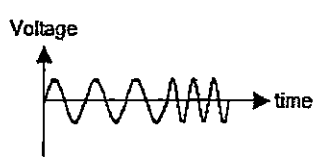
A



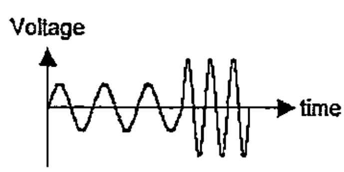
C



B



D



– END OF PAPER –

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME:			
CLASS:	/	INDEX NUMBER:	

PHYSICS **5059/02**

Paper 2 Theory

1 September 2015

1 hour 45 minutes

1045 – 1230h

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. The last question is in the form **EITHER / OR**.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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.

You may use a calculator.
Leave your answers in 2 significant figures unless stated otherwise.

You may take g, the gravitational field strength of Earth, to be 10 N/kg.

For Examiner's Use	
Section A [50]	
Section B [30]	
Total [80]	

This document consists of **16** printed pages.

Setter: Mr Ng Wei Da

Section A [50 marks]

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

For Examiner's Use

1 Fig. 1.1 is the speed-time graph for a rocket from the moment that the fuel starts to burn at time $t = 0$.

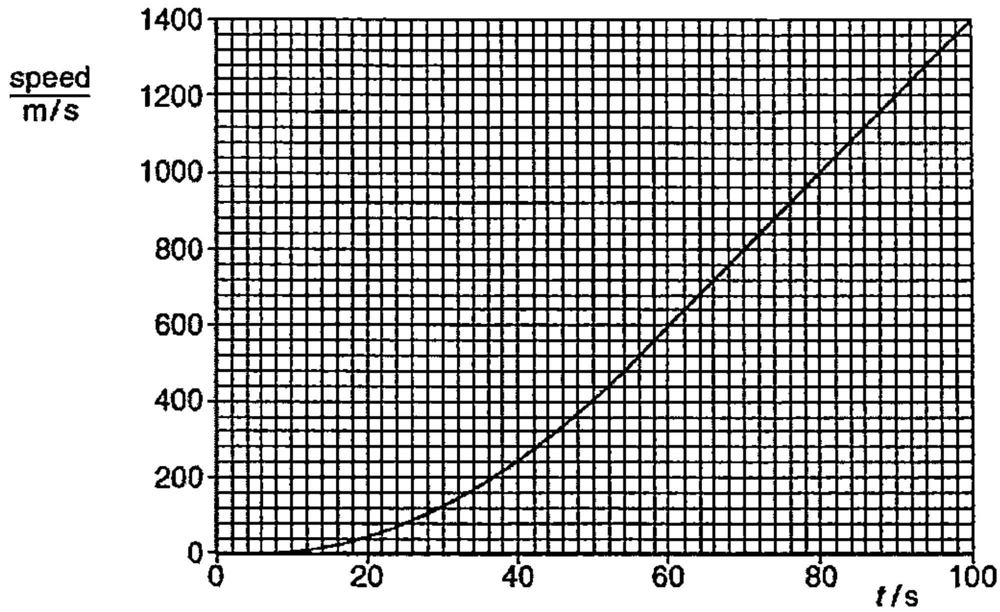


Fig. 1.1

(a) **(i)** State what happens to the acceleration of the rocket between $t = 5$ s and $t = 80$ s.

.... [1]

(ii) Calculate the acceleration of the rocket at $t = 80$ s.

acceleration = ... [2]

(iii) The total mass of the rocket at $t = 80$ s is 1.6×10^6 kg. Calculate the upward force on the rocket at this time, caused by the burning fuel.

upward force = ... [2]

For Examiner's Use

(b) As the rocket burns fuel, it ejects hot gas downwards. Explain how Newton's third law of motion applies to the upward force on the rocket and to the force on the hot gas.

....

.... [1]

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

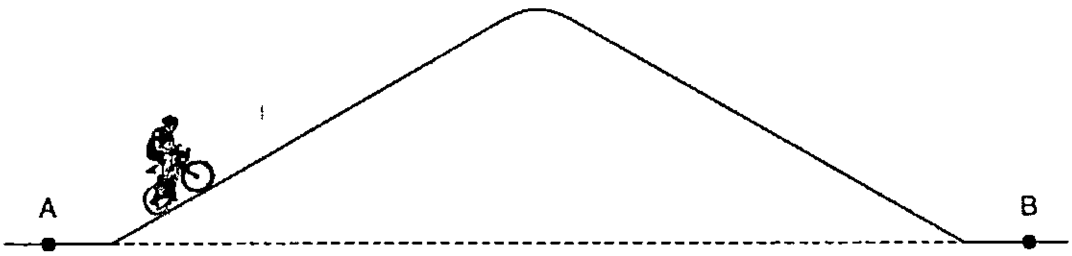


Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

....

....

.... [2]

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

....

....

.... [2]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg.

Calculate the height above A of the cyclist at this point.

height = ... [2]

3 Fig. 3.1 shows a refrigerator. A fluid pumped through the pipes removes thermal energy from the ice box for freezing to occur. This energy passes into the air at the back of the refrigerator through the black metal fins.

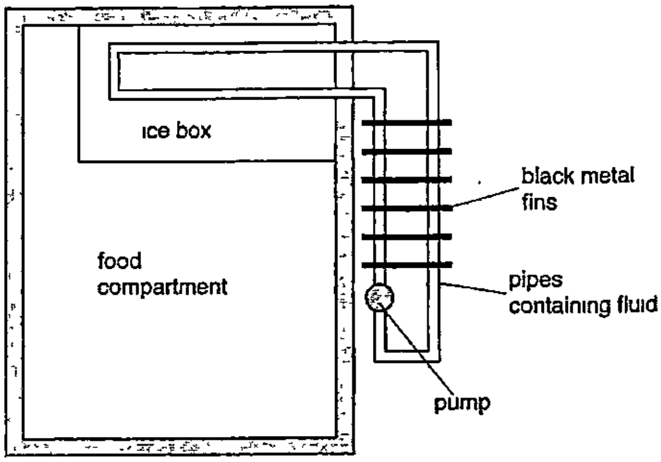


Fig. 3.1

(a) Explain why the fins at the back of the refrigerator are painted black and are made of metal.

....

....

.... [2]

(b) Explain how using a fluid with high specific heat capacity increases the efficiency of the refrigerator.

....

....

.... [2]

(c) A student fills a plastic tray with 400 cm^3 of water which has an initial temperature of 25 °C. The ice box removes thermal energy from the water at a rate of 35 W. Using the information below, estimate the time taken for all the water in the tray to freeze into ice.

Density of water = 1000 kg/m^3
Specific heat capacity of water = 4.2 kJ/(kg°C)
Specific latent heat of fusion of water = 330 kJ/kg

time taken = ... [3]

4 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

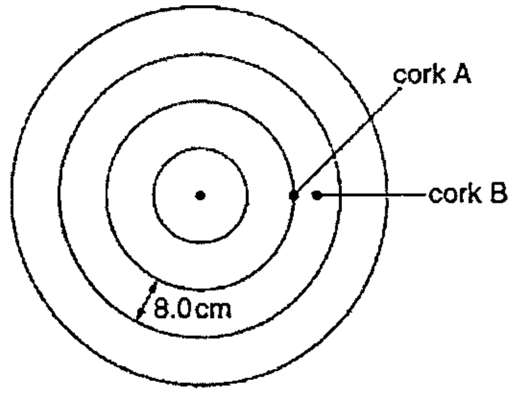


Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

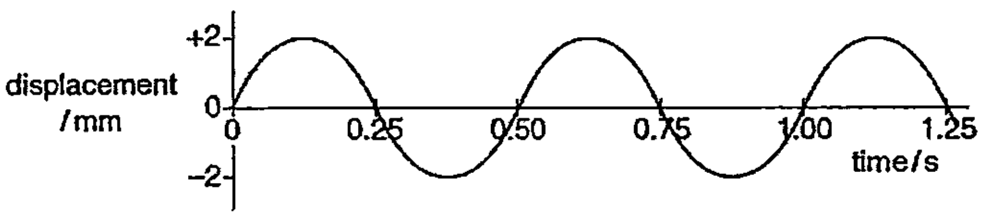


Fig. 4.2

(a) Define what is meant by *wavefront*.

