Name: ……..…….. Reg. No. …… Class: ……..…

Founded 1842

St. Margaret's Secondary School

Preliminary Examinations 2011

PHYSICS 5058/02

Secondary 4 Express

15th September 2011
Duration : 1 hour 45 minutes
Total Marks : 80

READ THESE INSTRUCTIONS FIRST

Do not open this Booklet until you are told to do so.

Write your name, register number and class in the spaces at the top of this page and on any separate writing paper used.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 13 has a choice of parts to answer.

Write your answers to Section A and to Questions 10,11 and 12 in the spaces provided on the Question Paper. Write your answer to Question 13 on the lined pages and, if necessary, continue on the separate Answer Paper provided.
At the end of the examination, fasten all your work securely together.

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

The number of marks is given in brackets [ ] at the end of each question or part question.
When necessary, assume the acceleration due to gravity, g to be 10 m/s^2.

Section A

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

1 A police driving test concluded that Sarah has a reaction time of 0.5 s. It was also tested that her car had a deceleration of 5.0 m/s^2.

a) Sketch the speed-time graph at the instance when she sees the traffic light turning red, assuming that she has to bring her car to rest from the speed of 10 m/s. [2]

b) Determine the distance she travelled from seeing the traffic light turning red till it comes to rest from the speed of 10m/s. [2]

2 In May 2006, Singapore first Helium ride, the DHL balloon was launched. Figure 2 shows the schematic diagram of the balloon. The weight of the balloon is 4200 N. The speed at which the balloon drifts up can be controlled by a cable attached to the balloon. The balloon is lifted up by an upthrust created due to the density of helium gas. This upthrust is constant throughout the motion of the balloon.

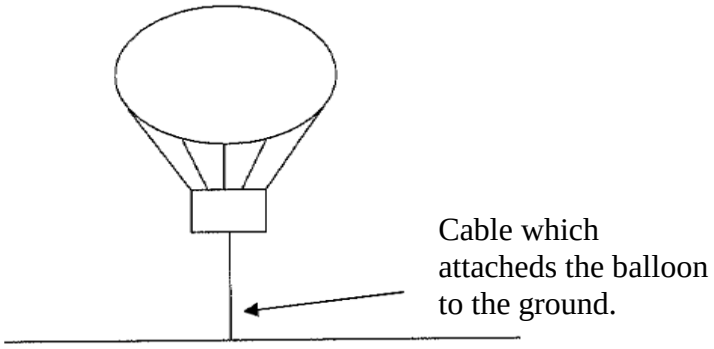


Fig. 2

a) On figure 2, draw and label the arrow to shows the direction of the forces experienced by the balloon. [3]

b) Find the tension in the cable when the balloon is moving up at constant speed, given that the upthrust is 4800 N. Explain your working clearly. [2]

Tension = ……..

c) How will the effect of wind from the side affect the value of the tension in the cables? [1]

……

……..

3 Fig. 3 shows a bullet of mass 4.20 g travelling towards a wooden barrier 1.00 m thick. It hits the barrier at 1500 m/s. The barrier exerts a constant resistive force of 3000 N on the bullet.

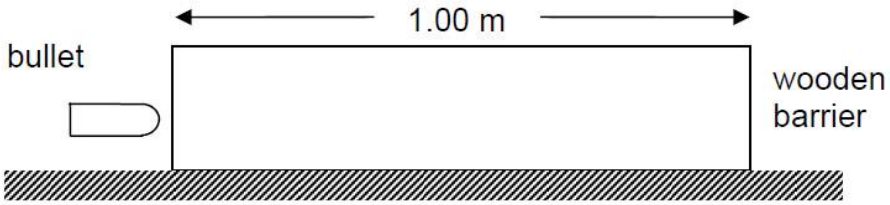


Fig. 3

a) Define work done by a force and state the SI unit for work done. [2]

……..

