CARIBBEAN EXAMINATIONS COUNCIL
CARIBBEAN ADVANCED PROFICIENCY EXAMINATIONS

ANSWER BOOKLET

CARIBBEAN EXAMINATIONS COUNCIL
CARIBBEAN ADVANCED PROFICIENCY EXAMINATIONS

ANSWER BOOKLET

31 MAY 2002 (a.m.)

I. FILL IN ALL THE INFORMATION REQUESTED CLEARLY AND LEGIBLY

TEST CODE | 0 | 0 | 2 | 4 | 7 | 1 |

SUBJECT: PHYSICS – UNIT 1 PAPER 01

REGISTRATION NUMBER: | | | | | | | | | | |

TEST CODE | 0 | 0 | 2 | 4 | 7 | 1 |

SUBJECT: PHYSICS – UNIT 1 PAPER 01

REGISTRATION NUMBER: | | | | | | | | | | |

II.

QUES NOS.	MODULE 1			
	P1	P2	P3	TOTAL
01				
02				
03				
TOTAL				
	MODULE 2			
	P1	P2	P3	TOTAL
04				
05				
06				
TOTAL				
	MODULE 3			
	P1	P2	P3	TOTAL
07				
08				
09				
TOTAL				

SCHOOL/CENTRE NUMBER			

NAME OF SCHOOL/CENTRE

CANDIDATE'S NAME

DATE OF BIRTH		
Day	Month	Year

SEX — MALE ☐ FEMALE ☐

SIGNATURE ____________

BELOW THIS LINE FOR CXC USE ONLY

BELOW THIS LINE FOR CXC USE ONLY

TEST CODE **002471**

FORM TP 22245

MAY/JUNE 2002

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

PHYSICS

UNIT 01 – Paper 01

1 hour and 45 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of NINE questions. Candidates must attempt ALL questions.

2. Candidates MUST write in this answer booklet and all working MUST be CLEARLY shown.

3. The use of non-programmable calculators is permitted.

LIST OF PHYSICAL CONSTANTS

Universal gravitational constant	G	=	6.67×10^{-11} N m^{2} kg^{-2}
Acceleration due to gravity	g	=	9.80 m s^{-2}
Radius of the Earth	R_E	=	6380 km
Mass of the Earth	M_E	=	5.98×10^{24} kg
Mass of the Moon	M_M	=	7.35×10^{22} kg
1 Atmosphere	Atm	=	1.00×10^{5} N m^{-2}
Boltzmann's constant	k	=	1.38×10^{-23} J K^{-1}
Density of water		=	1.00×10^{3} kg m^{-3}
Thermal conductivity of copper		=	400 W m^{-1} K^{-1}
Specific heat capacity of aluminium		=	910 J kg^{-1} K^{-1}
Specific heat capacity of copper		=	387 J kg^{-1} K^{-1}
Specific heat capacity of water		=	4200 J kg^{-1} K^{-1}
Specific latent heat of fusion of ice		=	3.34×10^{5} J kg^{-1}
Specific latent heat of vaporization of water		=	2.26×10^{6} J kg^{-1}
Avogadro's number	N_A	=	6.02×10^{23} per mole
Molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
Stefan-Boltzmann constant	σ	=	5.67×10^{-8} W m^{-2} K^{-4}
Speed of light in vacuum	c	=	3.0×10^{8} m s^{-1}

1. (a) Write down the conditions necessary for a body to be in a state of equilibrium.

____

____

____

[2 marks]

(b)

