COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2016

PHYSICS (5059/1)

PAPER 1

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

22 August 2016
1030 - 1130
1 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

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

Read very carefully the instructions on the OTAS.

INFORMATION FOR CANDIDATES

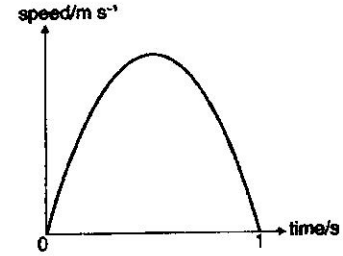
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Take the gravitational field strength on Earth, g to be 10 Nkg^{-1}.

Name of setter: Mdm Quek Lay Hong

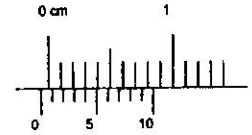
1 The graph shows the speed-time graph of a pendulum bob oscillating from a point.



What is the period of the oscillation of the pendulum bob?

A 5 s **B** 1.0 s **C** 1.5 s **D** 2.0 s

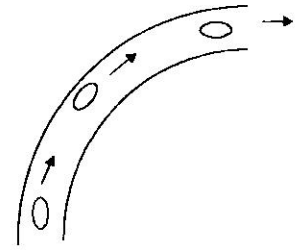
2 The diagram below shows part of a vernier scale when the jaws of the vernier calipers are closed.



What is the zero error of the vernier calipers shown?

A +0.04 cm **B** -0.04 cm **C** +0.06 cm **D** -0.06 cm

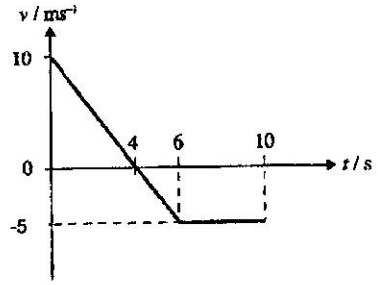
3 A car travels at *constant speed* round a bend.



Which of the following statements about the motion of the car is **not** correct?

A The car is accelerating.
B The velocity of the car is uniform.
C The displacement of the car increases.
D The distance covered per unit time by the car is constant.

4 The velocity-time graph below shows the motion of an object moving in a straight line.



Which of the following statements is/are true?

1. The object is stationary at 4 s.
2. The object is 5 m behind the starting point at t = 6 s.
3. The object is furthest away from its starting point at t = 10 s.

A 1 only
B 1 and 2 only
C 1 and 3 only
D All of the above

5 The engine of an 800 kg sports car exerts a constant forward force of 500 N on the car.

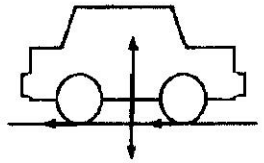
When the parachute is opened, the car decelerates at 2.5 ms^{-2} while the engine continues to provide the forward force of 500 N.

What is the tension in the cord at this instant? (Assuming that there is no other resistive force.)

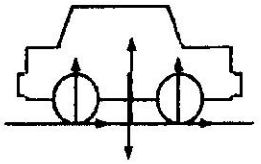
A 500 N
B 1500 N
C 2000 N
D 2500 N

6 A car starting from rest accelerates towards the right without skidding along a horizontal road. Which diagram below illustrates the forces acting on the car?

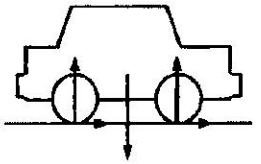
A



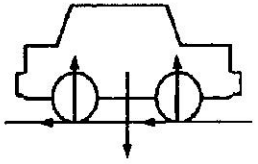
B



C



D

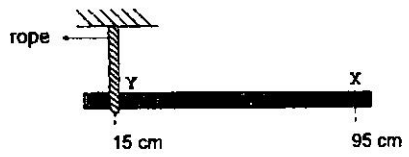


7 The gravitational field strength of a particular planet is 5 N/kg. On earth, the gravitational field strength is 10 N/kg. A rock weighs 80 N on that planet.

What would be its weight on earth?

A 10 N B 16 N C 80 N D 160 N

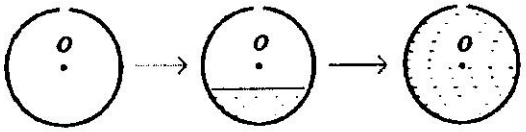
8 In the diagram below, the uniform metre rule is pivoted at X and held up at the point Y by a rope.



Given that the weight of the metre rule is 4.0 N, calculate the tension in the rope that is needed to ensure that the ruler stays horizontal.

A 1.8 N B 2.3 N C 3.1 N D 5.1 N

9

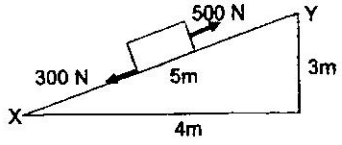


The above diagram shows a uniform hollow metal sphere with a small opening on top. *O* is the position of the centre of gravity of the hollow sphere.

What will happen to the position of the centre of gravity of the system as the sphere is being slowly filled with oil from the opening?

A It will remain unchanged throughout the process.
B It will fall gradually, and its final position will be below *O*.
C It will rise gradually and its final position will be above *O*.
D It will fall gradually at first and then rise to its original position.

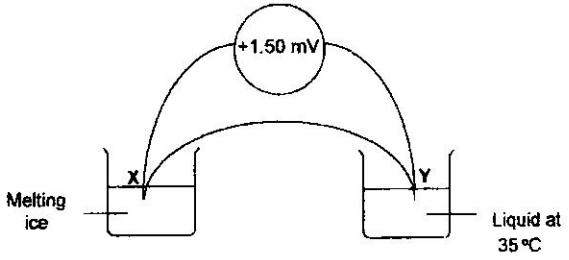
10 A force of 500 N is applied to a box to move it up the ramp as shown. The friction acting on the box is 300 N.



How much work is done against friction?

A 300 J B 1 200 J C 1 500 J D 3 000 J

11 The diagram shows a thermocouple thermometer when junctions X and Y are placed in melting ice and in a liquid at 35°C respectively.



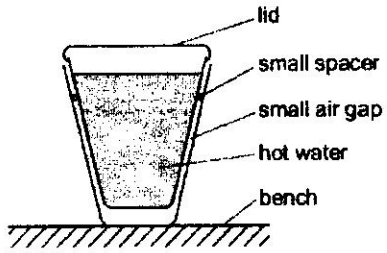
What is the voltmeter reading when junction X is removed and placed in boiling water instead?

A -2.79 mV B -1.92 mV
C +1.50 mV D +2.79 mV

12 Which of the following best explains steam point?

A The temperature of pure water when it boils at a pressure of 1 atm.
B The temperature of pure water just after it boils at a pressure of 1 atm.
C The temperature of steam from pure boiling water at a pressure of 1 atm.
D The temperature of the air above pure boiling water at a pressure of 1 atm.