....

.... [1]

(b) **(i)** Use Fig. 4.2 to determine the frequency of the wave.

frequency = ... [1]

(ii) Hence, calculate the speed of the wave.

speed = ... [2]

(c) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

5 Fig. 5.1 represents a simple camera which makes use of a converging lens of focal length *f*.

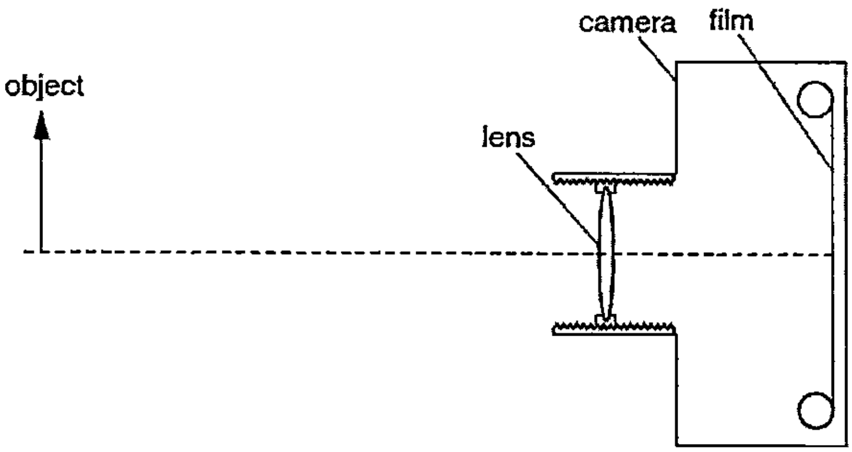


Fig. 5.1 (to scale)

(a) Define what is meant by *focal length*.

....

.... [1]

(b) Draw two rays from the top of the object to show how the image is formed on the film.
Mark and label the image on the film. [2]

(c) Fig. 5.1 is drawn to scale. Determine the linear magnification of the object shown in Fig. 5.1.

linear magnification = ... [1]

(d) Explain why, when taking photographs of other objects, it may be necessary to move the lens towards the film.

....

....

.... [2]

6 The fluorescent tube shown in Fig. 6.1 converts electrical energy into light more efficiently than a filament lamp.

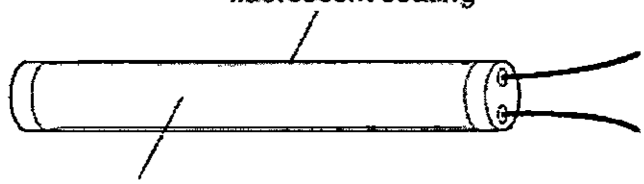


Fig. 6.1

In the gas inside the tube, both light and ultraviolet radiation are produced.

There is a fluorescent coating on the inside surface of the tube.

(a) **(i)** Explain the purpose of the fluorescent coating.

....

.... [1]

(ii) Suggest why the fluorescent tube is more efficient than a filament lamp.

....

....

.... [2]

(b) State the name of one region of the electromagnetic spectrum with wavelengths shorter than ultra-violet radiation.

.... [1]

(c) The ultra-violet radiation inside the tube has a wavelength of 3.6×10^{-7} m. Calculate the frequency of the ultra-violet radiation.

frequency = ... [2]

For Examiner's Use

7 Fig. 7.1 shows part of a circuit that includes a variable resistor R and a battery of e.m.f. 9.0 V.

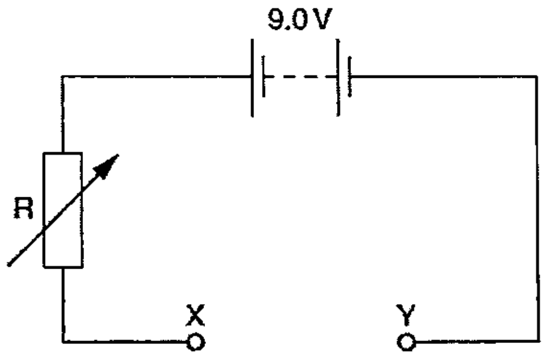


Fig. 7.1

(a) State one similarity and one difference between electromotive force (e.m.f.) and potential difference (p.d.).

similarity: ....

....

difference: ....

....

.... [3]

(b) A light-emitting diode (LED) is connected between points X and Y, so that it emits light.

On Fig. 7.1, draw the symbol for the LED connected between points X and Y. [1]

(c) The LED is marked "maximum current 25 mA when the p.d. is 1.7 V".
Calculate the minimum value of the resistance of R.

resistance = ... [2]

8 Fig. 8.1 shows the structure of a circuit-breaker that uses an electromagnet. The circuit-breaker operates when the current is 10 A.

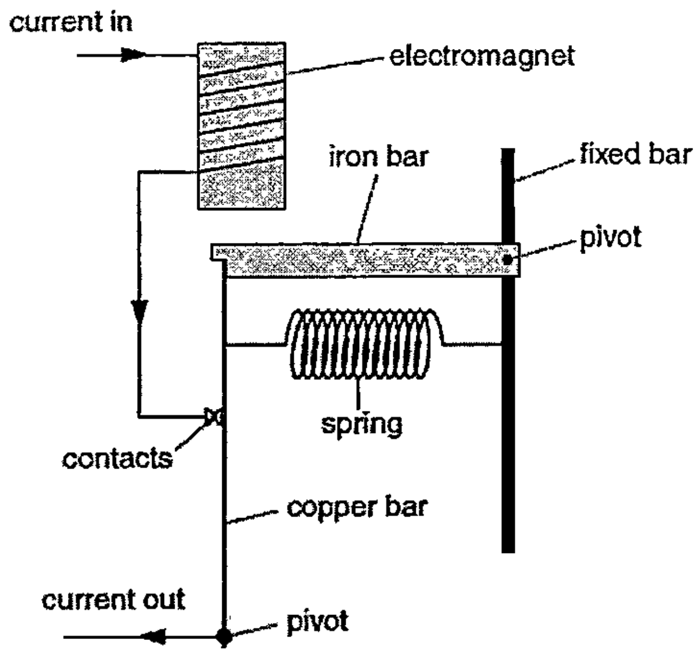


Fig. 8.1

(a) On Fig. 8.1, mark with an arrow the force on the iron bar caused by the electromagnet. [1]

(b) Suggest a reason why the iron bar does not move when the current is less than 10 A.

....

.... [1]

(c) When the current is greater than 10 A, the circuit-breaker stops the current. Explain what happens in the circuit-breaker when this occurs.

....

....

....

.... [3]

(d) State and explain how the electromagnet can be altered so that the circuit-breaker stops the current at less than 10 A.

....

....

.... [2]

SECTION B [30 marks]

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

9 **(a)** Fig. 9.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the Earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

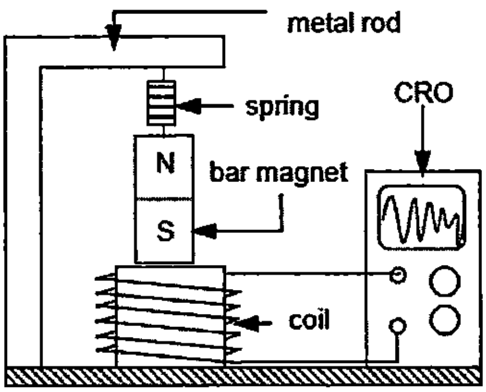


Fig. 9.1

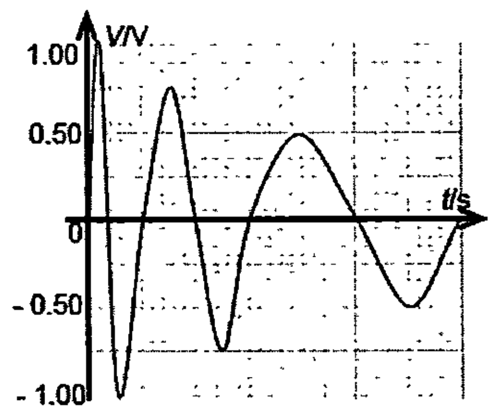


Fig. 9.2

Fig. 9.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 9.2 is obtained when there is an earthquake.

