CARIBBEAN EXAMINATIONS COUNCIL
CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

ANSWER BOOKLET

CARIBBEAN EXAMINATIONS COUNCIL
CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

ANSWER BOOKLET

11 MAY 2010 (a.m.)

FILL IN ALL THE INFORMATION REQUESTED CLEARLY AND LEGIBLY

TEST CODE | 0 | 2 | 1 | 3 | 8 | 0 | 2 | 0 |

SUBJECT PHYSICS – UNIT 1 PAPER 02

REGISTRATION NUMBER | | | | | | | | | | |

TEST CODE | 0 | 2 | 1 | 3 | 8 | 0 | 2 | 0 |

SUBJECT PHYSICS – UNIT 1 PAPER 02

REGISTRATION NUMBER | | | | | | | | | | |

QUES NOS.	MODULE 1 TOTAL
01	
04	
TOTAL	
	MODULE 2 TOTAL
02	
05	
TOTAL	
	MODULE 3 TOTAL
03	
06	
TOTAL	

SCHOOL/CENTRE NUMBER

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME

DATE OF BIRTH

Day *Month* *Year*

SEX MALE ☐ FEMALE ☐

SIGNATURE _____

BELOW THIS LINE FOR CXC USE ONLY

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TEST CODE **02138020**

FORM TP 2010233

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

PHYSICS

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This paper consists of **SIX** questions.
2. Section A consists of **THREE** questions. Candidates must attempt **ALL** questions in this section. Answers for this section must be written in the spaces provided in this question paper.
3. Section B consists of **THREE** questions. Candidates must attempt **ALL** questions in this section. Answers for this section must be written in the space at the end of each question.
4. All working **MUST** be **CLEARLY** shown.
5. The use of non-programmable calculators is permitted, but candidates should note that the use of an inappropriate number of figures in answers will be penalised.

LIST OF PHYSICAL CONSTANTS

Universal gravitational constant	G	=	6.67×10^{-11} N m^2 kg^{-2}
Acceleration due to gravity	g	=	9.8 m s^{-2}
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}
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 constant	N_A	=	6.02×10^{23} per mole
Molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
Stefan-Boltzmann's constant	s	=	5.67×10^{-8} W m^{-2} K^{-4}
Speed of light in free space	c	=	3.00×10^8 m s^{-1}

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided in this answer booklet.

1. (a) Figure 1 shows a ball placed at the top of an inclined plane with a block rigidly fixed to the bottom of the plane.

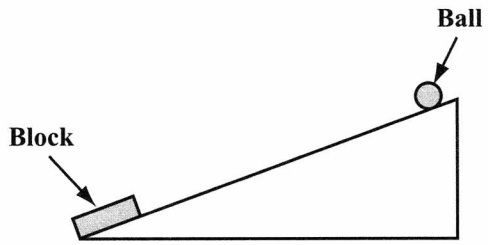

Figure 1

The ball of mass 0.60 kg is released from rest from the top of the plane and v, the velocity of the ball down the plane, is measured for various values of time t. Table 1 shows the variation of velocity with time.

Table 1

Velocity v/m s–1	Time, t /s	Velocity v/m s–1	Time, t /s
0	0	– 3.4	1.25
0.6	0.2	– 2.8	1.4
1.4	0.4	– 2.1	1.6
2.1	0.6	– 1.4	1.8
2.8	0.8	– 0.8	2.0
3.5	1.0	0	2.2
4.2	1.2		

(i) On the grid on page 5, plot a graph of velocity v, versus time t.

[4 marks]

(ii) Using your graph, describe qualitatively the motion of the ball.

_____

_____

_____

_____

_____

[3 marks]