……

……

b) Determine the kinetic energy of the bullet just before impact. [1]

Kinetic energy = ……..

c) Calculate the work done by the resistive force on the bullet if the bullet passes through the wooden barrier. [1]

Work done = ……...

d) Hence determine whether the bullet passes through the wooden barrier and state a reason. [2]

……

……

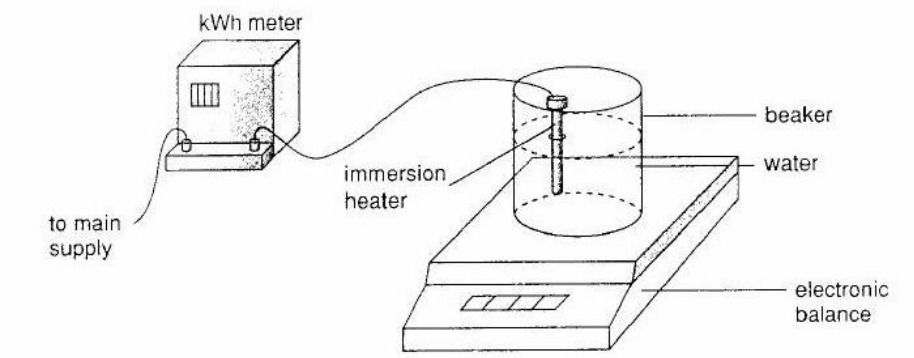
……

e) State the main energy change in the bullet as it travels through the wooden barrier. [1]

……

……

4 An experiment set-up shown below is used to measure the specific latent heat of vaporization of water. Water in a beaker is kept boiling by an immersion heater which is connected to the main supply through the kilowatt-hour meter. The following data are obtained from the experiment right after the water star to boil:



Energy consumed by the heater = 0.128 kWh
Initial reading of the electronic balance = 0.846 kg
Final reading of the electronic balance = 0.712 kg
Heat capacity of the beaker and the heater = 240 J/^{o}C

a) Before water starts to boil, the reading of the electronic balance decreases slowly with time. Explain why this happens in terms of the motion of molecules. [2]

……

……

……

……

b) Calculate the specific latent heat of vaporization of water from the data obtained. [2]

Latent heat = ……

c) Heat loss to the surroundings is one of the major sources of error in this experiment. Give one way heat is lost in this experiment set-up. Suggest a method to reduce the heat lost. [2]

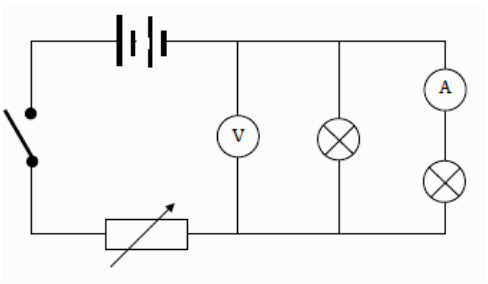
……

……

……

……

5 The diagram shows a lamp connected in series with an ammeter of negligible resistance. A second identical lamp is connected in parallel across this series arrangement. The lamp circuit is connected in series with a 12 V battery, a switch and a variable resistor.



The ammeter reading is 2 A when the voltmeter reading is 5 V. Calculate:

a) the resistance of each lamp, [1]

Resistance = ……

b) the potential difference across the variable resistor. [1]

Potential difference = ……..

c) the current through the variable resistor. [1]

current = ……..

6 Power plug is to be connected to an electric water heater. The three wires in the power plug and the circuit of the heater are shown in Fig. 6. The rating of the heater is '240 V 1500 W' while the rating of the lamp is '240 V 50 W'.

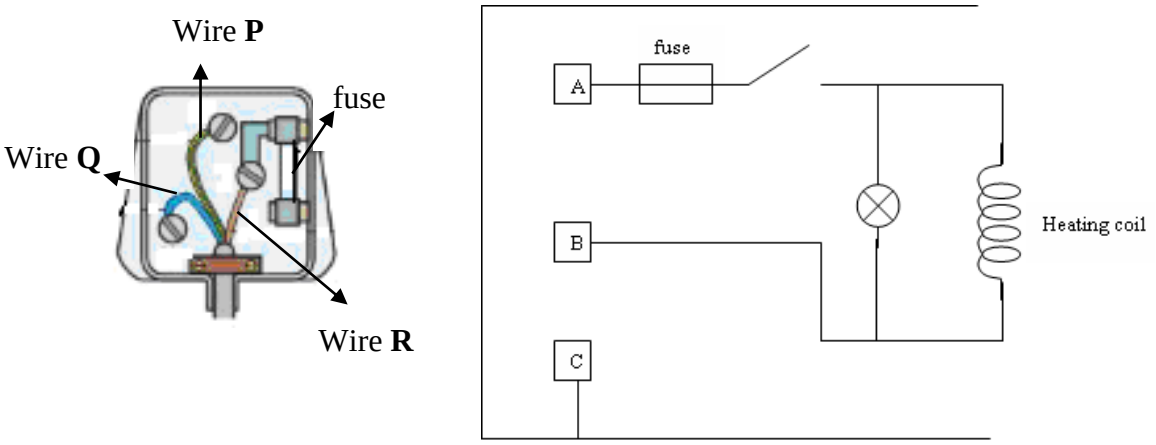


Fig. 6

a) State which wire of the cable should be connected to terminals **A**, **B** and **C** respectively. [2]

i) Wire **P** connected to terminal _____

ii) Wire **Q** connected to terminal _____

iii) Wire **R** connected to terminal _____

b) Suggest a purpose of the lamp in the circuit. [1]