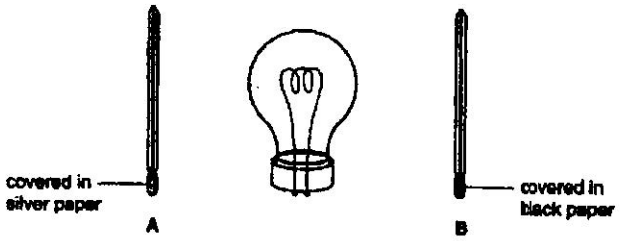
13 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top, as shown.



Which statement is correct?

A No heat passes through the sides of either cup.
B The lid is used to reduce heat loss by convection.
C Heat loss by radiation is prevented by the small air gap.
D The bench is heated by convection from the bottom of the outer cup.

14 The experiment is set up using a light bulb and two thermometers, **A** and **B**. The light bulb is switched on. After two minutes the thermometers show an increase in temperature. Thermometer **B** shows a greater increase in temperature.



Which of the following is/are **true** statements about this experiment?

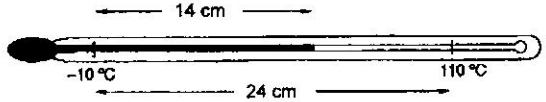
1. The silver paper is a better reflector of radiation.
2. The black paper is a better absorber of radiation
3. Heat is transferred to the thermometers mainly by radiation.

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

15 What happens when a liquid is being heated at its boiling point?

A An increase in molecular size
B An increase in molecular spacing
C An increase in the total number of molecules
D An increase in the average kinetic energy of the molecules

16 The figure below shows a mercury thermometer. The distance between the -10°C and 110°C markings is 24 cm.



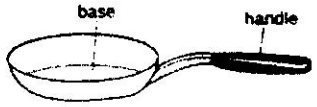
What temperature does the thermometer read?

A 48 °C
B 58 °C
C 60 °C
D 70 °C

17 Which statement is true about water molecules at 70 °C?

A There are forces between the molecules and no molecules have enough energy to escape the liquid.
B There are forces between the molecules and some molecules have enough energy to escape the liquid.
C There are no forces between the molecules and no molecules have enough energy to escape the liquid.
D There are no forces between the molecules and some molecules have enough energy to escape the liquid.

18 The diagram below shows a frying pan.



The table shows three solid materials with their respective specific heat capacities.

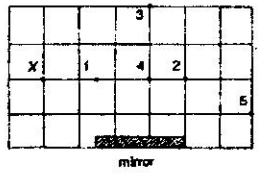
Solid Material	*Specific Heat Capacity (J/kg°C)*
K	440
L	920
M	4250

Assuming all these materials have reasonably high melting points, which materials are best suited to make the base and handle?

	Base	Handle
A	K	M
B	L	M
C	M	K
D	M	L

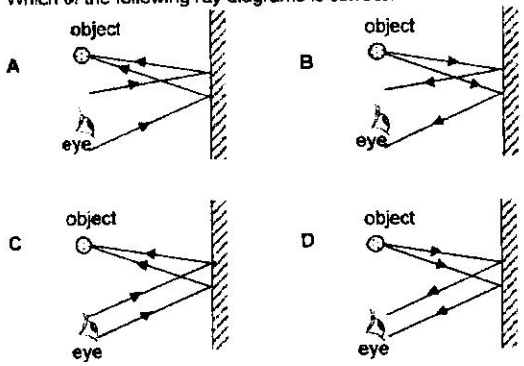
19 A person stands at point *X* as shown in the diagram.

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



A 1, 3
B 2, 3 and 4
C 2, 4
D 2, 4 and 5

20 Which of the following ray diagrams is correct?

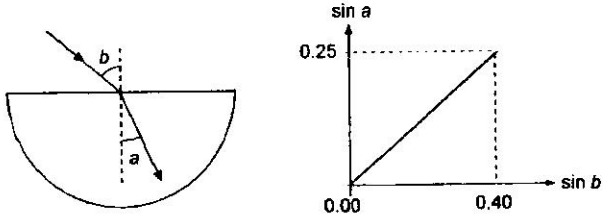


21 A ray of light travels with speed v_1 through medium 1 and then passes into another medium 2, where it travels at speed v_2. The refractive index for medium 1 and medium 2 are n_1 and n_2 respectively.

Which row in the following table correctly compares the speeds and refractive indices for each medium?

	Speed of light	Refractive index
A	v_2 is less than v_1	n_1 is less than n_2
B	v_2 is less than v_1	n_2 is same as n_1
C	v_2 is greater than v_1	n_2 is same as n_1
D	v_2 is greater than v_1	n_1 is less than n_2

22 A light beam is incident into a semi-circular glass block and refracted out as shown. A graph of sin *a* against sin *b* is plotted as shown.

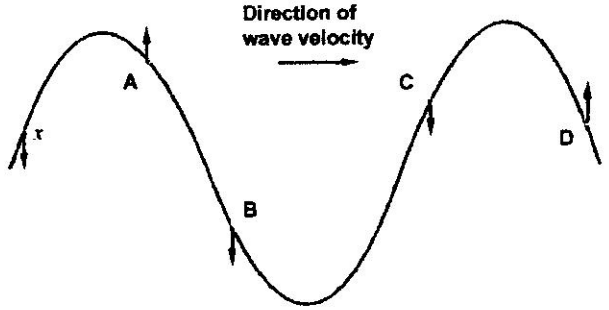


What is the critical angle of the glass?

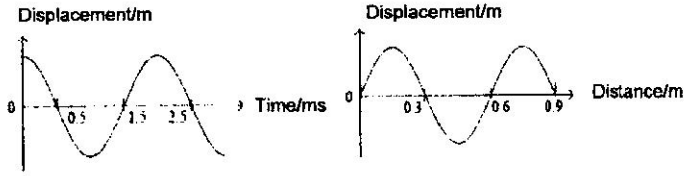
A 36.9°
B 38.7°
C 51.3°
D 53.1°

23 The diagram shows a section of a wave motion. The particle at position *x* moves in the direction of the arrow shown.

Which of the following particles at the labelled positions, **A**, **B**, **C** and **D** is incorrect?



24 The two graphs shown below refer to the same wave.

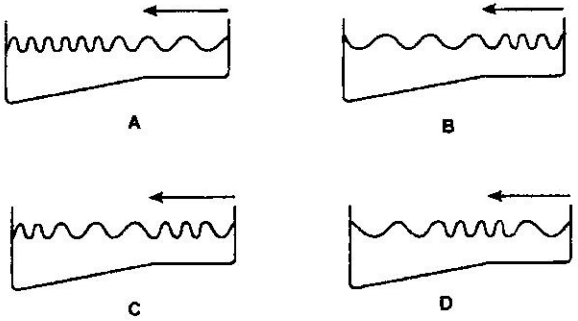


What is the speed of the wave?

