TEST CODE **01238020**

FORM TP 2007117

MAY/JUNE 2007

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

PHYSICS

Paper 02 – General Proficiency

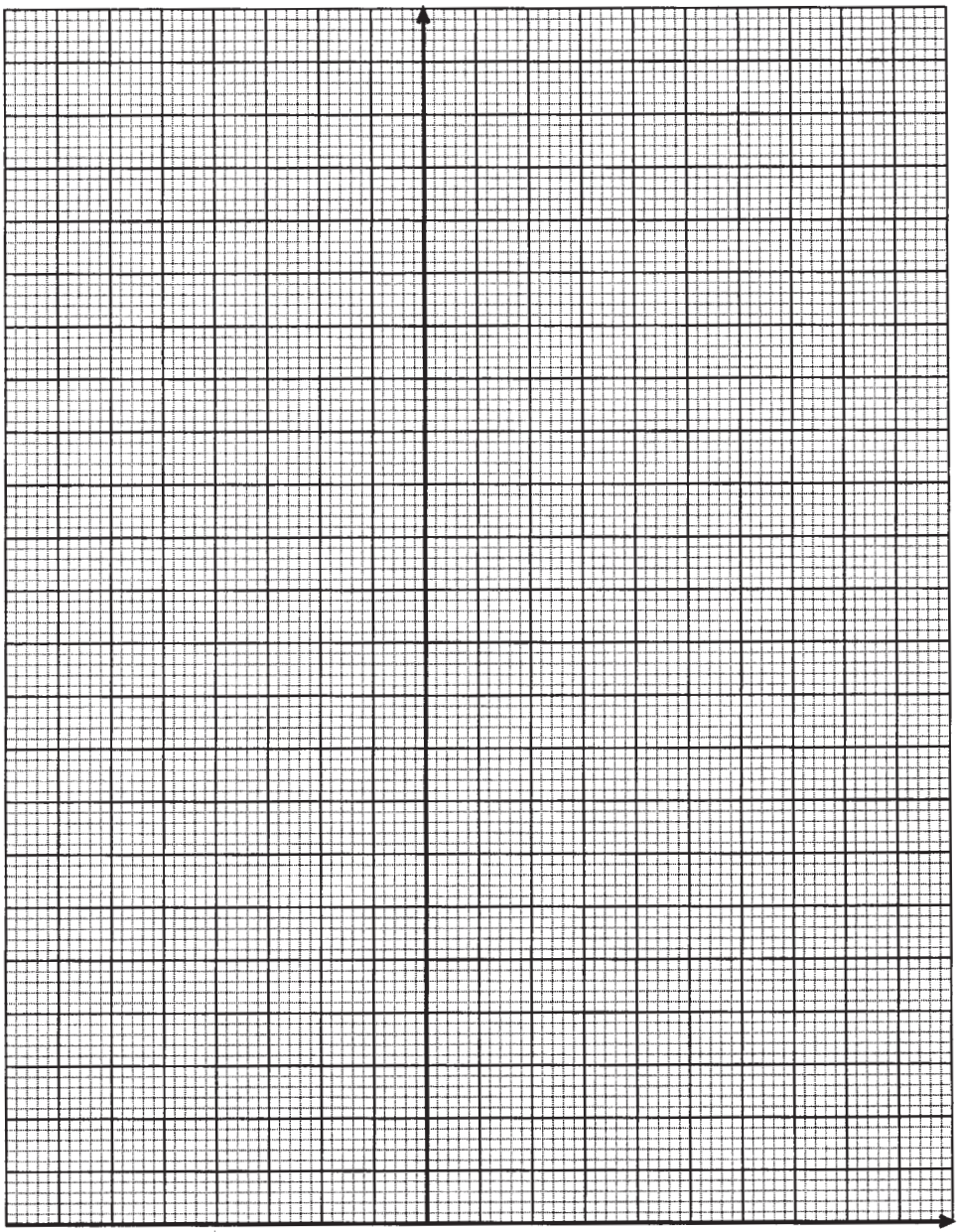
$1\frac{1}{2}$ hours

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.
2. ALL WORKING MUST BE SHOWN in this booklet, since marks will be awarded for correct steps in calculations.
3. Attempt ALL questions.
4. The use of non-programmable calculators is allowed.
5. Mathematical tables are provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

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Graph for Question 1

1. No more than $\frac{1}{2}$ hour should be spent on this question.

DATA ANALYSIS

A student investigates the relationship between the volume and temperature of a fixed mass of gas at a constant pressure of 1 atmosphere.