……

……

c) Now, the heater is plugged into a wall socket and switched on. Calculate the cost of using the heater for 0.50 hours if electricity costs 50 cents per kWh. [2]

cost = ……

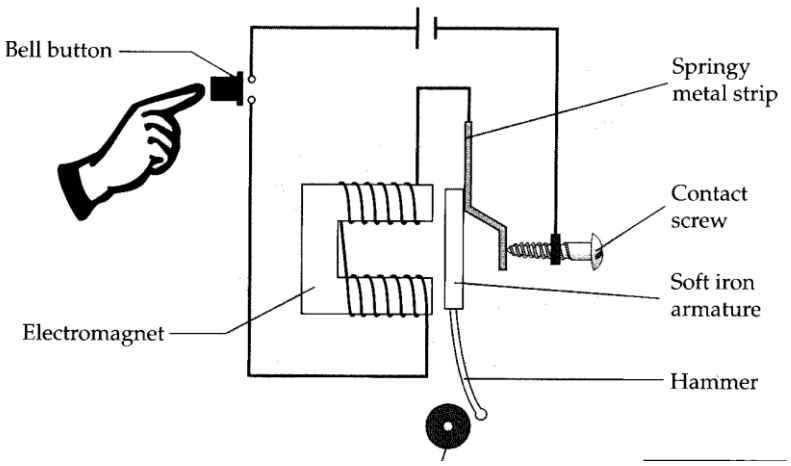
d) The water heater is protected by a fuse. Explain how the fuse works. [2]

……

……

……

7 The diagram below shows a simple circuit of an electric bell. Explain how the electric bell works by referring to the diagram below. [3]



……

……

……

……

……

……

……

……

8 a) Fig 8.1 below shows a positive charge moving into a magnetic field, the direction of which is perpendicular to and into the plane of the paper. Fig 8.2 shows a negative charge moving into a magnetic field, the direction of which is perpendicular to and out of the plane of the paper. In the two figures below, draw the paths of the two charges in the respective magnetic fields. [1]

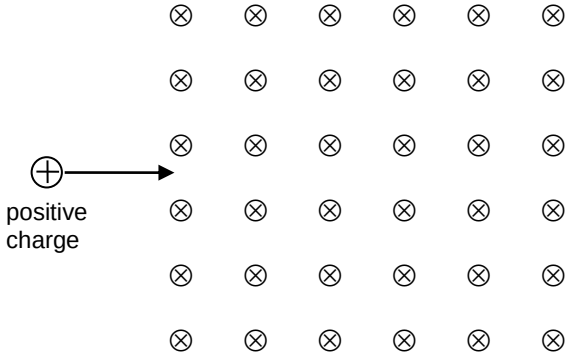


Fig. 8.1

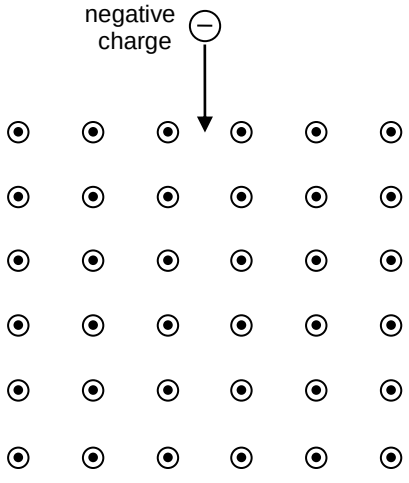


Fig. 8.2

b) Figure 8.3 shows the essential features of a home-made d.c. motor. WXYZ is a wooden frame.

