~~Pre~~ Post Standardisation, Markscheme.

Centre No.						Paper Reference	Surname	Other names
Candidate No.						6 7 3 3 / 2 A	Signature A. Rannaghan.	

Edexcel GCE

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test

Friday 11 January 2008 – Afternoon

Time: 1 hour 30 minutes

For Examiner's use only

For Team Leader's use only

Question numbers	Leave blank
A	
B	
Total	

For the Supervisor's use		
B	Tick if either circuit set up for candidate (Give details below)	
Comments		

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, other names and signature.

PHY3 consists of questions A and B. Each question is allowed 35 minutes plus 5 minutes writing-up time. There is a further 10 minutes for writing-up at the end. The Supervisor will tell you which experiment to attempt first.

Write all your results, calculations and answers in the spaces provided in this question booklet.

In calculations you should show all the steps in your working, giving your answer at each stage.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets.

The total mark for this paper is 48.

The list of data, formulae and relationships is printed at the end of this booklet.

Printer's Log. No.
N26762A
W850/R6733/57570 6/6/5/5/4

N 2 6 7 6 2 A 0 1 1 6

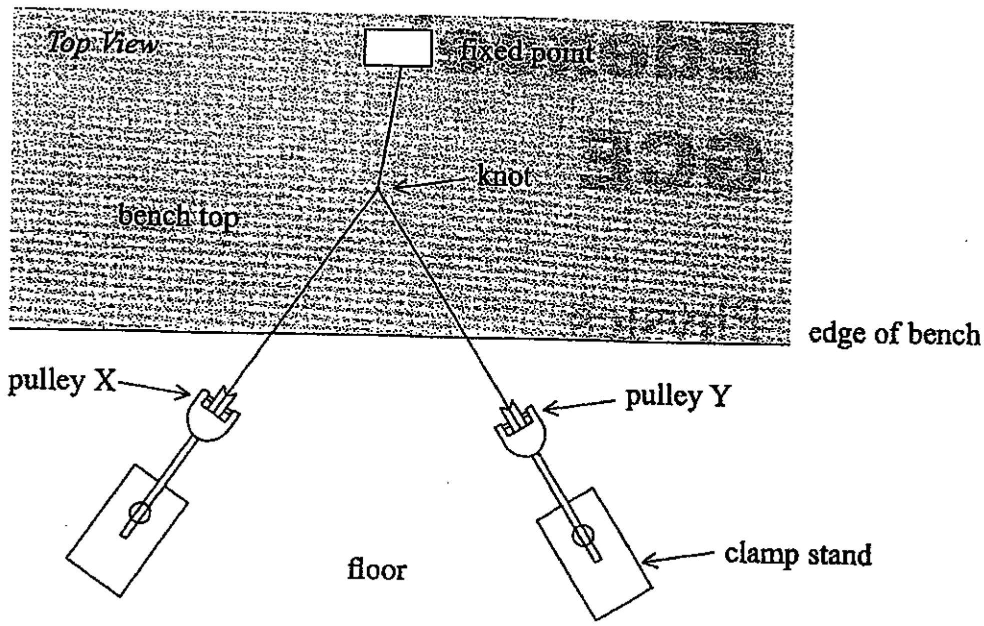
Turn over

edexcel
advancing learning, changing lives

Leave blank

Question A

(a) (i) The apparatus shown in the diagram below has been set up for you. Do not move the fixed point or change the masses.



- Adjust the position of the stands and pulleys until the string leading to the 70 g mass and the string leading to the 40 g mass are approximately at right angles to each other.
- Place page 3 of the question paper underneath the strings. Adjust the position of the question paper until the knot which joins the strings together is vertically above the point labelled O.

The string leading to the 70 g mass should lie vertically above the line OA and the string leading to the 40 g mass should lie vertically above the line OB.

- Re-adjust the apparatus so that all these conditions are met. Ensure that the system is in stable equilibrium and that all strings lie in the same horizontal plane.
- Mark a point C on the page that is vertically below the string that passes to the fixed point.

Remove the question paper from beneath the strings.