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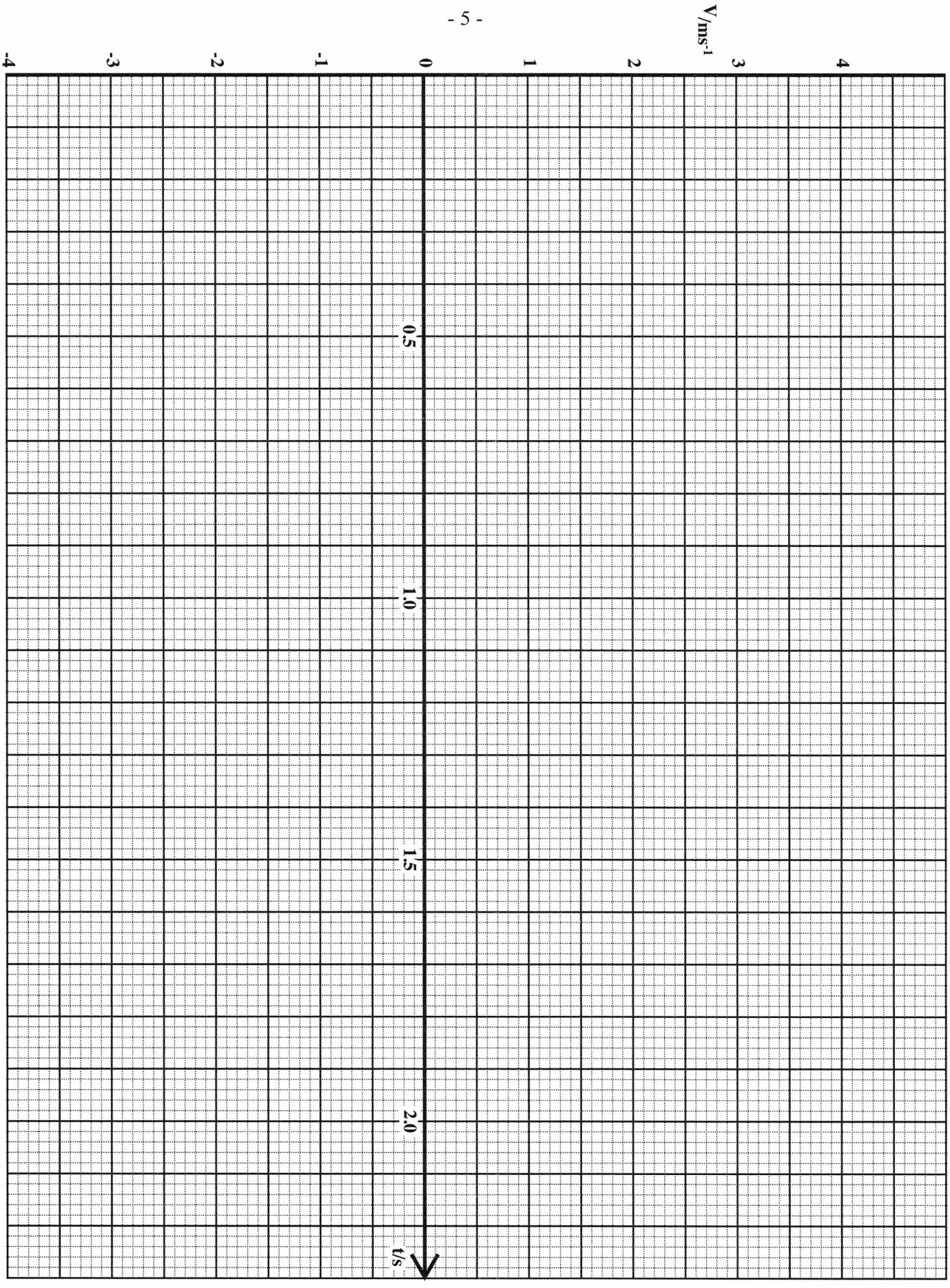
v/ms-1
-4
-3
-2
-1
0
1
2
3
4
0.5
1.0
1.5
2.0
t/s

(iii) Calculate

a) the acceleration of the ball down the inclined plane

[2 marks]

b) the length of the incline

[2 marks]

c) the MEAN force experienced by the ball during the impact with the block.

[2 marks]

(iv) State, with a reason, whether the collision between the block and the ball is elastic or not.

_____

_____

_____

_____

[2 marks]

Total 15 marks

NOTHING HAS BEEN OMITTED

2. (a) Draw rays to show the passage of **white** light through

(i) Figure 2, a diffraction grating

(ii) Figure 3, a triangular glass prism

(iii) Figure 4, a rectangular glass block. **[4 marks]**

Figure 2: Diffraction grating

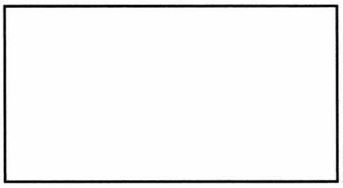

Figure 4: Glass block

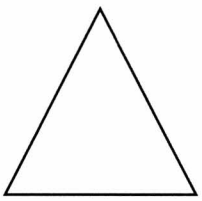

Figure 3: Prism

(b) The graph on page 9 shows the relationship between the sines of the angle of incidence, θ_1 and the angle of refraction, θ_2 for monochromatic yellow light travelling from glass to air.