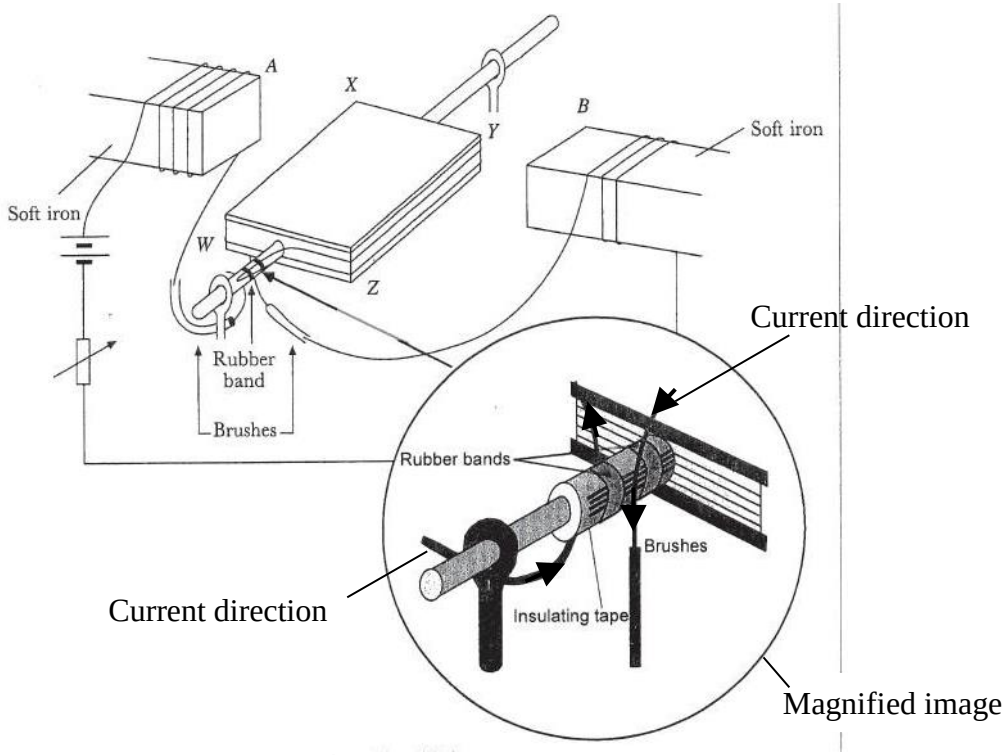


Fig. 8.3

i) What would the direction of rotation of the coil WXYZ as viewed from the front be? [1]

……

ii) What is the function of brushes? [1]

……

iii) State and explain an improvement that you can make to the motor. [2]

……

……

……

……

iv) If the battery is replaced by a 50 Hz a.c. supply, state and explain the change in the rotation of the motor. [2]

……

……

……

……

9 a) Fig. 9 below shows an ideal step-down transformer. There are 1600 turns on the primary coil and 800 turns on the secondary coil. The primary coil is connected to the 240 V, 50 Hz mains supply. A resistor of resistance 500 Ω is connected across the secondary coil.

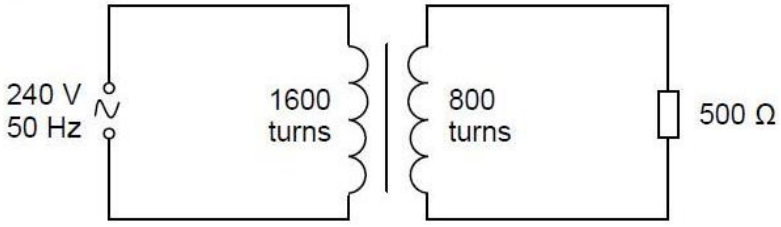


Fig. 9

Assuming that the transformer has an efficiency of 100%, determine [3]

i) the voltage across the 500 Ω resistor,

Voltage = …….

ii) the current in the secondary coil,

Current = ……

iii) the current in the primary coil.

Current = …….

b) Suggest one reason why, in a real transformer, the power drawn from the supply exceeds the power dissipated in the secondary coil. [2]

……...

……..…….

c) What happens when the primary coil is connected to a d.c. supply? Explain briefly. [2]

……

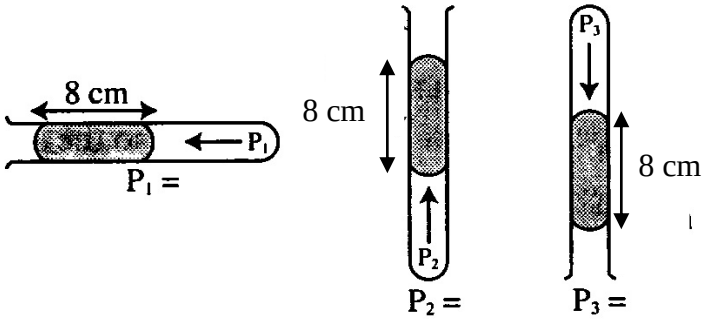
……

……

Section B

Answer **all** the questions from this section. Question 12 has a choice of parts to answer.