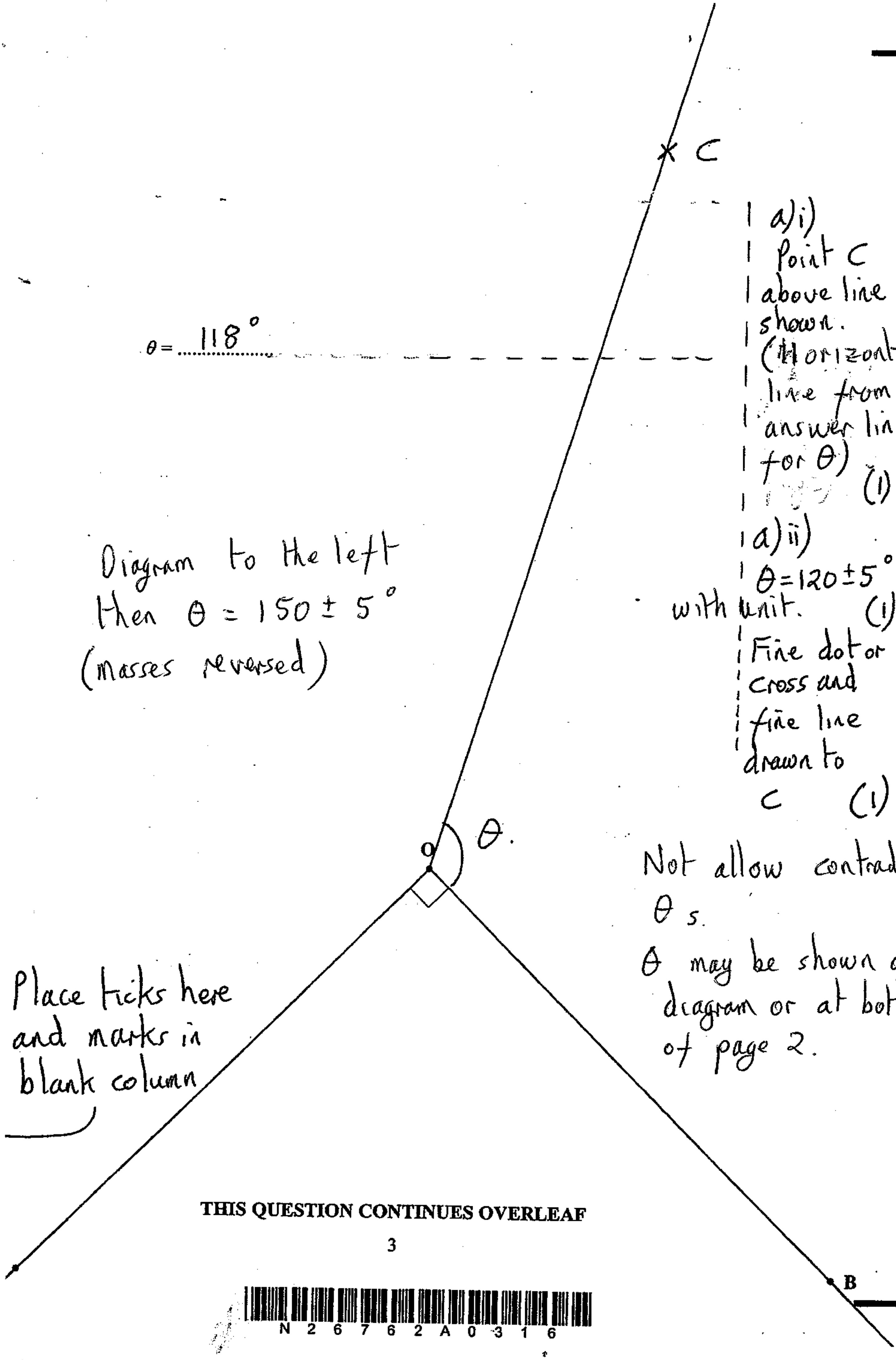
(1) 1

(ii) Draw a line connecting point O to point C. Measure θ, where $\theta = \angle BOC$.

$\theta =$ ....

(2) 2

N 2 6 7 6 2 A 0 2 1 6



a)i) Point C above line shown. (Horizontal line from answer line for θ) (1)

a)ii) θ = 120 ± 5° with unit. (1)

Fine dot or cross and fine line drawn to C (1)

Diagram to the left then θ = 150 ± 5° (masses reversed)

Not allow contradictory θs.