(i) Use the graph to find the missing values of θ_1 and θ_2 and insert them in the table below.

θ_1	sin θ_1	θ_2	sin θ_2
31.0°			
		75.2°	
		90.0°	

State the value of the critical angle of the glass. _____

[7 marks]

(ii) Describe what happens when the angle of incidence θ_1 is 55°.

_____

_____

[1 mark]

(iii) Use the gradient of the graph to determine the refactive index of the glass for this colour light.

_____

_____

[3 marks]

Total 15 marks

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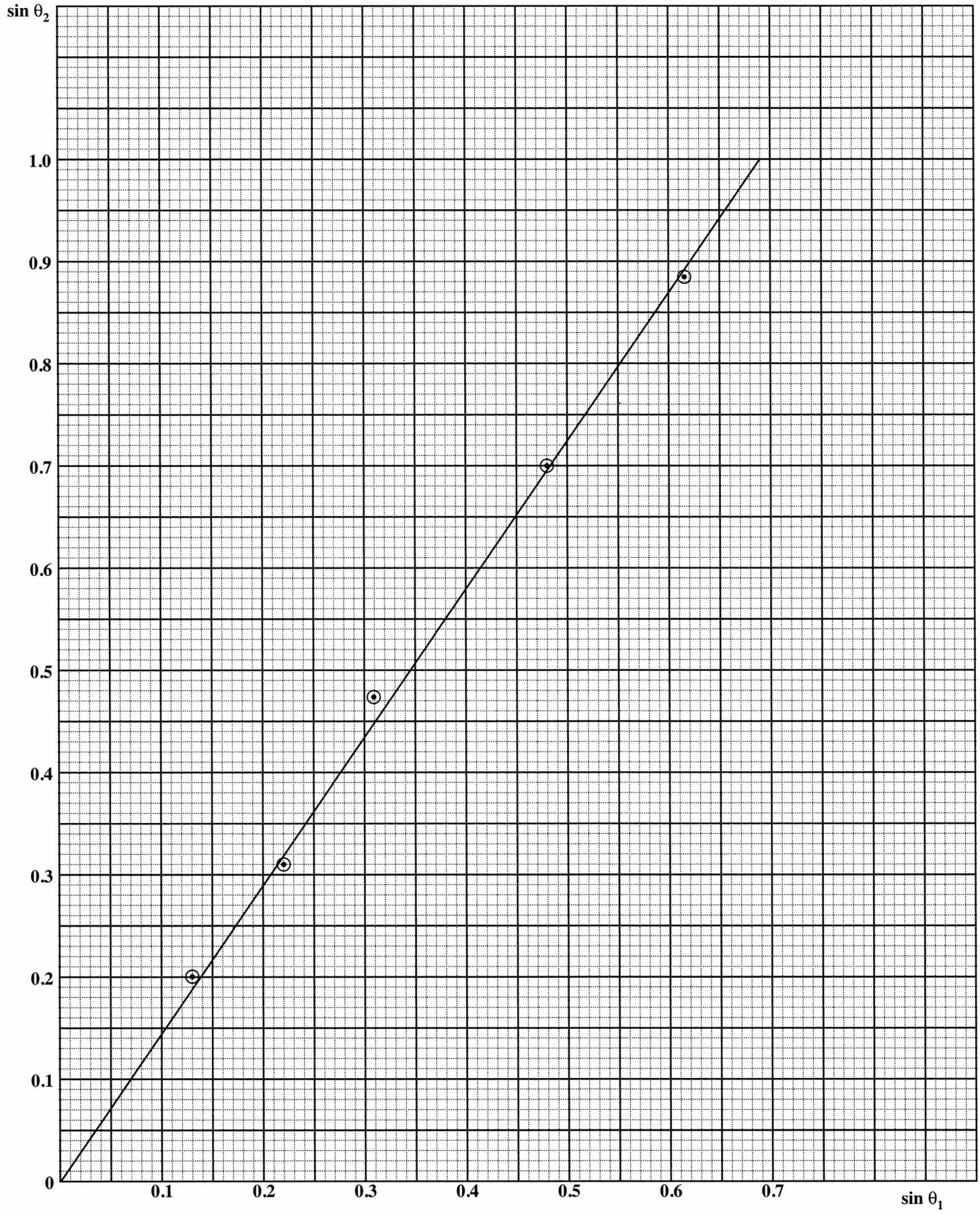
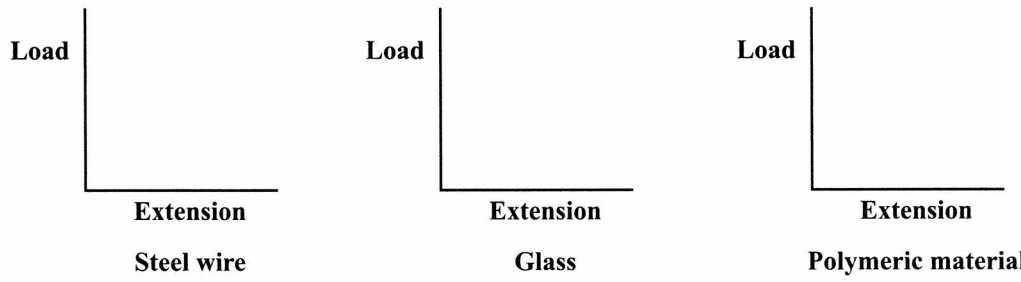