....

....

....

....

....

....

....

.... [4]

(ii) On Fig. 9.1, indicate the direction of the current in the coil when the South pole of the magnet is moving into the coil. [1]

For Examiner's Use

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 1:50. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

.... [1]

(ii) Calculate the current in the primary coil.

current = ... [2]

(iii) State two reasons why a typical transformer is not 100% efficient.

....

....

....

.... [2]

10 (a) In an experiment to measure the specific heat capacity of water, an electric heater heats water in a glass beaker. The temperature of the water is measured at regular intervals of time. Fig. 10.1 shows how the temperature varies with time t.

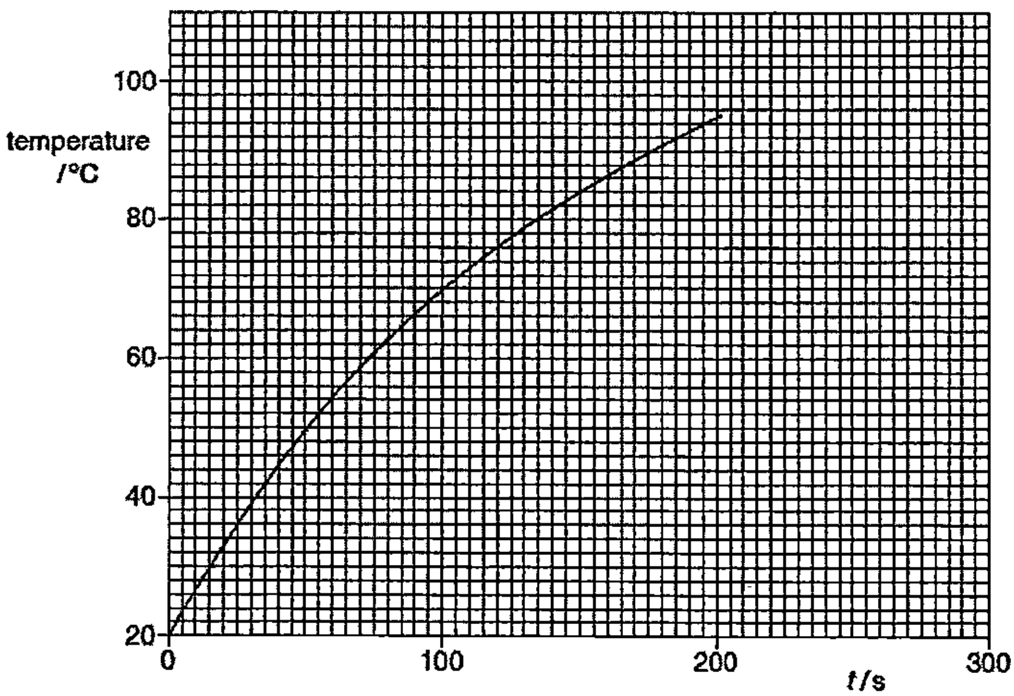


Fig. 10.1

(i) Use Fig. 10.1 to determine the change in temperature between

t = 0 and t = 100 s, change = ...

t = 100 s and t = 200 s. change = ... [1]

(ii) Explain why the values in **(i)** are different.

....

....

.... [2]

(b) **(i)** The experiment in **(a)** is repeated using 72 g of water. The heater supplies 7400 J of thermal energy to the water and the temperature rise of the water is 23 °C. Calculate the specific heat capacity of water.

specific heat capacity = ... [2]

(ii) A bullet of mass 72 g is fired from a gun at a speed of 450 m/s. Calculate the kinetic energy of the bullet.

kinetic energy = ... [2]

(iii) The amount of internal energy gained by the water and the amount of kinetic energy gained by the bullet are approximately equal.

Describe the change in the motion of the molecules of the water and of the molecules of the bullet caused by this addition of energy.

water: ....

....

....

bullet: ....

....

.... [3]

For Examiner's Use

11 EITHER

A crankshaft is a shaped metal bar that is part of a car engine. It is free to rotate about an axis, as shown in Fig. 11.1a.

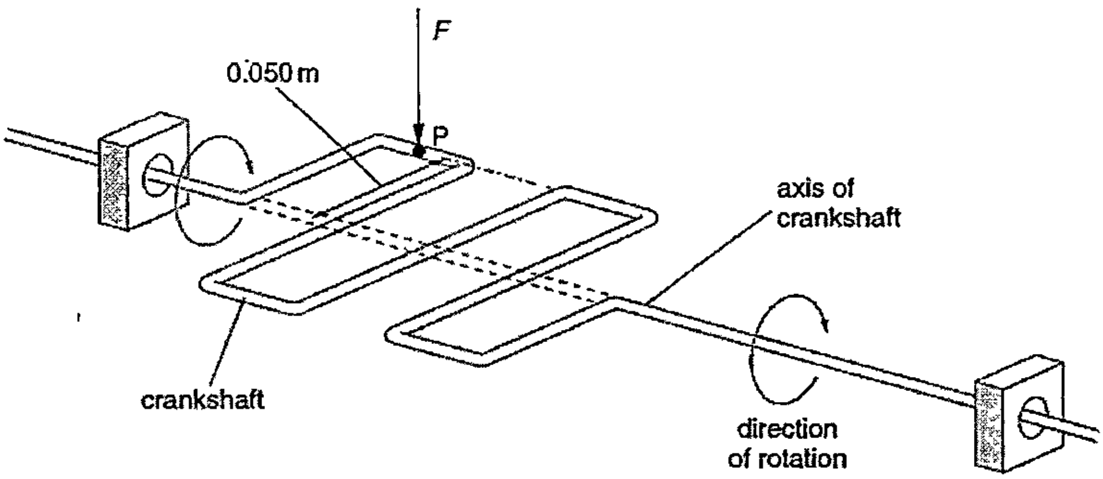


Fig. 11.1a

When the crankshaft is horizontal, a vertical force F of 8200 N acts downwards on the crankshaft at P. This causes the crankshaft to rotate. The distance between P and the axis of the crankshaft is 0.050 m.

(a) **(i)** State what is meant by the *moment* of a force.

....

.... [1]

(ii) The crankshaft is horizontal. Calculate the moment of F about the axis of the crankshaft.

moment = ... [2]

(iii) The size and direction of the vertical force F, acting on the crankshaft at P, remain constant. Explain what happens to the moment of F as the crankshaft rotates through a small angle.

....

....

.... [2]

(b) The force *F* on the crankshaft at P is exerted by a metal rod connected to a piston. The piston traps high-pressure gas in a cylinder, as shown in Fig. 11.1b.

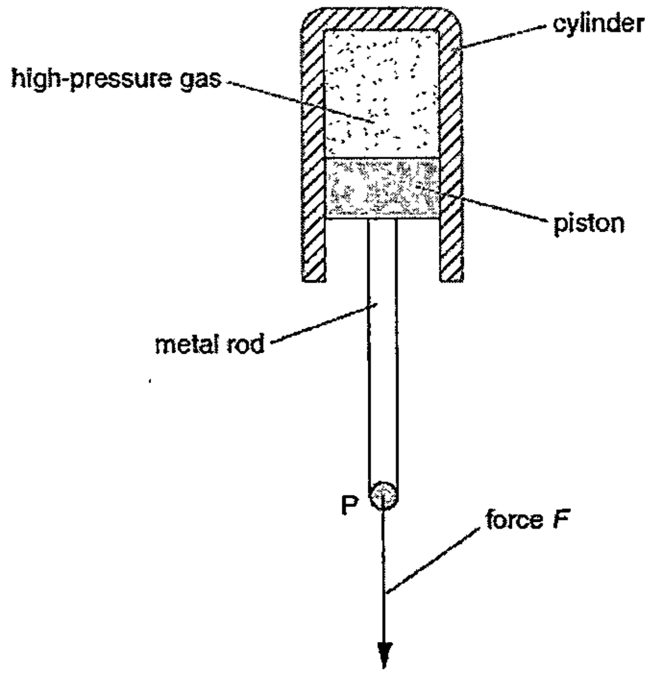


Fig. 11.1b

The force *F*, of 8200 N, acts because the high-pressure gas pushes down on the piston. The air pressure outside the cylinder is 1.0×10^5 Pa and the cross-sectional area of the piston is $0.0067\ m^2$.