θ may be shown on diagram or at bottom of page 2.

Place ticks here and marks in blank column

THIS QUESTION CONTINUES OVERLEAF

N26762A0316

(iii) Explain how you ensured that:

- the system was in stable equilibrium/mass/system.

  Displaced the knot (and ensured it returned to the same point) (1)
  or Repeat the procedure.

- all the strings were in the same horizontal plane,

  Either: Measured the height of the strings [above the bench with the set square] (1)
  Or: All heights should be the same.
  Or: Eye level with horizontal plane of strings.

- the knot was vertically above the point labelled O,

  Looked vertically down onto O / Birds eye view above O / Top view of O
  or used set-square or rule on bench touching knot/O (1)

- friction at the pulley wheels was minimised.

  Ensured strings and pulley wheels were aligned/parallel (1)
  or string straight in the groove.

(4) 4

(iv) Assuming that the pulleys are frictionless, calculate the tensions T_1 and T_2 in the strings OA and OB respectively.

T_1 = $mg = 0.070 \times 9.81 = 0.687$ N.

T_2 = $mg = 0.040 \times 9.81 = 0.392$ N

(1) 1

Correct calculation of tension with unit shown on at least one value. (1)
and answers to 2/3 s.f.

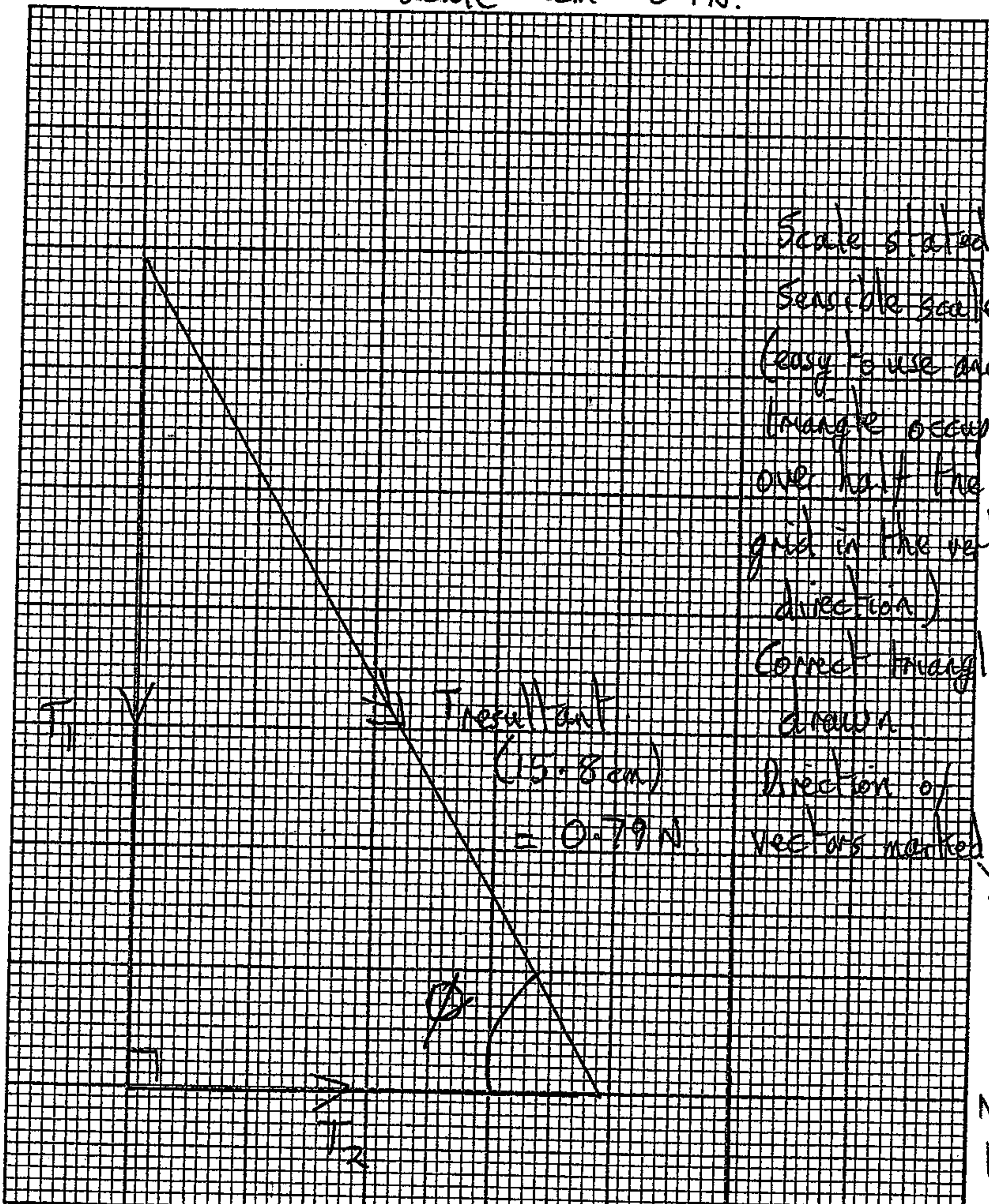
Accept: 0.687, 0.69, 0.70
0.686

0.392, 0.39, 0.40

N 2 6 7 6 2 A 0 4 1 6

On the grid below draw to scale a vector diagram to determine the resultant T of these two tensions. State the scale that you are using. Measure the angle φ between the tension T_2 and the resultant tension.

Scale 2cm = 0.1 N.



Scale stated (1)

Sensible scale (easy to use and triangle occupies over half the grid in the vertical direction) (1)

Correct triangle drawn (1) with sides with 2mm of correct value

Direction of vectors marked (1) on a correct diagram.

Resultant tension T = 0.79 N. — 0.79 ± 0.04 N with unit (1)

Angle φ = 61° — ϕ = 60° ± 3° with unit (1)

If masses reversed, angle = 30° ± 3°

(6)

No ect for these values. Allow ect units of T and θ

6

Leave blank

N 2 6 7 6 2 A 0 5 1 6

Turn over

Leave blank