sin θ2
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
sin θ1

3. (a) (i) In the spaces provided, sketch graphs of load versus extension for a steel wire, glass and a polymeric material



[3 marks]

(ii) Define the terms 'stress' and 'strain'.

Stress:

_____

_____

_____

[1 mark]

Strain:

_____

_____

_____

[1 mark]

(b) When a rubber strip with a cross-section of 3×10^{-3} m by 1.5×10^{-3} m is suspended vertically and various masses are attached to it, a student obtains the following data for length versus load.

Load, M/kg	0	0.1	0.2	0.3	0.4	0.5
Length, L/cm	5.0	5.6	6.2	6.9	7.8	10.0
Extension, ΔL / m	0					

(i) Fill in the missing values of extension, ΔL, in the table. **[1 mark]**

(ii) On the grid on page 11, draw a graph of load versus extension. **[4 marks]**

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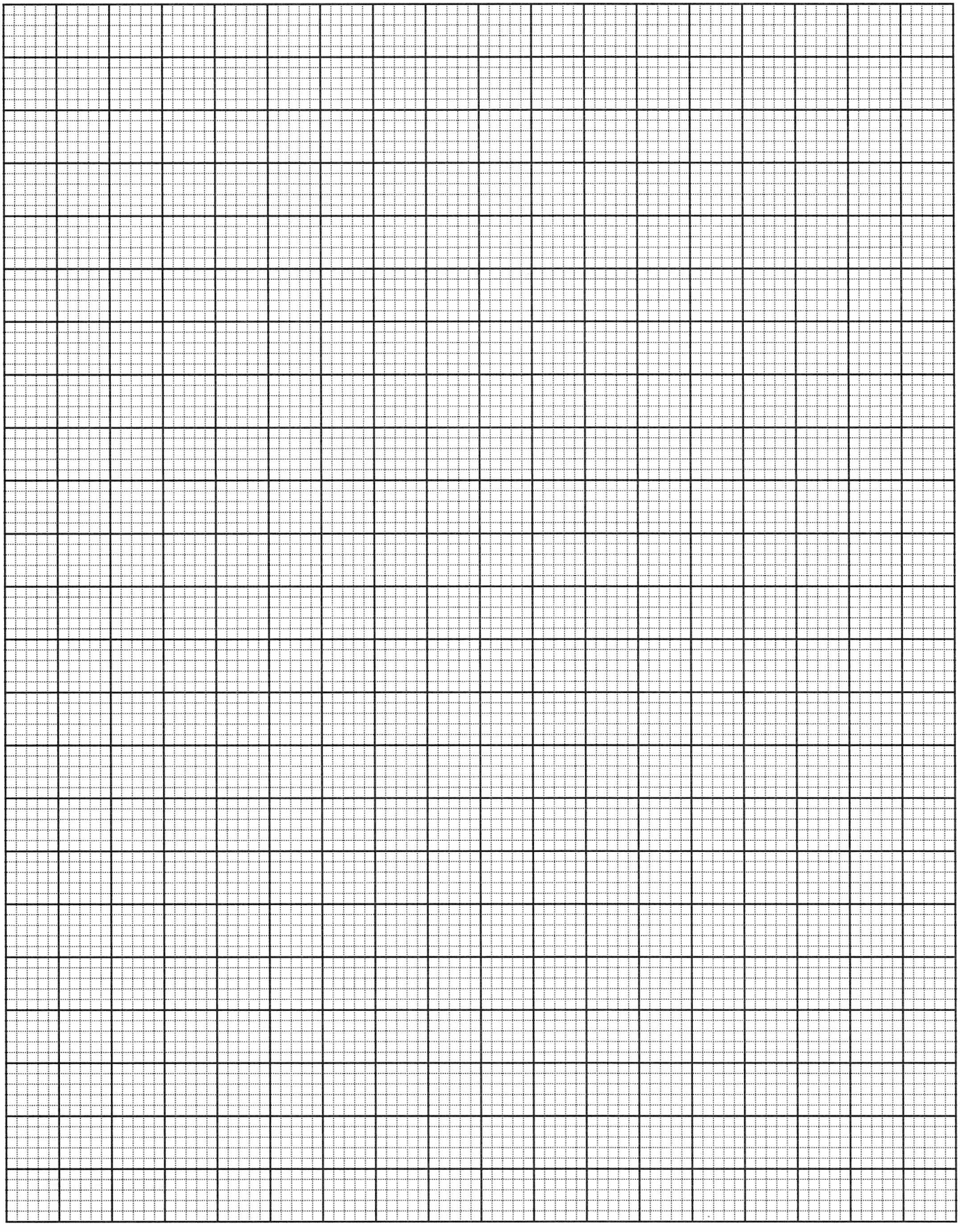