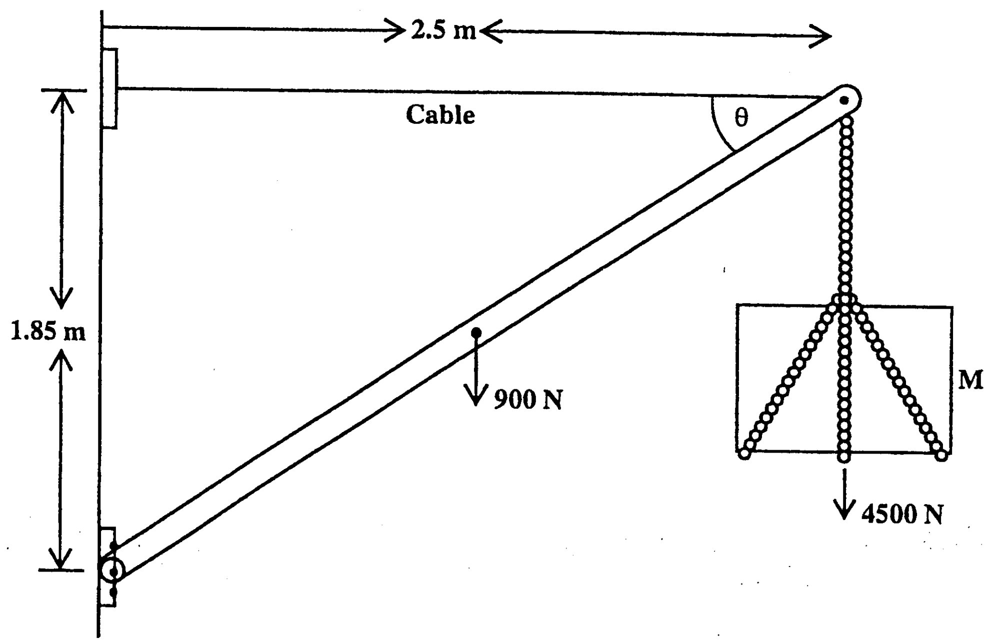


Figure 1

The diagram shows a hinged beam that is connected to a wall by a horizontal cable and supporting a concrete slab of weight 4500 N. The uniform beam has a weight of 900 N. The mass of the cable and rope are negligible.

(i) Draw a free-body diagram showing the forces acting on this system.

[3 marks]

1. (ii) Calculate the tension T in the cable

[2 marks]

(iii) Calculate the net force on the beam from the hinge.

[3 marks]

Total 10 marks

2. (a) An electric pump with a power output of 3 MW moves 4×10^{12} kg of water from a depth of 80 m in a reservoir to the surface.

(i) Use energy conservation considerations to explain how the pump moves the water to the surface of the reservoir.

[3 marks]

(ii) How long will it take the pump to move the 4×10^{12} kg of water to the surface?

[2 marks]

(b) Water flowing into the same reservoir is allowed to strike a set of blades. The blades, which rotate, are connected to a generator which is used to keep the light bulbs in the reservoir alight. Use energy conservation considerations to explain

(i) how this system works

[3 marks]

(ii) why the electrical power used by the light bulbs is less than the power of the water striking the blades.

[2 marks]

Total 10 marks

3. There has been a scare of a terrorist attack at the Grantley Adams International Airport in Barbados. An incoming flight as shown in Figure 2 has been asked to circle the airport at a steady height and an angle of θ° to the horizontal for the next 20 minutes while checks are being made at the airport.

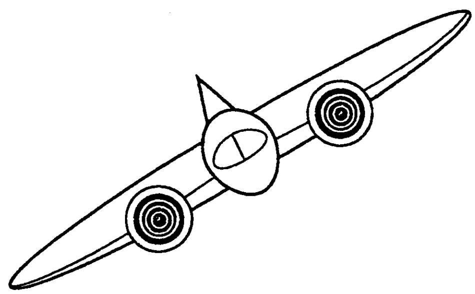


Figure 2

(a) On Figure 2 draw and label the actual forces acting on the aeroplane in the vertical plane. **[2 marks]**

(b) The aeroplane travels at constant speed in a circular fashion.

(i) Name and explain the origin of the horizontal force that keeps the plane in this circle.

____

____

____

[2 marks]

(ii) What force opposes the weight to keep the plane at a constant height.

____

____

[1 mark]

3. (c) The aeroplane circles the airport in a circle of radius 1 km at a speed of 340 km/hr. Find the angle θ at which the aeroplane moves to the horizontal.

[5 marks]

Total 10 marks

4. (a) State what is meant by 'coherent light sources'.

[2 marks]

(b) (i) Describe the diffraction grating.

[1 mark]

(ii) Explain the part played by diffraction in the operation of the diffraction grating.

[1 mark]

4. (c) Draw diagrams showing how two light waves produces (i) constructive and (ii) destructive interference.

[2 marks]

(d) A grating is illuminated with light consisting of two wavelengths, 700 and 550. Calculate the angular separation of the third orders of the wavelengths given that the grating spacing is 4×10^{-6} m.

____

____

____

____

____

____

____

[4 marks]

Total 10 marks

5. (a) A small bright source of light is located at the horizontal bottom of a swimming pool as shown in Figure 3.