(i) Calculate the minimum value of the pressure of the gas in the cylinder.

pressure = ... [2]

(ii) Suggest why, in practice, the pressure of the gas in the cylinder is greater than the value calculated in **(i)**.

....

....

.... [2]

(iii) The piston moves in the cylinder and the gas expands. State what happens to the force *F*.

.... [1]

For Examiner's Use

11 OR

Fig. 11.2a shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0×10^5 Pa.

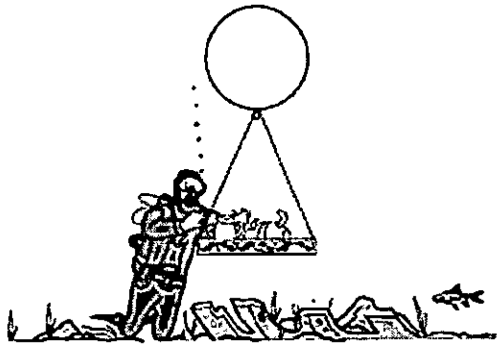


Fig. 11.2a

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure at 15 m below the surface of the lake.

pressure = ... [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure.

volume = ... [2]

(ii) The pressure of the air inside the balloon is less at the surface than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less.

....

....

.... [2]

For Examiner's Use

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

....

....

....

....

.... [3]

(ii) On the axes in Fig. 11.2b, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [1]

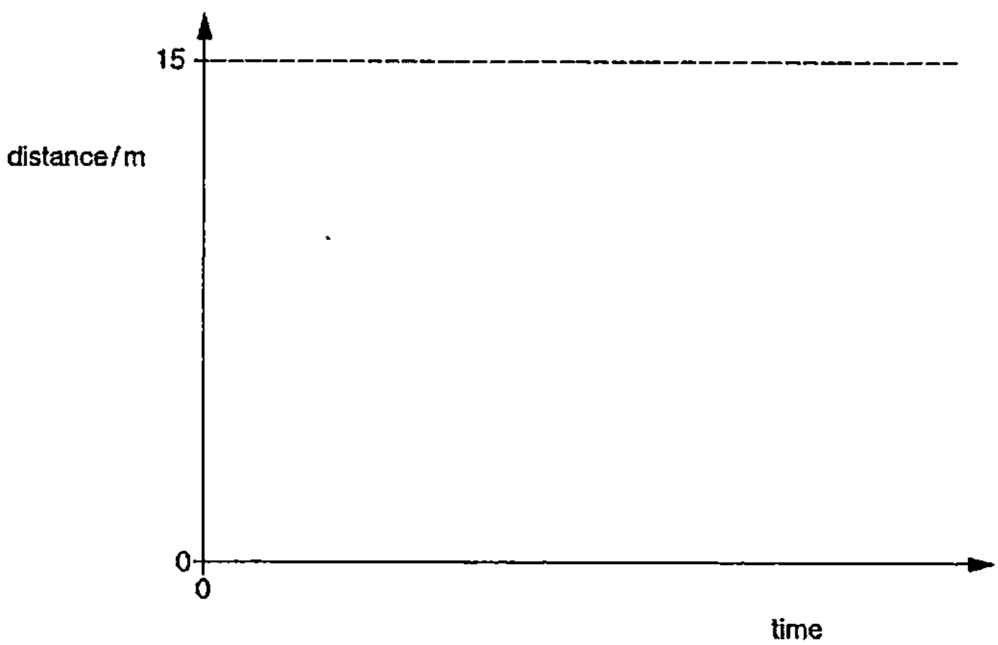


Fig. 11.2b

– END OF PAPER –

Anderson Secondary School
2015 Secondary 4 Express Preliminary Examination

Physics (5059)
Paper 1 Answers

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

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2015
Secondary Four Express & Five Normal

CANDIDATE NAME:	SUGGESTED ANSWERS		
CLASS:	/	INDEX NUMBER:	

PHYSICS **5059/02**

Paper 2

1 September 2015

1 hour 45 minutes

1045 – 1230h

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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Section B
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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.

You may use a calculator.
Leave your answers in 2 significant figures unless stated otherwise.

You may take g, the gravitational field strength of Earth, to be 10 N/kg.

For Examiner's Use	
Section A [50]	
Section B [30]	
Total [80]	

Setter: Mr Ng Wei Da

Section A [50 marks]

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

1 Fig. 1.1 is the speed-time graph for a rocket from the moment that the fuel starts to burn at time $t = 0$. *For Examiner's Use*

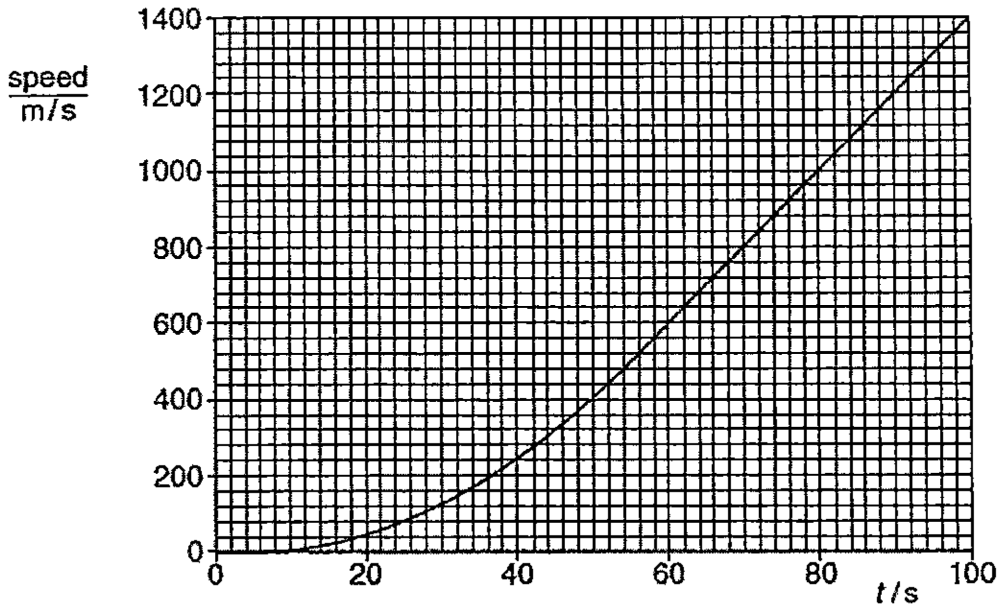

Fig. 1.1

(a) **(i)** State what happens to the acceleration of the rocket between $t = 5$ s and $t = 80$ s.

It **increases** and **eventually reaches a constant value.** [1]

(ii) Calculate the acceleration of the rocket at $t = 80$ s.

Acceleration = gradient of speed-time graph
= (1400 – 400) / (100 – 50) **[1]**
= <u>20 m/s^2</u> **[1]**

acceleration = 20 m/s^2 [2]

(iii) The total mass of the rocket at $t = 80$ s is 1.6×10^6 kg. Calculate the upward force on the rocket at this time, caused by the burning fuel.