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(iii) Write an equation relating M and ΔL for small loads to Young's modulus E for the rubber.

Write an equation relating Young's modulus and the gradient of your graph for small loads.

[2 marks]

(iv) Use your graph to determine Young's modulus for the rubber for small loads.

[4 marks]

Total 15 marks

SECTION B

Answer ALL questions in this section.
Write your answers in the spaces provided at the end of each question.

4. (a) (i) State the conditions necessary for a body to be in equilibrium under the action of coplanar forces.

(ii) A block weighing 150 N hangs from a cord. It is pulled aside, as shown in Figure 5, by a horizontal force F. Find the tension in the cord and the magnitude of F.

[7 marks]

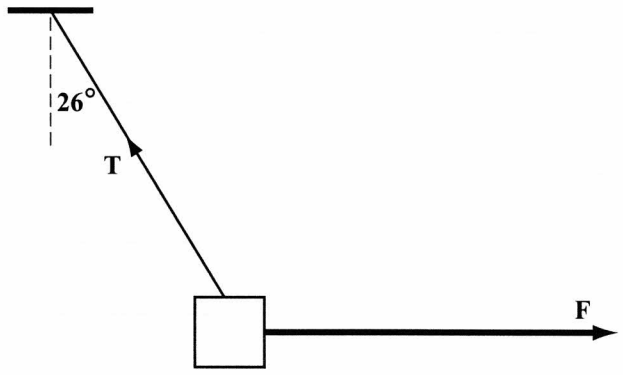

Figure 5

(b) A boy jumps off a flat-bed truck that is 2.2 m high. The initial velocity of the boy is 1.6 m s^{-1} at an angle 20° above the horizontal.

(i) State the horizontal and vertical components of the initial velocity.

(ii) Calculate the time taken for the boy to reach the ground.

(iii) How far horizontally from the truck does the boy land?

[8 marks]

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

5. Use the data presented in Figure 6 to answer this question.

(a) Figure 6 shows how the intensity and intensity level of the human ear vary with frequency.