10 a) Given that the atmospheric pressure is 76 cmHg, find the gas pressure in the following diagram. [3]



Pressure in P_1 = ……...

Pressure in P_2 = ……...

Pressure in P_3 = ……...

b) The diagram shows a set of apparatus to study the relationship between heat and pressure.

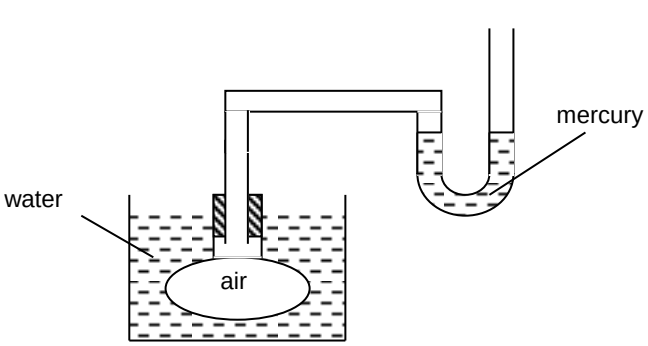


Figure A

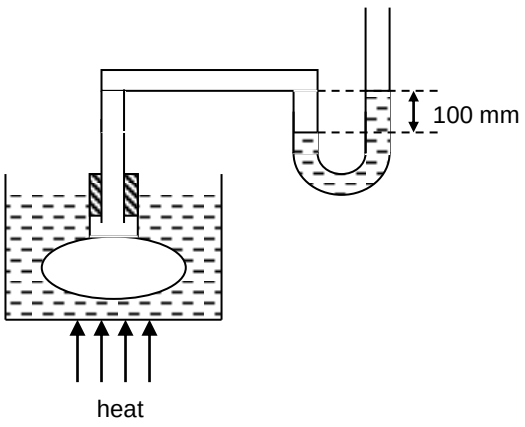


Figure B

The pressure of the air in the flask was observed to be at atmospheric pressure before heat was applied as seen in the manometer (*Figure A)*.

i) It was observed that just after heat was applied to the water, the manometer was seen to indicate a drop in pressure in the flask. Explain. [1]

……..……...

……..……..

ii) Explain in term of particle movements (in the flask) what happen next as heat is continued to be supplied to the water. [2]

……

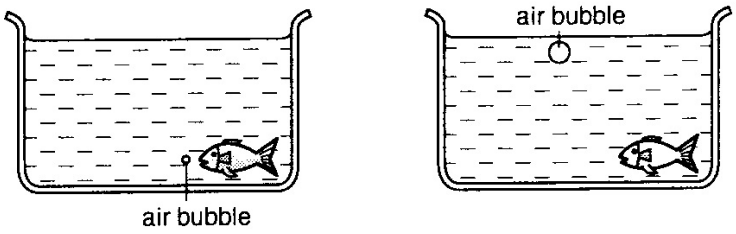
……

……

iii) After 5 minutes the manometer shows an increase of pressure in the flask as shown from Figure B. Given that atmospheric pressure to be 1.013×10^5 Pa, and the density of mercury to be 13 600 kg m^{-3}, calculate the pressure of air in the flask in Pa. [2]

Pressure of air = …….

c) Diagram below shows the size of an air bubble released by a fish at the bottom of an aquarium. Diagram below shows the size of the same air bubble when it is nearer to the surface of water in the aquarium. Explain the observation. [2]