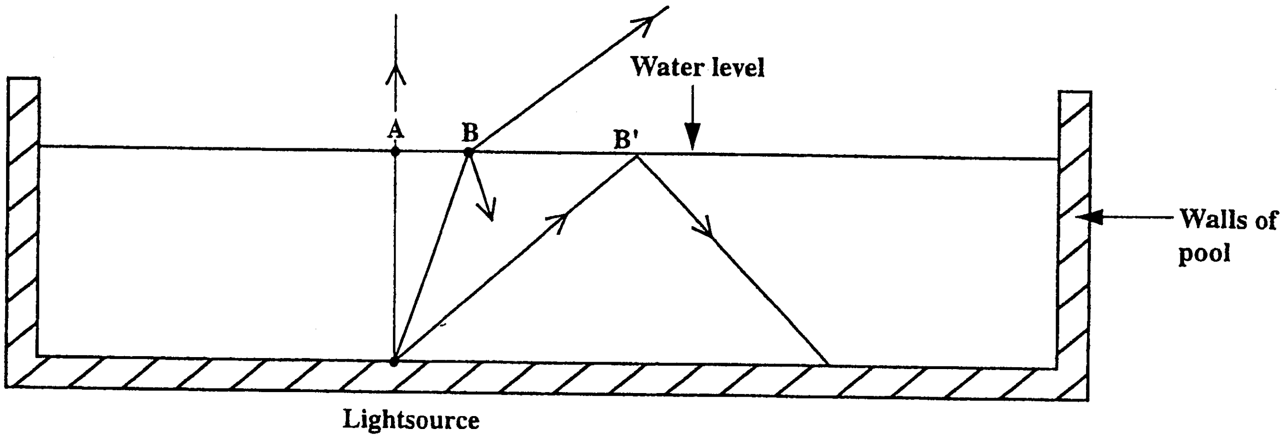


Figure 3

Light from the source is shown incident at three points A, B and B′. Consider a point of incidence of B and B′ and explain

(i) what happens to the incident light as B moves away from A towards B′

____

[1 mark]

(ii) what happens to the incident light at B′ and beyond

____

____

____

____

____

[2 marks]

5. (iii) how does the intensity of the light, as seen from the surface, vary across the

a) top of the pool

[1 mark]

b) bottom of the pool.

[1 mark]

(b) The distance of a storm can be estimated by counting the number of seconds between seeing the flash of lightning and hearing the sound of the thunder and dividing by three (3). The result gives the approximate distance of the storm away in kilometres. (Speed of sound in air = 300 m s^{-1}).

(i) Show why this method works.

[3 marks]

(ii) State any assumptions made.

[2 marks]

Total 10 marks

6. (a) The equation for the displacement of a body moving with simple harmonic motion is

$$x = A \sin \omega t.$$

(i) What do the symbols A and ω represent?

____

____

[2 marks]

(ii) Draw a graph showing how x varies with time for the case in which the motion is damped.

[2 marks]

(b) For a body executing simple harmonic motion the equation is

$$x = 0.03 \sin \pi t$$

where distances and times are in metres and seconds respectively. At $t = 1.75$ s, calculate the

(i) displacement

____

____

____

[2 marks]

6. (ii) velocity

[2 marks]

(iii) acceleration.

[2 marks]

Total 10 marks

7. (a) A student uses the apparatus shown in Figure 4 to find the specific latent heat of vaporization of a liquid, B. The experiment was repeated using a different rate of evaporation in order to eliminate heat losses.