(b) (i) Measure out 80 cm^3 of water at room temperature from the beaker and pour the water into the plastic cup. Record the temperature θ_1 of the water in the cup.

θ_1 = 19.5 °C | Accept Kelvin but not °nor °K.

Take a heaped spoonful of crushed ice and place it into the cup. Record the final temperature θ_2 of the water when all the ice has melted.

θ_2 = 13.0 °C | Sensible values with unit seen on at least one value (1)

State any precautions that you took when carrying out the experiment.

Stirred water (1)

or Held rim of cup so less heat transferred from hand to cup (1) Max (2)

or Recorded the lowest / steady / settled temperature. (1)

or One temperature reading recorded to better than 1 °C (1)

(3) 3

(ii) Measure the final volume of water in the plastic cup; hence deduce the volume of the melted ice.

Final volume: 86 cm^3 } No mark here.

Volume of melted ice: 6 cm^3

Given that 1.0 cm^3 of water or melted ice has a mass of 1.0 g write down the initial mass m_w of the water and the mass m_i of the melted ice.

m_W = 80 g. | Sensible masses with unit seen somewhere (1) and $m_I \leq 25$ g.

m_I = 6 g.

(1) 1

Leave blank

(iii) The specific heat capacity of water is 4.2 J g^{-1} K^{-1} (4200 J kg^{-1} K^{-1}). Calculate the loss of thermal energy of the water that was initially in the plastic cup.

Loss of thermal energy = 80 × 4.2 × (19.5 − 13)
= 2184 J.

Correct correct with unit seen somewhere. (1)

Calculate the gain in the thermal energy of the water that was obtained from the melted ice.

Gain in energy = 6 × 4.2 × (13 − 0)
= 328 J.

Correct calculation and unit seen somewhere (1)

e.c.f wrong value of C used. **(2)** 2.

(iv) Deduce how much energy was needed to melt the ice, hence calculate a value for the specific latent heat of fusion L of ice.

Gain in energy of ice = 2184 − 328
= 1856 J.

Correct subtraction First value in (iii) − Second value in (iii) (1)

$L = \frac{1856}{6}$
= 309 J/g.

Correct calc of L + unit (1) Allow e.c.f.

(Any ΔQ can be used) **(2)** 2

(v) By considering possible sources of error in the experiment, explain whether your value of θ_2 is likely to be too high or too low.