……

……

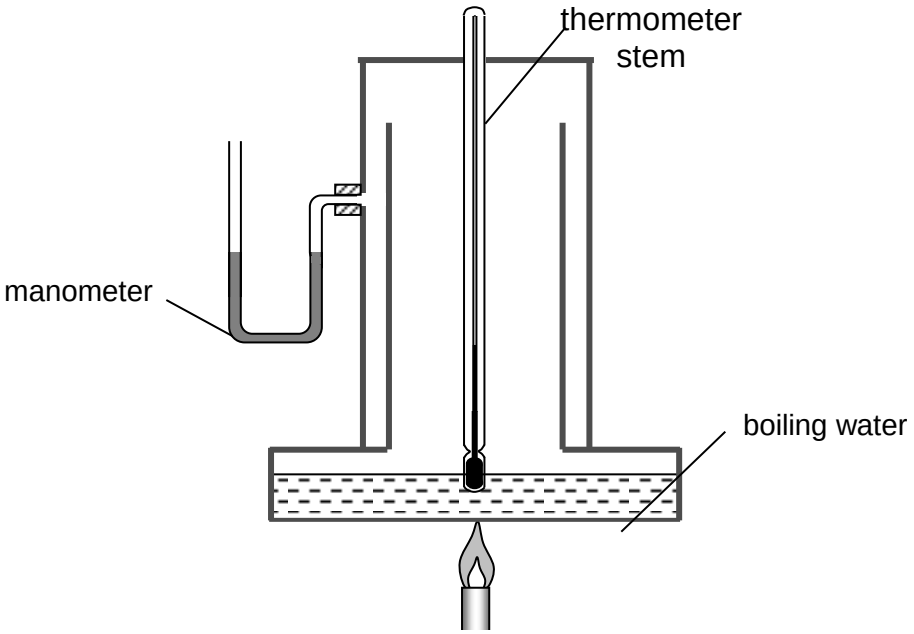
……

……

11 a) Complete the table below. [2]

Type of Thermometer	Thermometric Substance	Thermometric Property
constant-volume gas thermometer	Gas	pressure of a fixed mass of gas at constant volume
Thermocouple		electrical voltage or electromotive force
Mercury-in-glass	Mercury	

b) The diagram below shows the calibration of a newly manufactured thermometer for the steam point.



i) Define steam point. [1]

……

……

ii) What is the function of the manometer in the calibration? [1]

……

……

iii) State the mistake made by the calibrator. [1]

……

……

c) The table below is a standard calibration table for a certain thermocouple. It shows the corresponding temperature for a certain magnitude of voltage.

°C	0	1	2	3	4	5	6	7	8	9
Thermometric Voltage in Millivolts										
0	**0.000**	**0.000**	**0.000**	**-0.001**	**-0.001**	**-0.001**	**-0.001**	**-0.001**	**-0.002**	**-0.002**
10	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.003**	**-0.003**
20	**-0.003**	**-0.003**	**-0.003**	**-0.003**	**-0.003**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**
30	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.002**	**-0.001**	**-0.001**	**-0.001**	**-0.001**	**-0.001**
40	**-0.000**	**-0.000**	**-0.000**	**-0.000**	**-0.000**	**-0.001**	**-0.001**	**-0.001**	**-0.002**	**-0.002**
50	**-0.002**	**-0.003**	**-0.003**	**-0.003**	**-0.004**	**-0.004**	**-0.004**	**-0.005**	**-0.005**	**-0.006**
60	**-0.006**	**-0.007**	**-0.007**	**-0.008**	**-0.008**	**-0.009**	**-0.009**	**-0.010**	**-0.010**	**-0.011**
70	**-0.011**	**-0.012**	**-0.012**	**-0.013**	**-0.014**	**-0.014**	**-0.015**	**-0.015**	**-0.016**	**-0.017**
80	**-0.017**	**-0.018**	**-0.019**	**-0.020**	**-0.020**	**-0.021**	**-0.022**	**-0.022**	**-0.023**	**-0.024**
90	**-0.025**	**-0.026**	**-0.026**	**-0.027**	**-0.028**	**-0.029**	**-0.030**	**-0.031**	**-0.031**	**-0.032**
100	**-0.033**	**-0.034**	**-0.035**	**-0.036**	**-0.037**	**-0.038**	**-0.039**	**-0.040**	**-0.041**	**-0.042**

This cell shows that at a voltage of -0.036 mV, the temperature is 103°C

i) Comment and explain whether this thermocouple is suitable for measuring low temperatures and high temperatures in the temperature range above. [2]

……...

……...

……...

……...

ii) Name 1 advantages of using the thermocouple. [1]

……

……

d) A thermocouple thermometer is attached to a millivoltmeter. It reads 5.0 mV at a temperature of -10 °C and 25.0 mV at a temperature of 110 °C. What is the temperature if the reading on the millivoltmeter is 10.0 mV? (Note: The cold junction of the thermocouple is not kept at 0°C.) [2]

12 Answer on the lined pages at the end of the booklet

EITHER

Table below shows the characteristics for four types of sound wave that can be radiated from a seabed mapping ship.