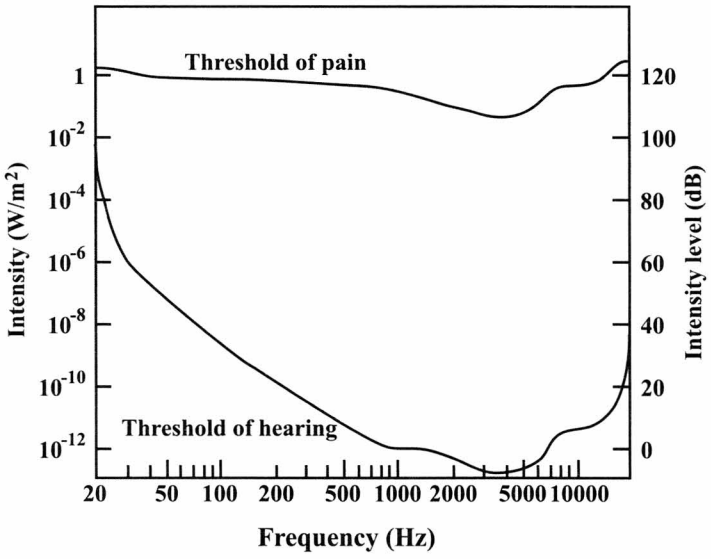

Figure 6

(i) Explain what is meant by 'threshold of hearing' and 'threshold of pain'.

(ii) What property of the human ear makes the decibel (dB) scale particularly useful?

(iii) Write down an expression that relates the sound intensity I, to the intensity level β, in dB.

(iv) What is the intensity level of a sound with intensity 3.82 mW m^{-2}?

(v) Figure 6 is drawn for a typical human ear. Suggest how the figure might change as a person ages.

[7 marks]

(b) Figure 7 shows a loudspeaker connected to an audio-frequency signal generator/amplifier that is set up in front of a large flat wall. A small microphone moved between the speaker and the wall detects regions of low and high intensity.

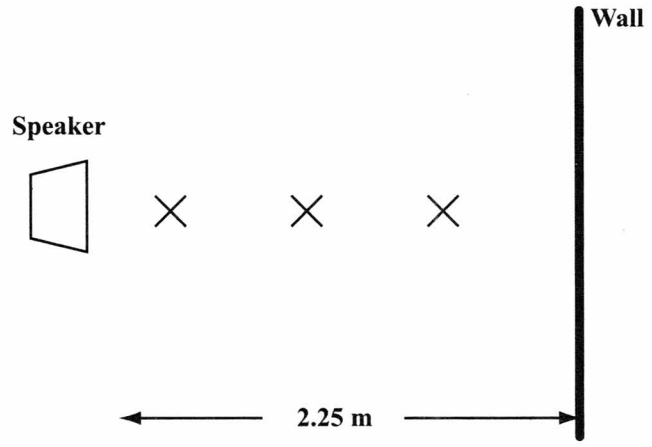

Figure 7

(i) Explain why there are positions between the speaker and the wall where intensity is a minimum and why these minima do NOT actually have zero intensity.

(ii) The points labelled X on Figure 7 are the only three points of minimum intensity detected at a certain frequency setting. What is the frequency?

(iii) When the signal generator is set at 165 Hz how far from the wall is the last **maximum** intensity position?

[Velocity of sound = 330 m s^{-1}]

[8 marks]

Total 15 marks

Write your answer to Question 5 here.

Write your answer to Question 5 here.

6. (a) (i) A hot object emits electromagnetic waves. Explain in terms of the kinetic theory how this radiation is able to warm a distant cold body.

(ii) The Earth's surface is said to be warming up due to the accumulation of carbon dioxide and other gases in the atmosphere. Explain this 'greenhouse effect'.

[5 marks]

(b) A black woodstove with a total surface area 4.6 m^2 is made from cast iron 4.0×10^{-3} m thick. The interior wall of the stove is at 650 °C while the exterior wall is at 647 °C. The temperature of the surrounding air is 30 °C.

Calculate

(i) the rate of the heat conduction through the stove wall

(ii) the net rate of heat loss by radiation from the stove, assuming it acts as a black body

(iii) the heat the stove loses by a combination of conduction and convection in the surrounding air. Explain your answer.

(Thermal conductivity of cast iron, k = 80.4 $Wm^{-1}K^{-1}$)

[10 marks]

Total 15 marks

Write your answer to Question 6 here.

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Write your answer to Question 6 here.

END OF TEST

DO NOT

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CANDIDATE'S RECEIPT

INSTRUCTIONS TO CANDIDATE:

1. **Fill in all the information requested clearly and legibly.**

TEST CODE

SUBJECT: _____

PROFICIENCY: _____

FULL NAME: _____
(BLOCK LETTERS)

Signature: _____

Date: _____

2. **Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.**

3. **Keep it in a safe place until you have received your results.**

INSTRUCTION TO SUPERVISOR/INVIGILATOR:

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature: _____
Supervisor/Invigilator.

Date: _____