Net force = ma = $1.6 \times 10^6 \times 20$
= 3.2×10^7 N **[1]**

Upward force = $3.2 \times 10^7 + (1.6 \times 10^6 \times 10)$
= <u>4.8×10^7 N</u> **[1] Max 1m ecf from (ii)**

upward force = 4.8×10^7 N [2]

(b) As the rocket burns fuel, it ejects hot gas downwards. Explain how Newton's third law of motion applies to the upward force on the rocket and to the force on the hot gas.

The upward force on the rocket is **equal in magnitude and opposite** to the **downward force acting on the hot gas.** [1]

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

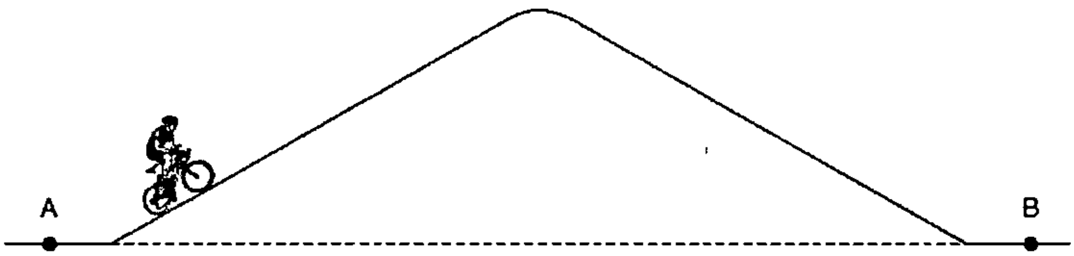

Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

Chemical potential energy in the cyclist is **converted to gravitational potential energy** as she pedals **up the hill**. Some of it is also **converted to thermal energy/heat** due to **friction** on the road. [2] **[1]** **[1]**

(if KE is mentioned, an idea of no net gain in KE must be conveyed)

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

From A to B, **all the chemical potential energy** used by the cyclist is **converted to thermal energy / heat**. Since the **total energy remains constant (or energy is not created nor destroyed)**, the law of conservation of energy applies to this journey. [2] **[1]** **[1]**

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg.

Calculate the height above A of the cyclist at this point.

Using GPE = mgh,

$5400 = 60 \times 10 \times h$ **[1]**

$h = \underline{9.0\text{ m}}$ **[1]**

height = 9.0 m [2]

For Examiner's Use

3 Fig. 3.1 shows a refrigerator. A fluid pumped through the pipes removes thermal energy from the ice box for freezing to occur. This energy passes into the air at the back of the refrigerator through the black metal fins.

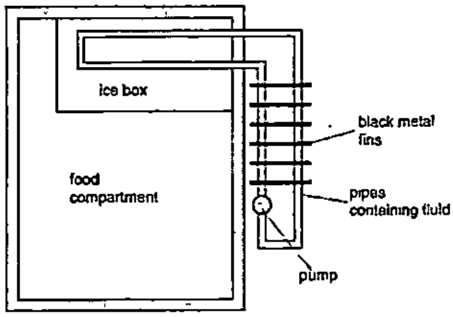

Fig. 3.1

(a) Explain why the fins at the back of the refrigerator are painted black and are made of metal.

Black surfaces are **good emitters of infrared radiation** *(accept good radiators / emitters of heat but emphasise correct phrase in class)*. At the same time, metals are **good conductors of heat**, so the black metal fins are able to **transfer heat** <u>**to the surroundings**</u> **quickly/effectively etc.** [2]

[1] [1] must be mentioned

(b) Explain how using a fluid with high specific heat capacity increases the efficiency of the refrigerator.

A given mass of the fluid will be able to **absorb a larger amount of thermal** energy from the ice box **per unit temperature change**, hence the pump **does not need to circulate the liquid as quickly / time taken to cool the contents will be shorter.** [2]

[1] [1]

(c) A student fills a plastic tray with 400 cm^3 of water which has an initial temperature of 25 °C. The ice box removes thermal energy from the water at a rate of 35 W. Using the information below, estimate the time taken for all the water in the tray to freeze into ice.

Density of water = 1000 kg/m^3
Specific heat capacity of water = 4.2 kJ/(kg°C)
Specific latent heat of fusion of water = 330 kJ/kg

Mass of water = 1000 x 400 x 10^{-6} = 0.40 kg [1]
Total energy absorbed = $ml_f + mc\Delta\theta$
= 0.40 x 330 000 + 0.40 x 4200 x 25
= 174 000 J [1]
Time taken = E / P = 174000 / 35
= <u>5000 s (2sf)</u> [1]

Max 1 mark awarded if mass is wrongly calculated

time taken = <u>5000 s (2sf)</u> [3]

4 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

For Examiner's Use

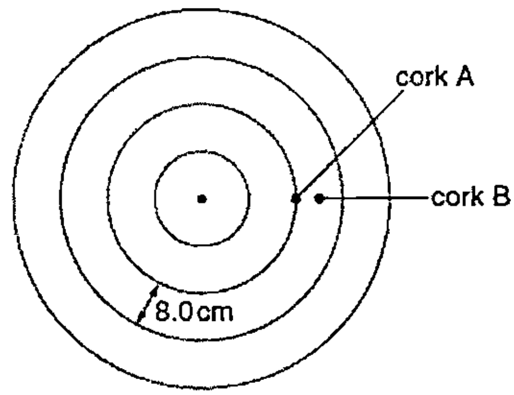

Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

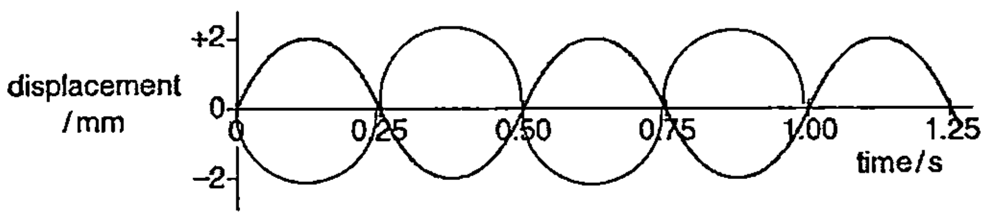

Fig. 4.2

[1] same amplitude and period

[1] opposite phase with at least 2 waves drawn

(a) Define what is meant by *wavefront*.

A wavefront is a(n) (imaginary) line on a wave that joins all adjacent points that are in phase. [1]

(b) **(i)** Use Fig. 4.2 to determine the frequency of the wave.

f = 1/ T = 1 / 0.50 = 2.0 Hz

frequency = 2.0 Hz [1]

cao

(ii) Hence, calculate the speed of the wave.

$v = f\lambda = 2.0 \times 8.0$ [1]

$= 16$ cm/s or 0.16 m/s [1]

speed = 16 cm/s (0.16 m/s) [2]

max. 1m ecf

(c) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

5 Fig. 5.1 represents a simple camera which makes use of a converging lens of focal length *f*.

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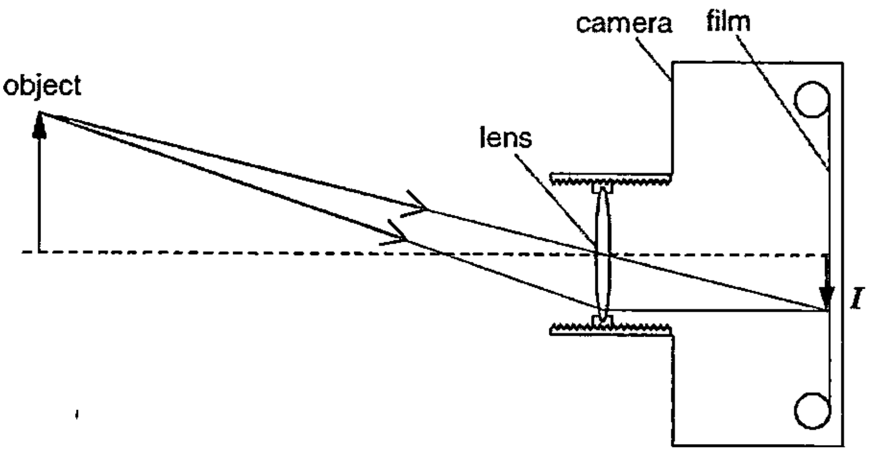

Fig. 5.1 (to scale)

[1] both rays correctly drawn

[1] Image correctly drawn <u>and</u> labelled

(1m penalty for missing arrows)

(a) Define what is meant by *focal length*.