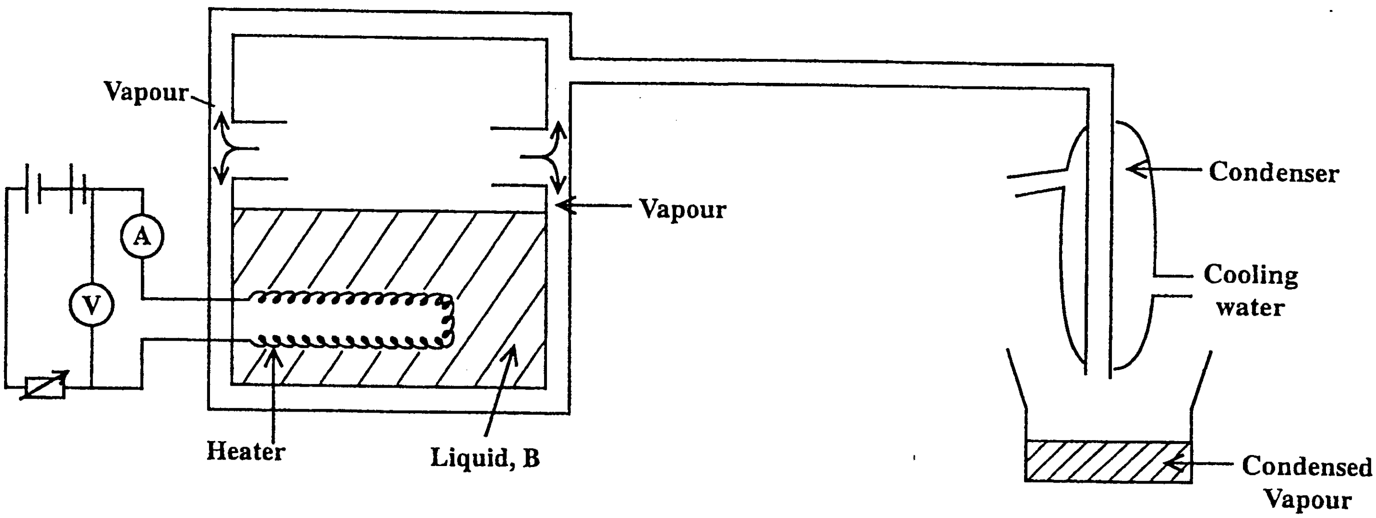


Figure 4

(i) State what quantities the student must measure in order to find the specific latent heat of vaporization of Liquid B.

____

____

____

____

[2 marks]

(ii) Write down TWO equations that the student must use to represent the conservation of energy for the apparatus in Figure 4.

____

____

[1 mark]

(iii) Show how the student must use the two equations written down in (a) (ii) above to arrive at a value for L.

____

____

____

[2 marks]

7. (b) A student performs this experiment to determine the specific latent heat of vaporization of water. When the student supplies 70 W of power, 30 g of water condenses. When the student supplies 80 W of power for the same time, 40 g of water condenses.

(i) How long does it take to condense the water in EACH case?

____

____

____

____

____

[4 marks]

(ii) The student wishes to perform the same experiment in the same time but using a liquid with a **much higher** specific latent heat of vaporization. How must the student adjust the power supply?

____

[1 mark]

Total 10 marks

8. (a) Figure 5 shows a lagged metal bar of uniform cross-sectional area, with heat being supplied at the end A.

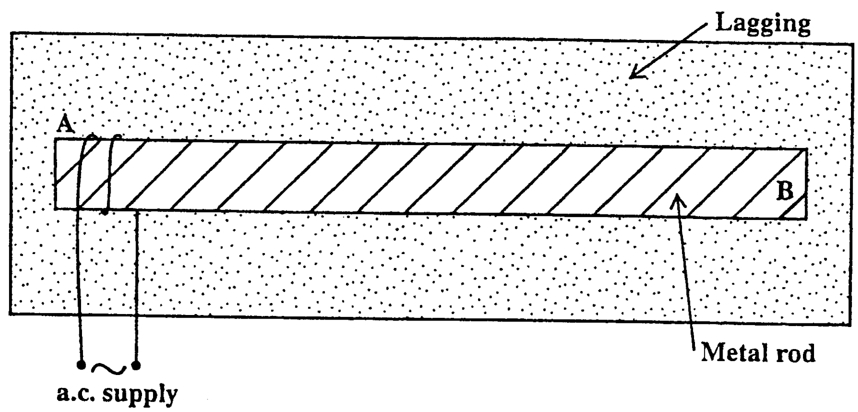


Figure 5

(i) Explain how the properties of the metal allows heat to be transferred by conduction from End A to End B.

____

____

____

[2 marks]

(ii) How does the structure of a metal make it a better conductor than a gas?

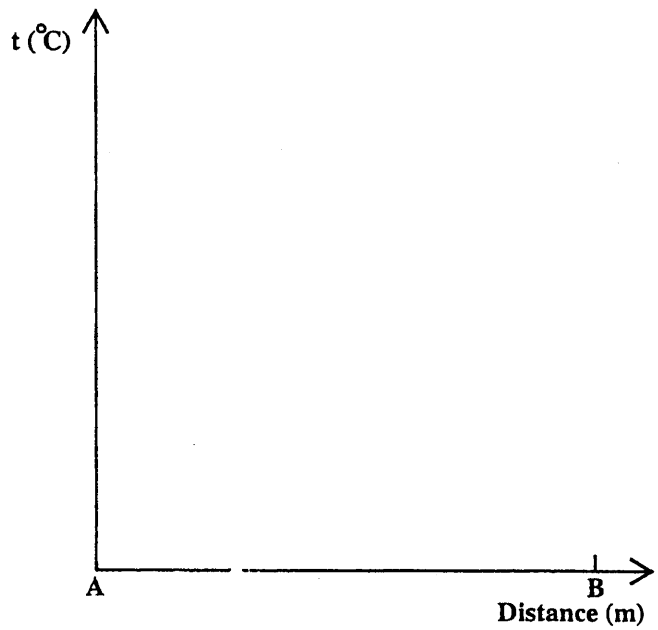
____

____

____

[2 marks]

8. (iii) Sketch a graph on the axis below to show the variation of temperature, t against the distance AB along the rod after a steady state has been reached.