The results she obtained are shown in the table below.

Temperature / °C	20	50	100	150	200	250
Volume / cm^3	49.1	54.0	61.3	70.5	78.9	87.0

(a) With the aid of a diagram, describe a method that the student could have used to obtain her results.

(6 marks)

(b) Plot a graph of volume, V, (y-axis) against temperature, T, (x-axis). The axes have been drawn for you. The scale for the x-axis should include the range –300 °C to +300°C, with 50 °C per division. Label the graph line of V against T "Line 1".

(9 marks)

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(c) From the graph determine V_1, the volume of the gas at –120 °C.

(2 marks)

(d) At what temperature is the volume $2V_1$?

(2 marks)

(e) Determine the slope, *S*, of the graph. Include its units.

(4 marks)

(f) From your graph read off the temperature, T_O, at which the volume would be zero. Explain the significance of T_O.

(3 marks)

(g) The equation of the graph line is $V = mT + C$. Write down the values of *m* and *C*.

(2 marks)

(h) The pressure on the gas is doubled and the experiment repeated. Draw, on the same set of axes, the line that would be obtained if the experiment is repeated at this higher pressure. Label this line "Line 2".

(2 marks)

Total 30 marks

2. (a) Explain what is meant by the terms 'velocity' and 'acceleration'.

(3 marks)

(b)

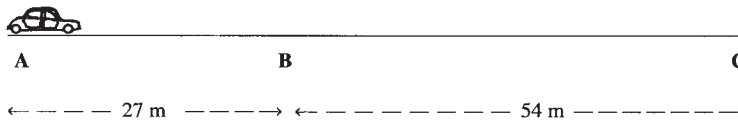


Figure 1

Figure 1 above shows a car at A moving towards C, with a constant velocity of 30 m s^{-1}. As the car passes A, the driver sees an obstruction in the road at C. Due to the reaction time of the driver, the car travels a distance of 27 m, at the same velocity, before the brakes are applied at B. The car now decelerates uniformly and comes to a halt at C, which is 54 m from B.

(i) Calculate the reaction time of the driver.

(2 marks)

(ii) The car takes 3.6 s to travel from B to C. In the space below, draw a velocity-time graph to represent the motion of the car between A and C.

(3 marks)

(iii) What is the average speed of the car between B and C?

_____

_____

(3 marks)

(iv) If the mass of the car is 750 kg, find the braking force that slows the car between B and C.

_____

_____

_____

_____

(5 marks)

Total 16 marks

3. (a) **Figure 2** below shows a shiny kettle which is placed on a gas stove to heat the water inside it.

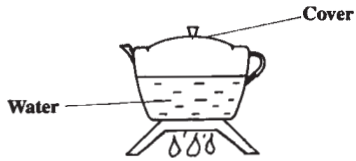


Figure 2

(i) By what process is heat transferred to the water through the kettle?

_____

(1 mark)

(ii) Explain why kettles are usually shiny on the outside.

_____

(1 mark)

(iii) How does the cover prevent heat losses?

_____

_____

(2 marks)

(b) Only about one-third of the thermal energy generated by burning the gas goes into heating the water, whilst the remainder is wasted.

State where the wasted energy goes and give the process by which this wasted heat is transferred.

_____

_____

(2 marks)

(c) If the mass of water in the kettle is 1.5 kg, calculate the thermal energy required to raise its temperature from 30 °C to 100 °C.

(3 marks)

(d) How much more energy must the water absorb for 0.2 kg of it to boil off?

_____

_____

(3 marks)

(e) Explain why it is better not to fill the kettle when making one or two cups of tea.

_____

_____

_____

(2 marks)

(Specific heat capacity of water = 4.2×10^3 J kg^{-1} K^{-1}.
Specific latent heat of vaporization of water = 2.3×10^6 J kg^{-1}.)