It is the distance between the optical centre and focal point of a converging lens. [1]

(b) Draw two rays from the top of the object to show how the image is formed on the film.
Mark and label the image on the film. [2]

(c) Fig. 5.1 is drawn to scale. Determine the linear magnification of the object shown in Fig. 5.1.

Linear magnification = <u>0.40 (± 0.05)</u> (can accept 1 sf)

linear magnification = 0.40 (± 0.05) [1]

(d) Explain why, when taking photographs of other objects, it may be necessary to move the lens towards the film.

For other **objects which are further away (or increased object distance)**, the lens has to move towards the film in order for the **light rays to converge onto the film** and **produce a sharp image.** [2]

[1]

[1]

6 The fluorescent tube shown in Fig. 6.1 converts electrical energy into light more efficiently than a filament lamp.

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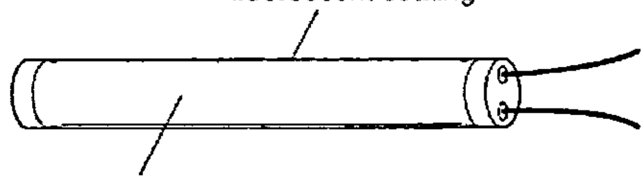

Fig. 6.1

In the gas inside the tube, both light and ultra-violet radiation are produced.

There is a fluorescent coating on the inside surface of the tube.

(a) **(i)** Explain the purpose of the fluorescent coating.

The fluorescent coating **gives out light / glows** when it is **hit by ultraviolet radiation** produced in the tube. [1]

(ii) Suggest why the fluorescent tube is more efficient than a filament lamp.

In a filament lamp, most of the energy is **converted to / lost as (unwanted) heat** while in a fluorescent tube, some energy is converted to **uv radiation** which **can also produce light.** [2]

[1]

[1]

(b) State the name of one region of the electromagnetic spectrum with wavelengths shorter than ultra-violet radiation.

X-rays / gamma rays [1]

cao

(c) The ultra-violet radiation inside the tube has a wavelength of 3.6×10^{-7} m. Calculate the frequency of the ultra-violet radiation.

Using $v = f\lambda$,

$3.0 \times 10^{8} = f \times 3.6 \times 10^{-7}$ **[1]**

$f = \underline{8.3 \times 10^{14}\ \text{Hz}}$ **[1]**

frequency = 8.3×10^{14} Hz [2]

7 Fig. 7.1 shows part of a circuit that includes a variable resistor R and a battery of e.m.f. 9.0 V.

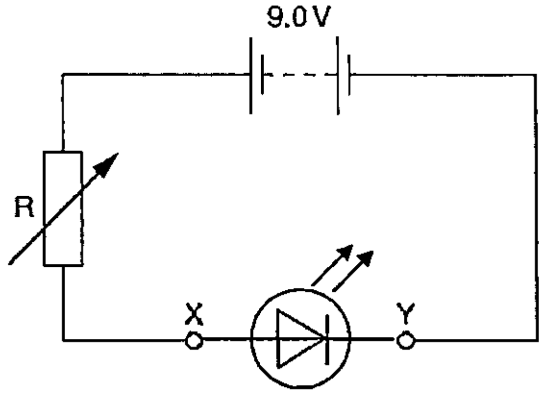

Fig. 7.1

(a) State one similarity and one difference between electromotive force (e.m.f.) and potential difference (p.d.).

similarity: Both involve energy (or work done) per unit charge / are measured in V (or J/C) / measured using a voltmeter (**any one**). [1]

difference: In e.m.f., energy is converted from **chemical (accept 'other forms') to electrical energy**, while in p.d., the energy change is **from electrical to other forms (accept heat/light energy)**. OR [1] [1]

In e.m.f., the work done is to **drive a unit charge around the circuit** but in p.d., the work done is to drive a unit charge **across a component.** [3] [1] [1]

(The difference mentioned must be a like-for-like comparison, or else 1 mark penalty.)

(b) A light-emitting diode (LED) is connected between points X and Y, so that it emits light.

On Fig. 7.1, draw the symbol for the LED connected between points X and Y. [1]

Correct symbol and direction

(c) The LED is marked "maximum current 25 mA when the p.d. is 1.7 V". Calculate the minimum value of the resistance of R.

p.d. across R = 9.0 - 1.7
= 7.3 V

Minimum value of R = V/I
= 7.3 / 0.025 [1]
= 290 Ω (2 s.f.) [1]

-1 mark for wrong sf

resistance = 290 Ω [2]

8 Fig. 8.1 shows the structure of a circuit-breaker that uses an electromagnet. The circuit-breaker operates when the current is 10 A.

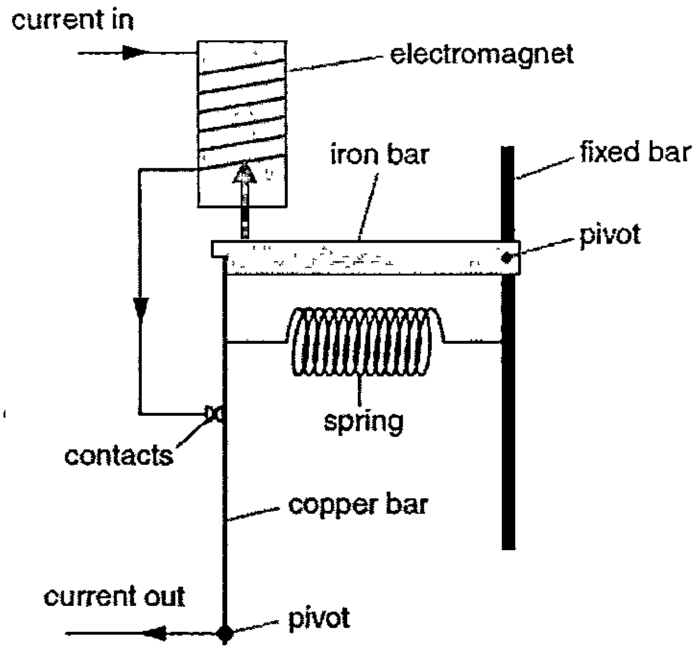

Fig. 8.1

(a) On Fig. 8.1, mark with an arrow the force on the iron bar caused by the electromagnet. [1]

Must be drawn from Iron bar

(b) Suggest a reason why the iron bar does not move when the current is less than 10 A.

When the current is less than 10 A, the **attractive force** exerted by the **magnetised electromagnet is not strong** enough to lift the iron bar. [1] **[1]**

(c) When the current is greater than 10 A, the circuit-breaker stops the current. Explain what happens in the circuit-breaker when this occurs.

When the current is greater than 10 A, the electromagnet becomes **strongly magnetised** and **attracts the iron bar upwards**. The **spring** **[1]**
contracts and **pulls the copper bar**, breaking the contacts. The **circuit** **[1]**
is now **open** and the **current stops flowing**. [3] **[1]**

(d) State and explain how the electromagnet can be altered so that the circuit-breaker stops the current at less than 10 A.