A 0.3 ms^{-1}
B 1.2 ms^{-1}
C 150 ms^{-1}
D 300 ms^{-1}

25 A ripple tank contains water of varying depths.

Which diagram correctly represents the water waves as they travel from the shallow to the deep region?



26 Below are three statements about electromagnetic radiation.

- Microwaves may cause the ionisation of cells.
- Radio waves are use in cancer radiotherapy.
- Ultraviolet radiation is used in remote controls for television sets.

How many of the statements is/are correct?

A 0
B 1
C 2
D 3

27 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.

What is the correct order of increasing wavelength?

	shortest ⟶ longest		
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

28 The speed of a sound wave is reduced by half when it passes from medium A to medium B.

Which statement below describes the change in the sound wave correctly?

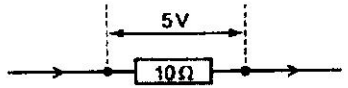
A The frequency is reduced by half.
B The wavelength is reduced by half.
C The frequency becomes twice its initial value.
D The wavelength becomes twice its initial value.

29 Sam plays a note on the guitar. He then plays a louder sound of the same pitch.

Which of the following correctly compares the speed and wavelength of the second note with the first note?

	Speed of second sound	Wavelength of second sound
A	Same	Same
B	Same	Different
C	Different	Same
D	Different	Different

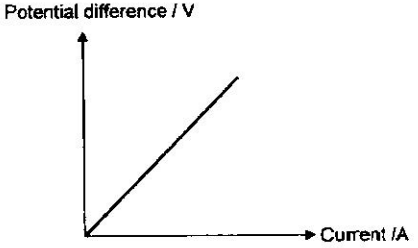
30 The potential difference across a 10 Ω resistor is 5 V.



How much charge passes through the 10 Ω resistor in 30 seconds?

A 2 C **B** 15 C **C** 60 C **D** 1500 C

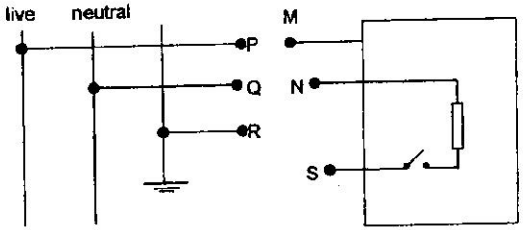
31 The graph below shows the variation of potential difference across a uniform resistance wire against the current in the wire.



Which of the following changes will make this graph steeper?

A A thinner wire is used.
B A shorter wire is used.
C The wire is made of a material of lower resistivity.
D A similar wire is connected in parallel to this wire.

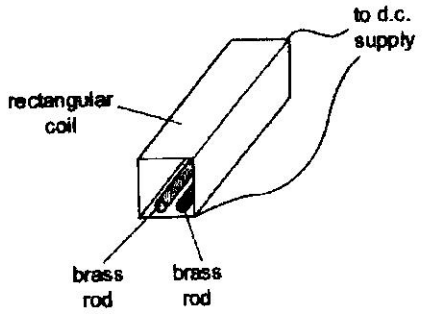
32 An electrical appliance with a metal case is to be connected to the mains supply as shown below.



Which of the following shows the correct connection of the wires from P, Q and R respectively?

	P	Q	R
A	S	M	N
B	S	N	M
C	N	M	S
D	N	S	M

33 The diagram shows two brass rods, side by side, at the bottom of a rectangular coil. The wires of the rectangular coil are insulated.

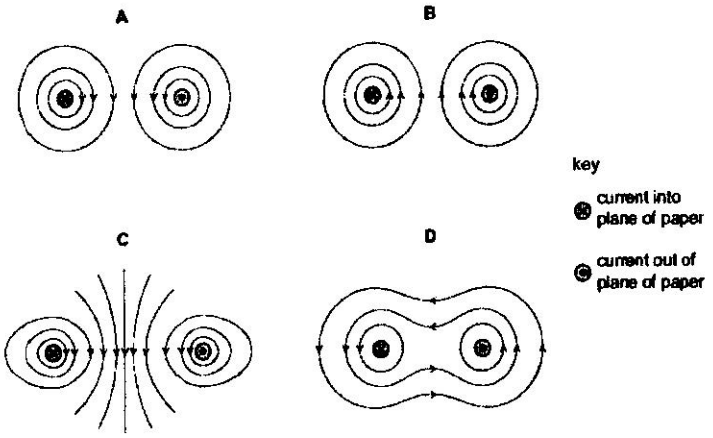


What happens when a direct current passes through the coil?

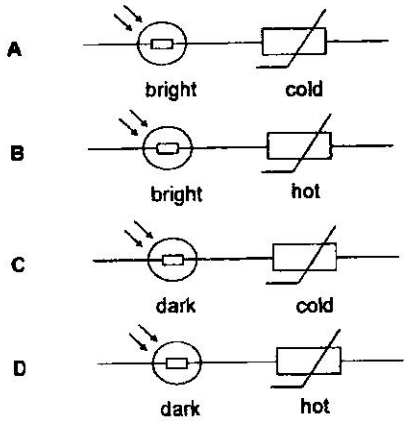
A Nothing happens.
B The two rods move towards each other.
C The two rods move away from each other.
D The two rods will move towards and then away from each other.

34 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

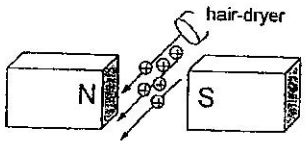
Which diagram shows the magnetic field around the two wires?



35 Given that the resistance of a thermistor decreases with increasing temperature, which of the following conditions will create the largest combined resistance in the circuit?



36 Hot air from a hair-dryer contains many positively charged ions.

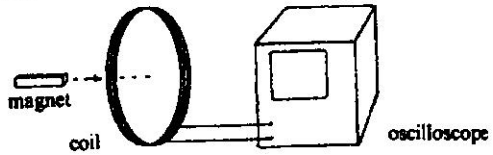


The hot air is directed between the poles of a strong magnet, as shown in the diagram above.

Which direction would the ions be defected?

A upwards.
B downwards.
C towards the north pole.
D towards the south pole.

37 A bar magnet is moved slowly into a coil of wire which is connected to an oscilloscope.

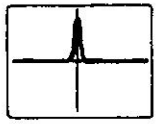


The trace on the oscilloscope is shown below:

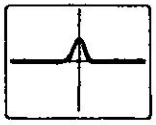
The magnet is then moved back from the coil at a greater speed.

Which trace shows this?