[1 mark]

(b) Figure 6 shows a lagged metal rod of uniform cross-sectional area with heat being supplied at End A. The rod is composed of two rods of equal length l. This first rod is made of aluminium of thermal conductivity 210 $Wm^{-1} K^{-1}$. The second rod is made of copper of thermal conductivity 400 $Wm^{-1} K^{-1}$.

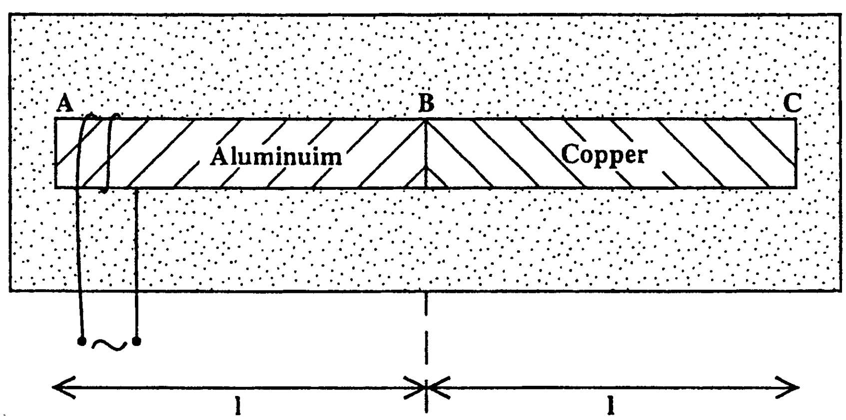


Figure 6

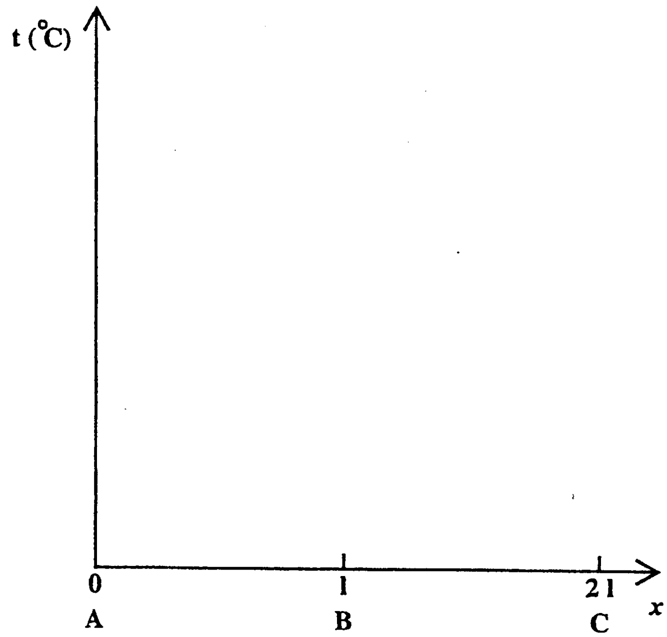
Assuming steady state conditions,

(i) comment on the rate of heat transfer in both the aluminium and the copper

____

[1 mark]

(ii) sketch on the pair of axes below how the temperature varies with distance x across the entire rod AC



[2 marks]

(iii) account for the shape of the graph you drew in (b) (ii) above.

____

____

____

____

[2 marks]

Total 10 marks

9. (a) Distinguish between an empirical scale of temperature and thermodynamic temperature scale.

[3 marks]

(b) Two bodies are in thermal equilibrium. What does this statement mean?

[1 mark]

(c) Give ONE example of an empirical scale and outline how you would measure centigrade temperatures on it.

[1 mark]

(d) The element of a resistance thermometer, R, has a mass of 15 g and specific heat capacity 4.5×10^{2} J K^{-1} kg^{-1}. The element was immersed in 0.4 kg of a liquid of specific heat capacity 3.4×10^{3} J K^{-1} kg^{-1} and the equilibrium temperature was found to be 70 °C. (Room temperature = 25 °C)

(i) What was the initial temperature of the liquid?

[2 marks]

9. (ii) State TWO assumptions you made in answering (d) (i).

____

____

____

____

[2 marks]

(iii) How could the cooling effect of the thermometer be reduced?

____

____

[1 mark]

Total 10 marks

END OF TEST