Total 14 marks

4. In the seventeenth century, two conflicting theories concerning the nature of light were put forward.

(a) State what these theories considered light to be.

Theory A

_____

_____

Theory B

_____

_____

(2 marks)

(b) **Table 1** below lists some of the properties of light.

Indicate, by ticking the relevant boxes, the properties which these theories can explain. Place an X in the box if the theory CANNOT satisfactorily explain the property.

Property	**Theory A**	**Theory B**
Travels in a straight line		
Reflection		
Conveys energy		
Diffraction		

Table 1

(4 marks)

(c) An optical fibre is a flexible glass rod of extremely small diameter which is used to carry light signals over distances of several kilometres.

Figure 3 below shows the structure of a typical optical fibre, with a glass core of refractive index, 1.50, surrounded by a glass cladding of different refractive index, n_2. Once the light enters the core, it is totally internally reflected and remains inside the fibre until it reaches the other end of the fibre. The ray of light, *AB*, in air is refracted into the core along the path, *BC*.

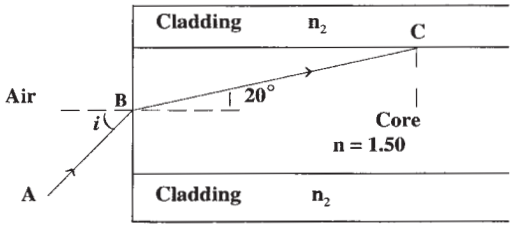


Figure 3

(i) What is meant by 'total internal reflection' at point C?

_____

_____

_____

(2 marks)

(ii) Is the refractive index of the cladding greater or smaller than that of the core?

_____

(1 mark)

(iii) Draw on **Figure 3**, the ray that shows the path of the light continuing on from *C*.

(1 mark)

(iv) Calculate the angle of incidence of the light entering the fibre.

(3 marks)

(v) Given that the speed of light in air is 3×10^8 m s^{-1}, determine the speed of light in the core of the fibre.

_____

_____

_____

(3 marks)

Total 16 marks

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5. (a) A negatively charged polythene strip is used to attract a small piece of insulating paper as shown in **Figure 4** below.

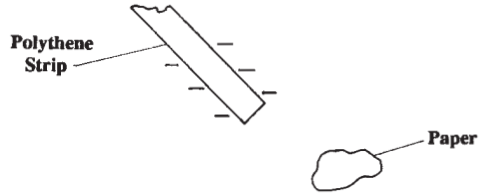


Figure 4

(i) Show, on the diagram above, the charge distribution on the paper.

(2 marks)

(ii) Explain why there is a net force of attraction.

_____

_____

(2 marks)

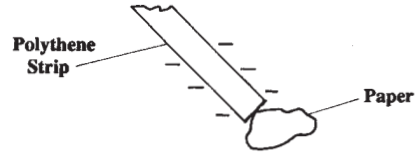


Figure 5

(iii) Draw, on **Figure 5** above, the charge distribution on the paper when it is in contact with the polythene strip. **(1 mark)**

(iv) State whether the paper gains or loses charge and the type of charge transferred, when it touches the strip.

_____

_____

_____

(2 marks)

(b) When lightning strikes the earth, there is a massive flow of electrons from a thundercloud to the earth during a short time interval.

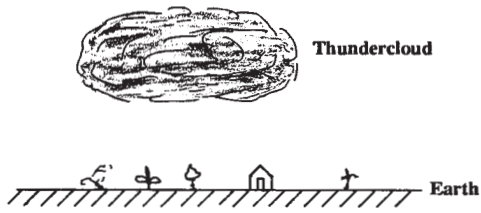


Figure 6

(i) Draw, on **Figure 6** above, electric field lines between the cloud and the earth.
(2 marks)

(ii) Describe a precaution which may be taken to protect a building against lightning.

_____

_____

_____

(2 marks)

(c) During a certain lightning strike, a current of 5×10^4 A flows for a time period of 0.15 ms.

Calculate the quantity of charge that flows from cloud to earth during the strike.

(3 marks)

Total 14 marks

END OF TEST