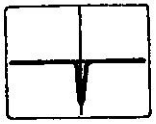
A



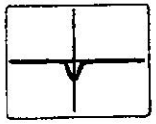
B



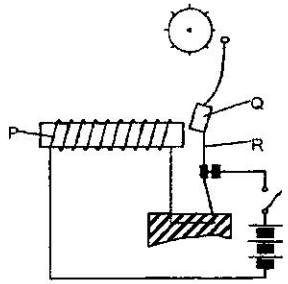
C



D

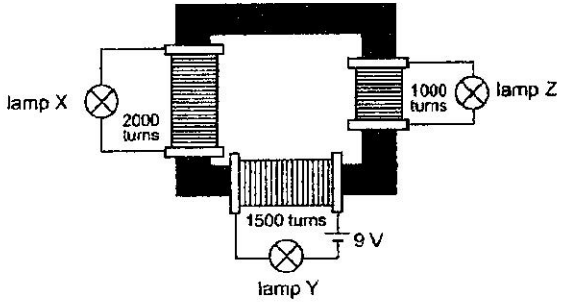


38 In an electric bell, what are parts P, Q and R made of?



	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

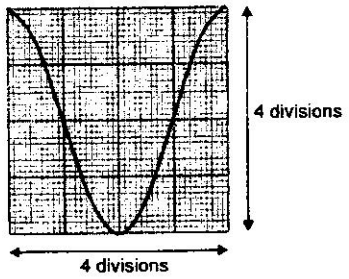
39 Three identical filament lamps, X, Y and Z, are connected to a transformer with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	Lamp X	Lamp Y	Lamp Z
A	Dimmer than normal	Normal brightness	Brighter than normal
B	Brighter than normal	Normal brightness	Dimmer than normal
C	Not lit	Normal brightness	Not lit
D	Not lit	Not lit	Not lit

40 The diagram illustrates the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.



The time-base is set to 2.0 ms/div and the voltage sensitivity is 2.0 V/div.

Which of the following correctly represents the peak voltage and frequency of the signal?

	Peak voltage	Frequency
A	4.0 V	83.3 Hz
B	4.0 V	125 Hz
C	8.0 V	83.3 Hz
D	8.0 V	125 Hz

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2016

PHYSICS (5059/2)

PAPER 2

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

18 August 2016
1115 - 1300
1 h and 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.
Write in dark blue or black pen.

Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer all three questions.
Question 12 has a choice of parts to answer.

INFORMATION FOR CANDIDATES

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

Take the gravitational field strength g on Earth to be 10 Nkg^{-1}.

At the end of the examination, ensure that you have submitted all your work.

For Examiner's Use	
Paper 1	40
Paper 2 Section A	50
Paper 2 Section B	30
Total	120

Name of setter: Mdm Quek Lay Hong

Parents'/Guardian's Signature

This paper consists of **19** printed pages and 1 blank page.

[Turn over

SECTION A (50 marks)

Answer all questions. Write your answers in the spaces on the question paper.

1 Fig. 1.1 shows the velocity-time graph of a moving object.

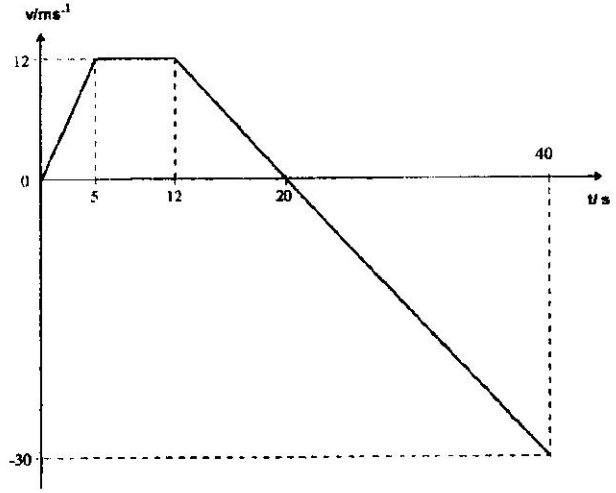


Fig. 1.1

(i) Calculate the acceleration of the object from t = 12 s to t = 20 s. [2]

Acceleration = ...

(ii) Describe the motion of the object from t = 12 s to t = 40 s. Indicate the direction of motion clearly throughout the entire duration. [2]

.....

.....

.....

2 A sky-diver jumps from a high-altitude helicopter as shown in Fig. 2.1.

Fig. 2.1

(a) Explain why the acceleration of the sky-diver

(i) is 10.0 ms^{-2} at the start of the jump. [1]

.....

.....

(ii) decreases with time. [2]

.....

.....

.....

(b) At one point during the dive, the acceleration of the sky-diver was 7.5 ms^{-2}. The sky-diver and his equipment have a total mass of 90 kg.

Determine the total resistive force acting on the sky-diver at that point. [2]

total resistive force = ...

3 Two identical barometers **P** and **Q** containing mercury are set up at sea level as shown in Fig. 3.1.

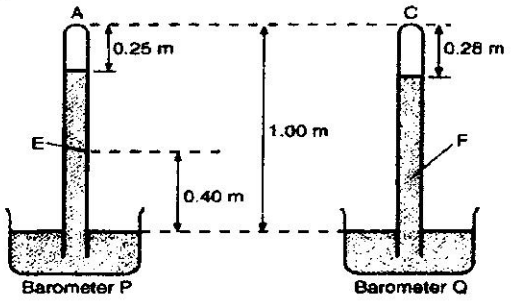


Fig. 3.1

The column of space A in barometer **P** is a perfect vacuum. The density of mercury is 13 600 kgm^{-3}.

(a) State the atmospheric pressure as measured by barometer **P**. [1]

.....

(b) Calculate the pressure at point E, giving your answer in Pascal. [2]

pressure = ...

(c) Suggest a possible reason why the column of space **C** is more than **A**. [1]

.....

(d) State the pressure within the space **C**. [1]

.....

4 The piston for the bicycle pump in Fig. 4.1 is pushed in slowly until the air pressure inside the pump in Fig.4.2 is three times greater. The air in the pump remains at a constant temperature of 20 °C.

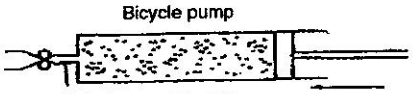


Fig. 4.1

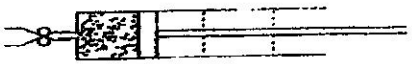


Fig. 4.2

(i) Explain in terms of molecular motion why the pressure in Fig. 4.2 should be three times greater than in Fig. 4.1. [2]

.....

.....

.....

(ii) If the piston had been pushed in quickly, the temperature of the air in the pump would have increased.

Explain in terms of molecular motion how this would affect the pressure in the pump. [3]

.....

.....

.....

.....

.....

5 Fig. 5.1 shows the path of a light ray through a converging lens.

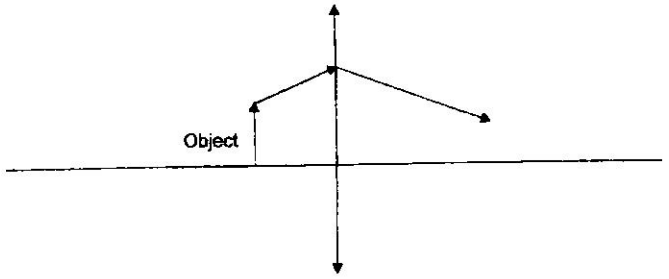


Fig. 5.1

(i) Complete the ray diagram in Fig. 5.1, locate and draw the image of the object. [2]

(ii) Explain how your diagram shows that the image is virtual. [1]

.....