Increase the number of turns in the coil. **[1]**
This will **increase the attractive force** acting on the iron bar when **[1]**
the current is less 10 A. **(accept other answers involving force on the iron bar)** [2]

SECTION B [30 marks]

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

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9 (a) Fig. 9.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the Earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

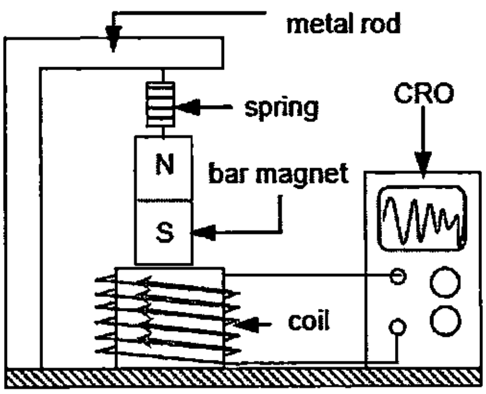


Fig. 9.1

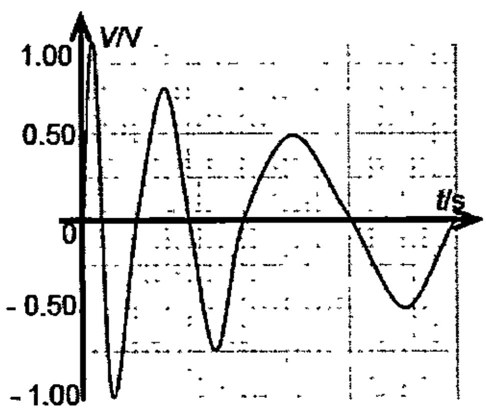


Fig. 9.2

Fig. 9.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 9.2 is obtained when there is an earthquake.

During an earthquake, the magnet moves in and out of the coil, **producing a change in magnetic flux linking the coil**, thus **inducing an emf.** [1]

By **Lenz's Law**, the **direction of the emf changes** when the magnet moves in and out of the coil, hence **an alternating trace** is produced. [1]

By **Faraday's Law**, the **magnitude** of the induced emf is **proportional to the rate of change of magnetic flux linkage,** [1]

hence a **larger tremor** will produce a trace with a **higher amplitude.** [4] [1]

(ii) On Fig. 9.1, indicate the direction of the current in the coil when the South pole of the magnet is moving into the coil. [1]

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 1:50. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

Soft iron [1] **cao**

(ii) Calculate the current in the primary coil.

$V_s = 50 \times 2.0$
$= 100$ V **[1]**

$0.75 \times V_pI_p = V_sI_s$
$0.75 \times 2.0 \times I_p = 100 \times 0.0024$
$I_p = \underline{0.16\text{ A}}$ **[1]**

current = 0.16 A [2]

(iii) State two reasons why a typical transformer is not 100% efficient.

Induced (eddy) currents are formed in the core of the transformer. / There is **heat loss due to the resistance in the wires.** / There is **magnetic flux leakage** between the primary and secondary coil. **(any two)** [2]

10 (a) In an experiment to measure the specific heat capacity of water, an electric heater heats water in a glass beaker. The temperature of the water is measured at regular intervals of time. Fig. 10.1 shows how the temperature varies with time t.

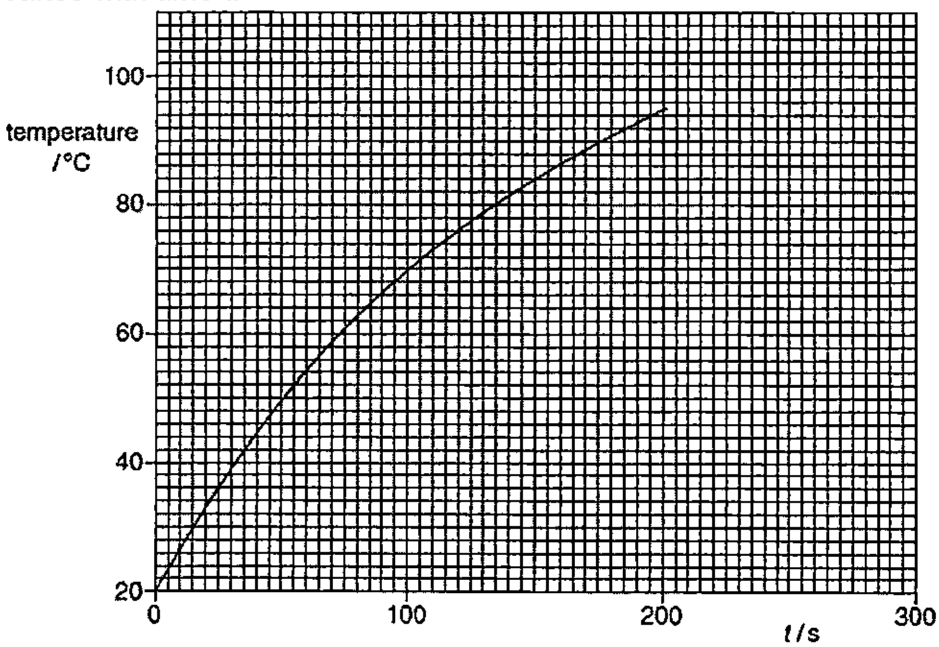


Fig. 10.1

For Examiner's Use

(i) Use Fig. 10.1 to determine the change in temperature between

t = 0 and t = 100 s, change = 50 °C

t = 100 s and t = 200 s. change = 25 °C [1]

[1] for both

(ii) Explain why the values in **(i)** are different.

At a later time, the **temperature of the water is higher**, hence **[1]**
there is **greater heat loss due to evaporation / greater heat loss** **[1]**
to the surrounding , so temp increases at a slower rate. OR
At a later time, some of the thermal energy supplied is **starting to**
be used to overcome the attractive forces of attraction **[1]**
between molecules **instead of being used to increase their** **[1]**
speed, hence the temp rise increases at a slower rate. [2]

(b) **(i)** The experiment in **(a)** is repeated using 72 g of water. The heater supplies 7400 J of thermal energy to the water and the temperature rise of the water is 23 °C. Calculate the specific heat capacity of water.

$Q = mc\Delta\theta$
$c = 7400 / (72 \times 23)$ **[1]**
$= \underline{4.5\ J / (g\ °C)\ or\ 4500\ J / (kg\ °C)}$ **[1]**

specific heat capacity = 4500 J / (kg °C) [2]

(ii) A bullet of mass 72 g is fired from a gun at a speed of 450 m/s. Calculate the kinetic energy of the bullet.

$KE = \frac{1}{2} mv^2$
$= \frac{1}{2} \times 0.072 \times 450^2$ **[1]**
$= \underline{7300\ J\ (2\ s.f.)}$ **[1]**

kinetic energy = 7300 J [2]

(iii) The amount of internal energy gained by the water and the amount of kinetic energy gained by the bullet are approximately equal.

Describe the change in the motion of the molecules of the water and of the molecules of the bullet caused by this addition of energy.

water: The water molecules **move faster**. However, the **motion** **[1]**
is still random as the molecules slide over each other in the **[1]**
liquid.

bullet: All the molecules of the bullet **move/vibrate faster about**
their fixed positions. [3] **[1]**

11 EITHER

A crankshaft is a shaped metal bar that is part of a car engine. It is free to rotate about an axis, as shown in Fig. 11.1a.

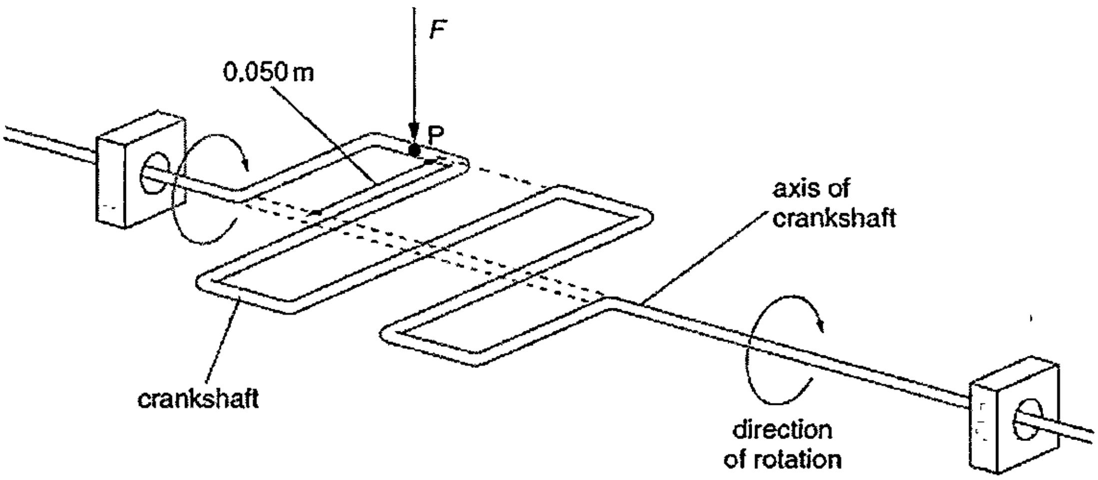


Fig. 11.1a

When the crankshaft is horizontal, a vertical force F of 8200 N acts downwards on the crankshaft at P. This causes the crankshaft to rotate. The distance between P and the axis of the crankshaft is 0.050 m.