Waves	Frequency/Hz	Amplitude	Percentage of reflected energy by seabed	Rate of absorption sound energy by water
A	1000	High	40	High
B	300	Medium	50	High
C	2000	Medium	30	Medium
D	15000	High	60	Low

a) Explain the suitability of each characteristic in the table above and then, select the most suitable wave that can be used to detect the depth of the sea. [5]

b) A cargo ship is used to measure the depth of the sea using sonar instrument. Wave with the frequency of 5.0×10^5 Hz is used to measure the depth of the sea. (Sound wave speed in sea water = 1500 m/s)

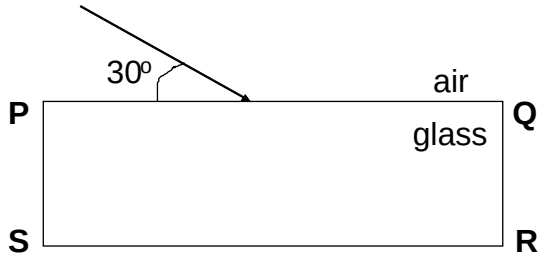
i) What is the wavelength of a sound wave in the sea water? [2]

ii) If the time interval between transmission and reception of sound wave is 2.4 s, what is the depth of the sea? [2]

c) Ultrasonic sound wave is commonly used by ship in the sonar instrument State one other uses of an ultrasonic sound wave. [1]

OR

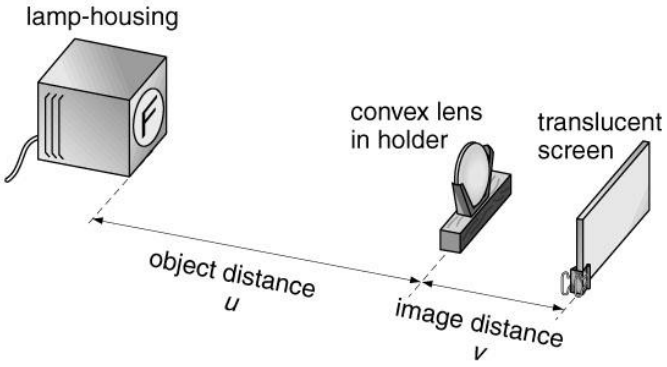
a) The figure below shows a ray of light travelling from air to glass. The incident ray makes an angle of 30° with the boundary and the refractive index of glass is 1.5.



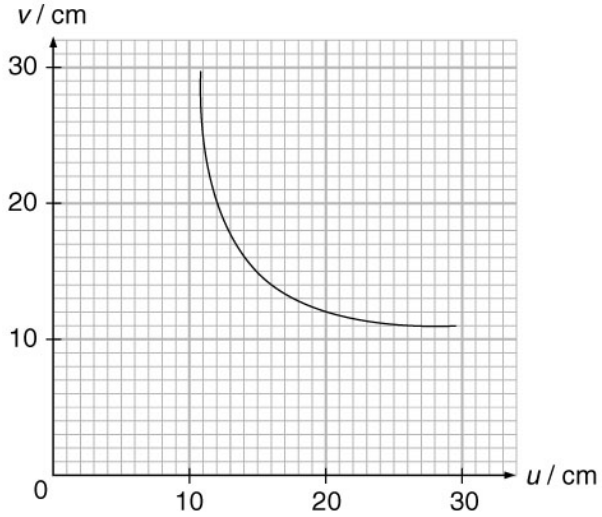
i) Calculate the angle of refraction when the light enters PQ. [2]

ii) When the light hits the surface **RS**, explain with calculations what will happen to the light ray. [3]

b) Anthony uses the set-up shown below to study the image formation of an object being placed in front of the converging lens. He puts an illuminated letter **F** in front of the lens and an image is formed on a translucent screen. He finds that the object distance ***u*** is larger than the image distance ***v***.



Anthony then changes the object distance ***u*** and measures the values of ***v***. After obtaining several sets of data, he constructs the graph shown below.



i) If the object is moved closer to the lens, how will the image **size** change? [1]

ii) Using the graph, determine the focal length of the lens. [2]

iii) Explain why Anthony is unable to form the image on the screen when he placed the illuminated object at a distance 5 cm away from the lens. [2]