.....

(iii) Complete the ray diagram in Fig. 5.1, locate the Principal Focus of the converging lens and label the point F. [2]

6 Fig. 6.1 shows wavefronts of a water wave in a ripple tank.

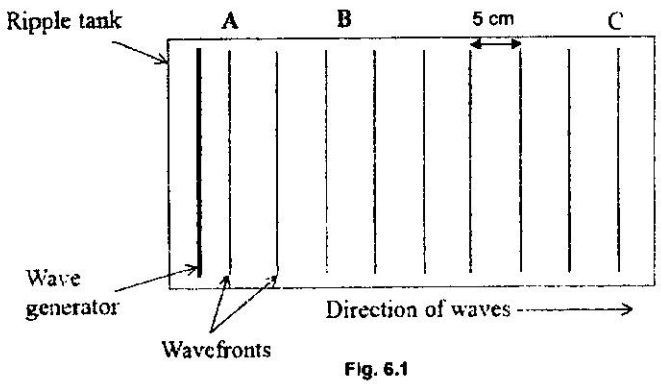


Fig. 6.1

(i) State the meaning of *"wavefront"*. [1]

.....

.....

(ii) Determine the wavelength of the wave. [1]

Wavelength = ...

(iii) A wavefront takes 1 second to travel from **A** to **C**. Determine the frequency of the wave. [1]

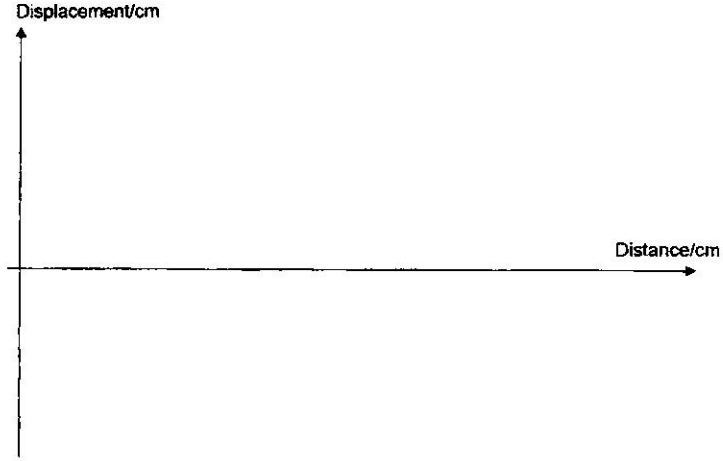
Frequency = ...

(iv) Calculate the speed of the wave. [2]

Speed = ...

(v) The wave generated has an amplitude 1.5 cm.

Sketch a displacement-distance graph. Indicate the position of **A** and **B** clearly in your graph. [2]



7 (a) The honey industry in Britain is under serious threat from a parasite that attacks bees. A company has developed a patented natural wax powder that keeps the parasites away from the bees. The formulated powder is added to a specially designed applicator placed in the doorway of the hive. Bees have specially modified hairs on their bodies that develop a static electricity charge.

Explain how the powder can adhere to the bodies the bees when they enter the hive. [2]

.....

.....

.....

(b) Large amounts of grains such as wheat can generate charges as they are poured from one storage bin to another. These organic materials are highly explosive when there is ample supply of oxygen.

State the method of charging of the grains during pouring and explain the main reason for the grains to be highly explosive. [3]

.....

.....

.....

.....

.....

8 Fig. 8.1 shows an electrical circuit with three identical lamps **X**, **Y** and **Z**, a switch, a 12 V battery, an ammeter, a voltmeter and a variable resistor.

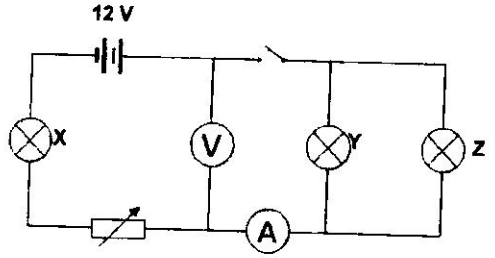


Fig. 8.1

(a) State the ammeter and voltmeter readings when the switch is opened. [2]

ammeter reading: .....

voltmeter reading: .....

(b) When the switch is closed, the ammeter reading is 1.50 A and the voltmeter reading is 3.00 V.

(i) Calculate the resistance of **each** lamp. [2]

resistance = ...

(ii) Calculate the power dissipated by Lamp **X**. [2]

power = ...

(iii) Calculate the potential difference across the variable resistor. [2]

potential difference = ...

(c) State what happens to the brightness of Lamp **Y** when the resistance of the variable resistor is increased. [1]

.....

9 Fossil fuels will eventually run out. This has led to scientists looking for alternative sources of energy. Tidal stream systems use the kinetic energy of seawater to generate electrical energy during the incoming and outgoing tides.

Fig. 9.1 below shows a twin-turbine system in which flowing seawater turns the turbine blades.

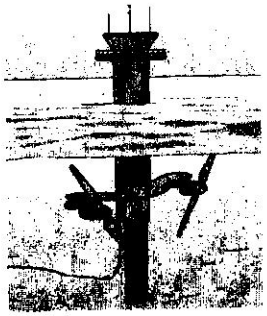


Fig. 9.1

When operating, 9.7×10^5 kg of seawater travelling at a speed of 3.0 ms^{-1} passes through each turbine every second. Each turbine generates 1.2×10^6 W of electrical energy.

(a) Define *power*. [1]

.....

(b) The input power to each turbine is the kinetic energy of the seawater that flows through each turbine in one second.

Calculate the input power of each turbine. [2]

Input power = ...

(c) Calculate the percentage efficiency of each turbine. [1]

Percentage efficiency =.....

(d) Suggest one advantage of tidal stream systems over conventional wind farms. [1]

.....

.....

SECTION B (30 marks)

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

10 Four transformers, **A**, **B**, **C** and **D** are being investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs in Fig. 10.1.