(a) **(i)** State what is meant by the *moment* of a force.

The moment of a force is the product of the force and the perpendicular distance from its line of action to the pivot. [1]

(ii) The crankshaft is horizontal. Calculate the moment of F about the axis of the crankshaft.

Moment = F x perpendicular d
= 8200 x 0.050 **[1]**
= 410 Nm **[1]**

moment = 410 Nm [2]

(iii) The size and direction of the vertical force F, acting on the crankshaft at P, remain constant. Explain what happens to the moment of F as the crankshaft rotates through a small angle.

When the crankshaft rotates through a small angle, the **perpendicular distance decreases / force is no longer** **[1]** **perpendicular** and hence the **moment of F decreases.** [2] **[1]**

(b) The force F on the crankshaft at P is exerted by a metal rod connected to a piston. The piston traps high-pressure gas in a cylinder, as shown in Fig. 11.1b.

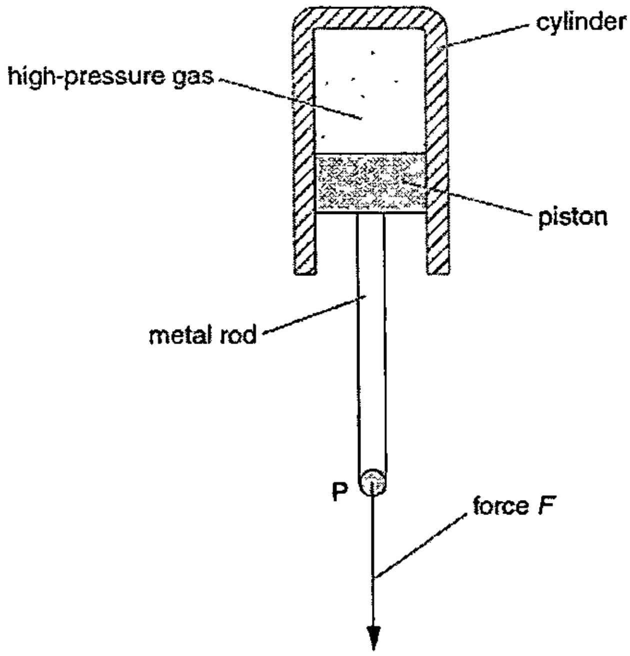


Fig. 11.1b

The force F, of 8200 N, acts because the high-pressure gas pushes down on the piston. The air pressure outside the cylinder is 1.0×10^5 Pa and the cross-sectional area of the piston is 0.0067 m^2.

(i) Calculate the minimum value of the pressure of the gas in the cylinder.

Pressure due to F = F / A
= 8200 / 0.0067
= 1.22×10^6 Pa **[1]**

Hence minimum pressure = $1.22 \times 10^6 + 1.0 \times 10^5$
= $\underline{1.3 \times 10^6 \text{ Pa}}$ **[1]**

pressure = 1.3×10^6 Pa [2]

(ii) Suggest why, in practice, the pressure of the gas in the cylinder is greater than the value calculated in **(i)**.

In practice, there is **friction** between **the piston and the cylinder** **[1]**

which **opposes the motion of the piston**, hence a larger gas **[1]**

pressure is required to **overcome** it. [2]

(iii) The piston moves in the cylinder and the gas expands. State what happens to the force F.

The gas pressure decreases and hence ***F* decreases.** [1]

For Examiner's Use

11 OR

Fig. 11.2a shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

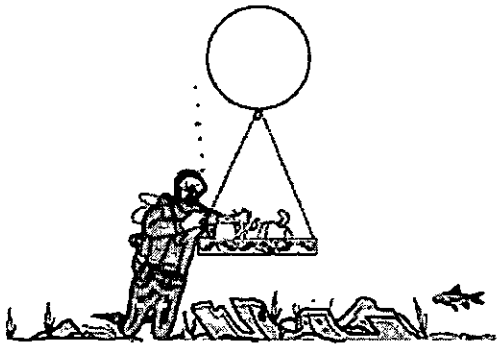


Fig. 11.2a

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure at 15 m below the surface of the lake.

Total pressure = $h\rho g + P_{atm}$
= 15 x 1000 x 10 + 1.0 x 10^5 [1]
= 2.5 x 10^5 Pa [1]

pressure = 2.5 x 10^5 Pa [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure.

Using $P_1V_1 = P_2V_2$,
$2.5 \times 10^5 \times 0.048 = 1.0 \times 10^5 \times V_2$ [1]
V_2 = 0.12 m^3 [1]
max 1m ecf

volume = 0.12 m^3 [2]

(ii) The pressure of the air inside the balloon is less at the surface than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less.

At the surface, the air molecules inside the balloon **occupy a large space / are further apart**, hence the **frequency of collisions with the inner walls** of the balloon is **lower.** [2]

[1]
[1]

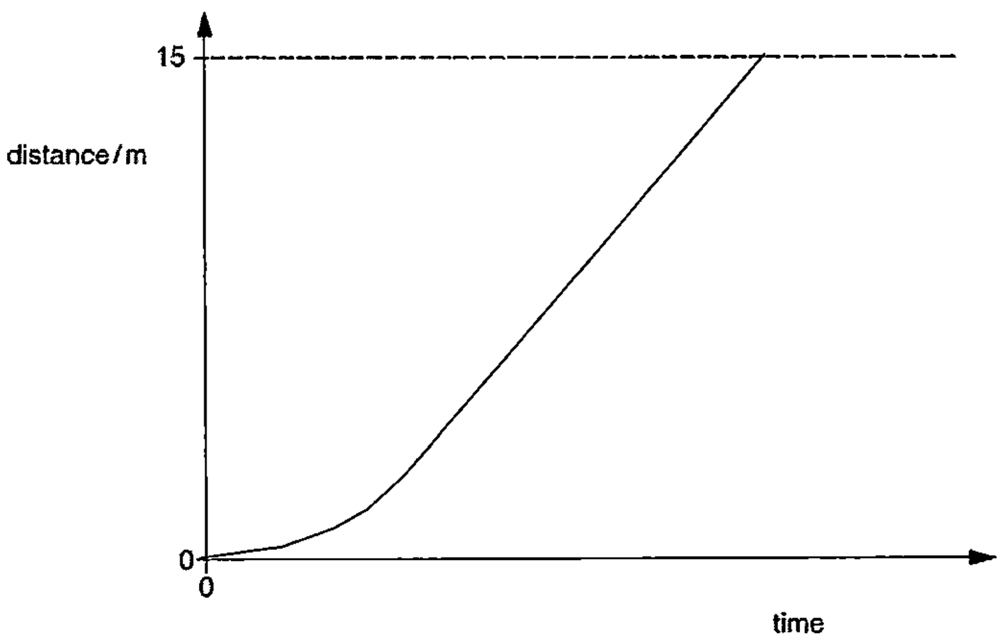
For Examiner's Use

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

When the diver first releases the tray, the **unbalanced / net upward force** causes the balloon to accelerate. As it moves **[1]**
upwards, the **downwards water resistance / friction increases.** **[1]**
Eventually, when there is **no net force** / the **upwards force is balanced by the downwards force**, the balloon will move at a **[1]**
constant speed. [3]

(ii) On the axes in Fig. 11.2b, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [1]



starts from (0,0)

gradient increases initially

constant gradient

graph ends at 15 m

– END OF PAPER –