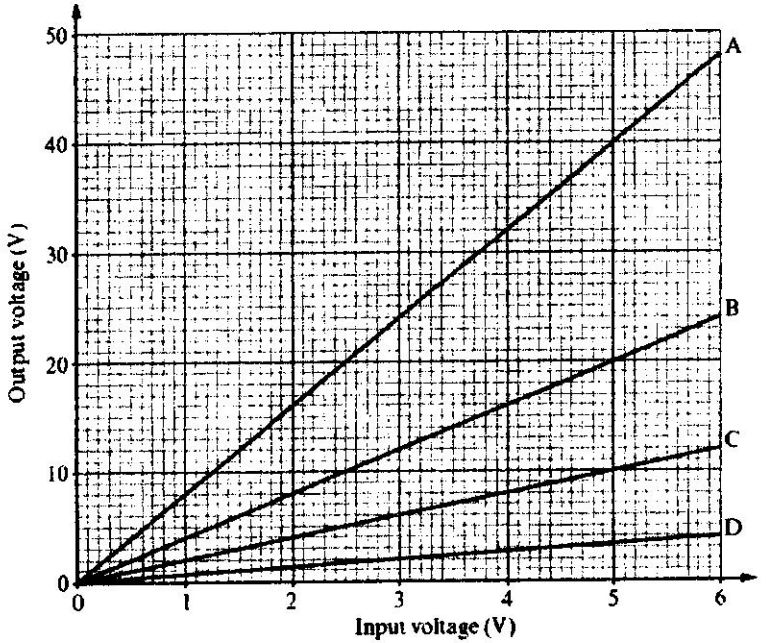


Fig. 10.1

One of the transformers is then used to light up a 12 V lamp from a 3 V power supply as shown in Fig. 10.2.

Fig. 10.2

(a) Explain how a current in the primary coil produces an output voltage in the secondary coil. [2]

.....

.....

.....

.....

(b) Describe the purpose of the iron core. [1]

.....

.....

(c) Using the data on the graphs in Fig. 10.1 to answer the following questions.

(i) State and explain which transformer, **A**, **B**, **C** or **D**, would be used to light the 12 V lamp to normal brightness, from a 3 V supply as shown in Fig. 10.2 [1]

.....

.....

(ii) Transformer **C** contains 50 turns on its primary coil. Calculate the number of turns on its secondary coil. [2]

Number of turns = ...

(iii) Transformer **A** has a current of 0.5 A in the primary coil. Calculate the current in the secondary coil. [2]

Current = ...

(iv) State and explain which transformer, **A**, **B**, **C** or **D**, is **not** suitable to be used for the transmission and distribution of energy from power stations to transmission cables. [2]

.....

.....

.....

11 A thermistor is placed in an environment where the surrounding temperature increases at constant rate of 1 °C/ minute. Fig. 11.1 shows how the resistance of a thermistor changes with its surrounding temperature.

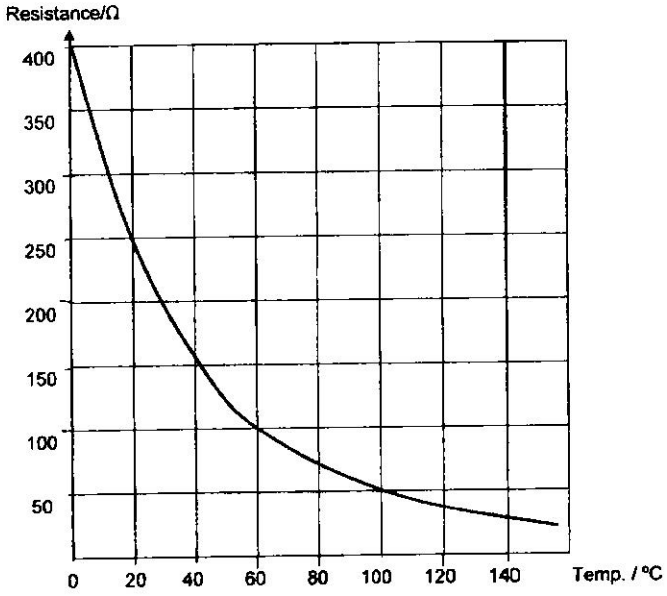


Fig. 11.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature. [1]

.....

.....

The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig. 11.2.

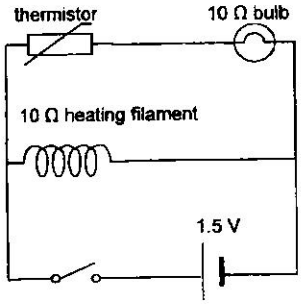


Fig. 11.2

Explain why the bulb

(i) fails to light up immediately when the switch is closed, [2]

.....

.....

.....

.....

(ii) lights up slowly after a while. [2]

.....

.....

.....

.....

(c) (i) Calculate the resistance of the thermistor when a current of 0.025 A flows through the light bulb [2]

Resistance = ...

(ii) Hence determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb [1]

Temperature = ...

(d) When the temperature of the thermistor is 100 °C, calculate the effective resistance of the whole circuit. [2]

Effective resistance = ...

12 EITHER

A pendulum consists of a metal sphere of mass 200 g attached to a thin thread as shown in Fig. 12.1. The length of the thread is 1.0 m.

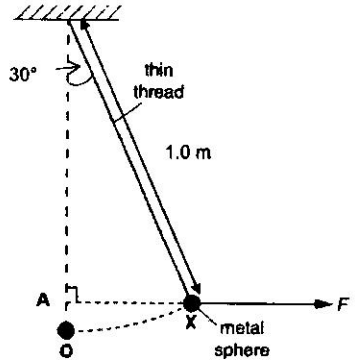


Fig. 12.1

When the thread is vertical, the metal sphere is at O. The metal sphere is moved from O to X and held in position by a horizontal force *F*. The angle between the thin thread and vertical is 30°.

(a) With an appropriate scale and drawing, determine *F* and the tension in the thread. [5]

Scale = ...

F = ...

Tension = ...

(b) Calculate the

(i) distance **OA**, which is the vertical displacement of the sphere from **O** to **X**. [1]

Distance **OA** =.....

(ii) work done to raise the sphere from **O** to **X**. [2]

Work done =.....

(iii) maximum speed of the sphere after it has been released. [2]

Maximum speed=.....

12 OR

A student poured 250 g of hot tea into a container. He placed a thermometer into the tea and started measuring the temperature with respect to time. After a while, he added *m* kg of ice cubes into the tea.

Fig. 12.2 below shows the temperature-time graph obtained.

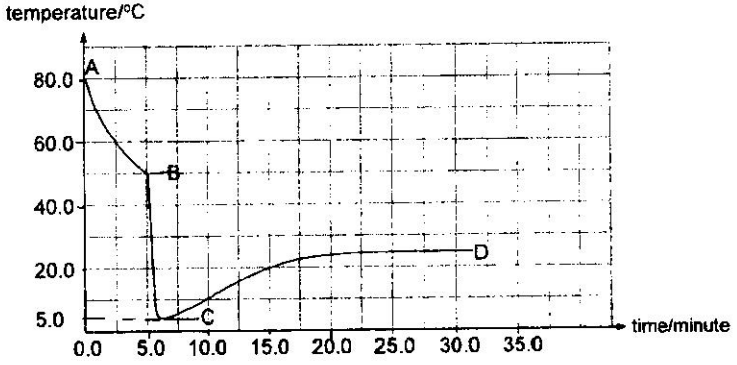


Fig. 12.2

The following information is provided :

specific heat capacity of ice = 2.10×10^3 J/kg°C
specific latent heat of fusion of ice = 3.36×10^5 J/kg
specific heat capacity of water or tea = 4.20×10^3 J/kg°C
specific latent heat of vaporisation of water or tea = 2.26×10^6 J/kg

The temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State and explain what time the student added the ice cubes into the tea. [1]

.....

.....

(b) Calculate the loss of thermal energy in the hot tea from B to C. [2]

loss of thermal energy = ...

(c) Calculate m. You may assume that there is no loss of thermal energy to the surrounding. [3]

m = ...

(d) Explain why the temperature of the tea increases from C to D. [2]

.....

.....

.....

(e) Estimate the temperature of the surrounding. [1]

.....

(f) In another experiment, the student placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

On Fig.12.2, draw the temperature-time graph for the second experiment. [1]

COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2016
SECONDARY FOUR EXPRESS PHYSICS
ANSWER KEY

Paper 1

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

COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS
PRELIMINARY EXAMINATION 2016
MARK SCHEME

Section A (50 marks)

1 **(i)** Acceleration = **(12 – 0)ms^{-1}/(12-20)s** [1]
= **-1.50 ms^{-2}** [1]

(ii) Object travel with **constant negative acceleration** [1]

Or: Decreasing velocity at a constant rate from 12 s to 20 s and increasing velocity at a constant rate from 20 s to 40 s.

The object **changes direction at t = 20s.** [1]
Or: The object moves in the positive direction from t = 12-20 s and it moves in the negative direction from t = 20-40 s.

To accept answer as long as student shows understanding that **the direction of motion is reversed at t = 20s.**

Total mark for Q 1 [4]

2 **(a)** **(i)** air resistance is **zero/negligible** [1]
or: weight / gravitational force is **only force**
Or: resultant force is the weight

(ii) **air resistance increases** as speed increases [1]
resultant force decreases [1]

2 **(b)** Resultant force = ma
= 90 kg x 7.5 ms^{-2}
= **675 N** [1]

Total resistive force = Weight – resultant force
= 900 N – 675 N
= **225 N** [1]

Total mark for Q 2 [5]

3 **(a)** Atmospheric Pressure: **0.75 mHg** or 75 cmHg or 750 mmHg [1]
Accept: 1.02 x 10^5 Pa

(b) identify h as **0.35 m** [1]

Pressure at E = 0.35 m x 13600 kg/m^3 x 10N/kg
= **47600 Pa** [1]

(c) There is **air** in C or C is not a perfect vacuum [1]

(d) P in C = **0.03 mHg** or 3 cmHg or 30 mmHg [1]
To accept answer in SI unit: 4080 Pa

Total mark for Q 3 [5]

Version 4 updated on 22 August 2016

4 **(i)** **The number of air molecules per unit volume is three times greater in Fig. 4.2.** [1]

Accept: Less space or distance deceases

As a result, the **frequency of collisions of the air molecules with the walls of the pump is three times greater.** [1]

Accept: 'three times' is mentioned once either in the first or second point.

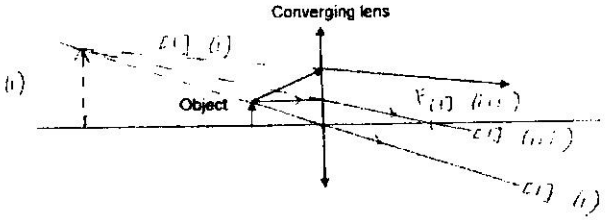
(ii) **Kinetic Energy** or **speed of air molecules increases** due to increase in temperature. [1]

The air molecules **collide more frequently and violently/forcefully with the walls** of the pump. [1]

Pressure increases [1]
Or: pressure is more than the previous se-up

Total mark for Q4 [5]

5



(i) A straight line passing through the tip of the object and Optical Centre and with extension. [1]

Extension of the given ray to intersect with the previous extension to form an upright image. Labelling of image is not required. Do not penalize if image is not dotted. [1]

(ii) The real rays do not intersect. [1]

(iii) A ray drawn parallel to Principal Axis, extended to tip of the image and passed through Principal Axis [1]

F correctly marked and labeled. [1]

To deduct a maximum of one mark for the following:
- missing arrows
- extension not in dotted lines
- arrows on extension
- arrows in wrong direction

Total mark for Q5 [5]

6 (i) A wavefront is an imaginary line **joining all the adjacent points in the same phase/adjacent crests/adjacent troughs.** [1]

(ii) Wavelength = **5 cm** [1]
Accept: 5.0 cm, 5.00 cm

(iii) Frequency = **8 Hz** [1]
Accept: 8.0 Hz, 8.00 Hz

(iv) Speed = frequency x wavelength
= **8 Hz x 5.0 cm** [1]
= **40 cms^{-1}** [1]
ecf from **(ii)** and **(iii)**

Accept: 0.4 ms^{-1}

(v) A sinusoidal wave with an amplitude of 1.5 cm [1]
B at the trough at 2.5 wavelength from **A.** [1]

Total mark for Q6 [7]

7 (a) By method of **induction** [1]
Or: a description of the induction process

The **charge of powder** nearer to the body of bee will be **opposite** to the **charge on the bee. Force of attraction is greater than the force of repulsion.** [1]

(b) Charging by **friction** or rubbing [1]

Large surface area of the grains and **charges accumulate fast** [1]
Or: large surface area of the grains and **large amount of charges accumulate** on the surface of the grains

Spark or **sudden discharge** might occur [1]
Or: high reaction/combustion rate

Total mark for Q7 [5]

Version 4 updated on 22 August 2016

8 (a) Ammeter reading = **0 A** [1]
voltmeter reading = **12 V** [1]

(b) (i) Since **Y** and **Z** are identical, current flowing through them = 1.50 A/2
= **0.75 A** [1]
R_Y = 3.00 V/0.75 A = **4.0 Ω** [1]
Hence resistance of each lamp = 4.0 Ω

(ii) P = I^2R = **(1.50 A)^2 x 4.0 Ω** [1]
= **9.0 W** [1]

(iii) p.d. across lamp X, V = IR = 1.50 A x 4.0 Ω
= **6.00 V** [1]

p.d. across the variable resistor = 12 V – 6.00 V– 3.00 V
= **3.00 V** [1]

(c) The brightness **decreases** [1]
Or: Lamp Y becomes dimmer.

Total mark for Q8 [9]

9 (a) **Rate of work done** [1]
Or: **Rate of energy conversion**
Accept: Formula expressed in words (work done divided by time taken)
Accept: Rate of energy generated/consumed

(b) **½ (9.7 X 10^6 kgs^{-1}) (3.0 ms^{-1})^2** [1]
= 4.37 X 10^6 J/s or W [1]

(c) (1.2 x 10^6 / 4.37 x 10^6) x 100%
= 27.5% [1]
e.c.f. from (b)

(d) Any of the following: [1]

- Tidal energy has **more consistent efficiency** as it is not dependent on climatic condition/wind condition and direction.
- **No noise pollution** for tidal energy.
- **Do not require large clearance of land space.**
- A tidal stream turbine system of identical size to a wind turbine system will **produce greater power** for the same water or wind speed
- Does not obstruct the flight path of birds

Total mark for Q9 [5]

10 (a) The **current** in the primary coil is **alternating**/changing [1]
Or: The magnetic field is changing

hence the **magnetic flux in the secondary coil is changing** continuously, hence induces an emf in the secondary coil. [1]
Or: The magnetic field linked to the secondary coil is changing

(b) To **concentrate the magnetic field lines** [1]
Or: to **link magnetic field to the secondary coil**

(c) (i) B because the **the output voltage is 12 V when the input voltage is 3V.** (as shown on the graph) [1]
Or: **the turns ratio is 4**
or the output voltage is four times the input voltage

(ii) $N_s/50 = 12V/6V$ [1]
Or: The turns ratio is 2

$N_s = 100$ [1]

(iii) $48\ V/\ 6V = 0.5\ A/I_s$ [1]

$I_s = 0.0625\ A$ [1]

(iv) D [1]

because it is a **step-down** transformer/current is stepped up hence the **power loss** in the cable is **higer** [1]

Total mark for Q10 [10]

11 (a) The resistance **decreases** as temperature **increases.** [1]

(b) (i) **Temperature is low** or the resistance of thermistor is high. [1]
Accept: Heating element has not been heated up
or the heating element takes time to get heated up

The p.d. across the thermistor is high hence **the p.d. across the bulb is low.** [1]
Or: No/low current through the bulb due to the high resistance in this path.

(ii) **Temperature of thermistor increases** due to the heat being transferred from the heating filament to the thermistor. [1]

The resistance and p.d of the thermistor decreases resulting in a **larger p.d. across the bulb.** [1]
Or: Current through the bulb increases due to the decrease in resistance in this path.

(c) (i) $V = IR$
$1.5\ V = 0.025\ A\ (R_{th} + 10\ \Omega)$ [1]
$Rth = 50\ \Omega$ [1]

Or:
P.d. across bulb = I x R = 0.025 x 10 = 0.25 V
P.d. across thermistor = 1.5 – 0.25 = **1.25 V** [1]
Resistance across thermistor = 1.25/0.025 = **50 Ω** [1]

(ii) Temperature = **100 °C** [1]
e.c.f. from (c) (i)
Accept: 80 °C to 100 °C for 60 Ω from (c) (i)

(d) R in series = 50 + 10 = 60 Ω
$1/R = 1/60 + 1/10$ [1]
$R = 60/7 = 8.57\ \Omega$ [1]

Total mark for Q11 [10]

12 EITHER

(a) Accept either parallelogram or tip-to-tail method

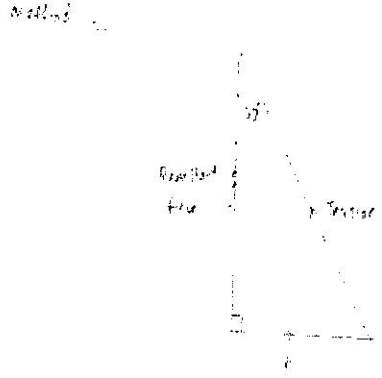
Vector diagram correctly constructed with **correct lengths for the 2.00 N vertical force** [1]

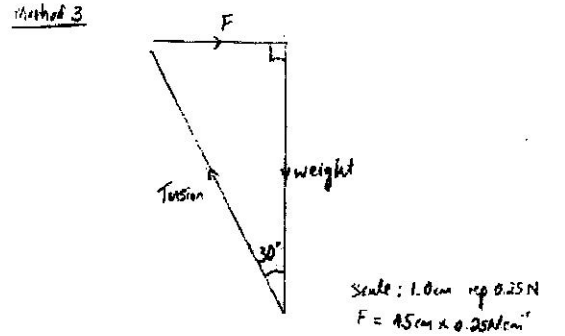
With an **enclosed angle of 30°** between vertical force and the tension [1]

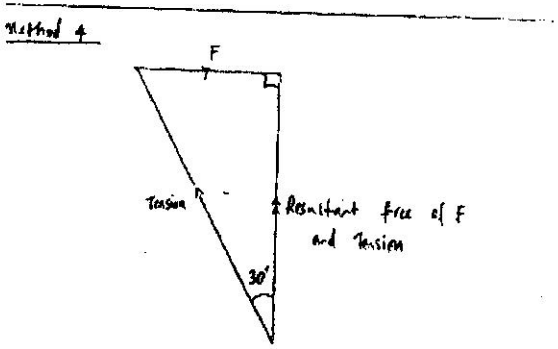
With **correct direction** of arrows for Tension, *F* and the 2.0 N vertical force. [1]

Values of *F* in the range from **1.02 N** to **1.25 N** [1]

Values of Tension in the range from **2.10 N** to **2.56 N** [1]







Method 5:
Similar to method 2 but with weight drawn with a single downward arrow

(b) **(i)** Distance OA = 1.0 m – (1.0 m cos 30°)
= **0.134 m** [1]

(ii) Work done = Gain in GPE
= mgh
= **0.200 kg x 10 Nkg^{-1} x 0.134 m** [1]
= **0.268 J** [1]
e.c.f. from (b) (i)

(iii) KE at O = GPE at X = 0.268 J
½ mv^2 = 0.268 J [1]
v = 1.64 ms^{-1} [1]
e.c.f. from (b) (ii)

Total mark for Q12 EITHER [10]

12 **OR**

(a) The student added the ice cubes at **5.0 minutes** (or at B). This is because there was a **sudden drop/decrease/change in temperature** from 5.0 minutes onwards. [1]

(b) Loss in thermal energy = $mc\theta$
= **0.250 kg x 4200 J /kg°C x (50.0 °C – 5.0°C)** [1]
= 47 250 J
= **47 300 J** (or 47 000 J) [1]

(c) Heat loss from tea = heat gained by ice cubes
47 300 = (m x 3.36 x 10^5) + (m x 4200 x 5.0)
= 336 000 m + 21 000 m
m = 47 250 / 357 000
= **0.132**

e.c.f. from (b)

Adding heat gained by ice in melting to heat gained by the melted ice in warming up: **(m x 3.36 x 10^5) + (m x 4200 x 5.0)** [1]
Equating heat gained by ice to answer in (b) [1]
Correct answer of 0.132 kg or 132 g [1]

(d) Since there is a **temperature difference** between the tea and the surrounding [1]

Or: the tea is at a lower temperature than the surrounding
Or: So to achieve equal temperature/equilibrium

thermal energy is transferred/gained/absorbed from the surrounding to the tea [1]
Or: heat flow from the surrounding to the tea

(e) **25.0 °C** (or 25 °C) [1]

(f) **Cooling curve** from 80°C to 25°C.
Final temperature of **25°C**
Takes a **longer time than 22.5 minutes** to reach 25°C

All three correct [1]

Total mark for Q12 OR [10]