Sensible explanation (1)
Correct conclusion (1)

Either Because apparatus is below room temperature, it gains thermal energy from the surroundings
Or. Ice is not dry so water at 0°C transferred to cup rather than ice (1)
Conclusion: θ_2 is too high. (1)

(2) 2.

QA 2 4

(Total 24 marks)

Or.

Because the ice is below 0°C so that some thermal energy is used to raise the temperature of the ice (1)

Conclusion θ_2 is too low (1)

Ignore Not all ice melted.

N 2 6 7 6 2 A 0 7 1 6

Turn over

Leave blank

BLANK PAGE

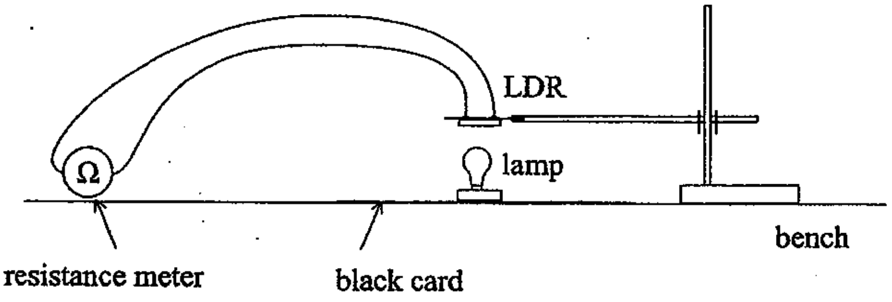
N26762A0816

Leave blank

Question B

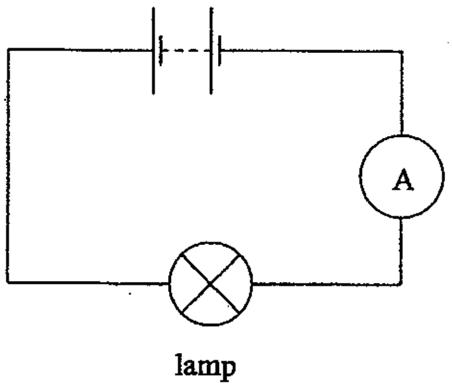
(a) Connect the resistance meter (ohmmeter) to the light dependent resistor (LDR). Clamp the LDR so that the light detecting face is facing downwards and is about 5 cm above the lamp. The arrangement is shown in Figure 1 below.

Figure 1



Set up the circuit containing the lamp as shown in Figure 2 below. Before you connect this circuit to the 6 V power supply, have your circuits checked by the Supervisor. You will be allowed a short time to correct any faults. If you are unable to set up the circuits, the Supervisor will set them up for you. You will lose only two marks for this.

Figure 2



Both circuits set up correctly (2)

(2) 2

N 2 6 7 6 2 A 0 9 1 6

Turn over

Incorrect units for I, R and L to be penalised once only for each quantity in b), c) and d)

s.f. on R to be penalised once only in b), c) and d) Mark s.f. penalties first.

(b) Connect the 6.0 V output of the power supply to the circuit. Adjust the height of the LDR so that the resistance of the LDR is approximately 1 kΩ. When taking readings from the meters try not to cast a shadow over the apparatus as this will affect the resistance reading. If the resistance reading is fluctuating estimate an average value for the reading. Record the current I in the lamp and the resistance R of the LDR. Use the graph opposite to determine the corresponding light intensity L.

I = 53.6 mA. — I in the region of 50 mA to 0.1 mA with unit (1)

R = 1.42 kΩ. — R 0.5 kΩ to 1.5 kΩ to 2/3 s.f. + unit (1)

L = 5.5 W m^{-2} — L correctly read from graph with unit (1)

(See Spreadsheet) **(3)** 3

(c) (i) Disconnect the power supply and, **without changing the position of the LDR or lamp**, record the resistance of the LDR. Use the graph to determine the corresponding light intensity. This may be thought of as the background light intensity $L_{background}$.

Resistance of LDR = 2.84 kΩ. — Sensible value (> part (b)) to 2/3 s.f. + unit (1)

$L_{background}$ = 2.3 W m^{-2} — Correctly read from graph with unit (1) ecf unit.

(See Spreadsheet)

(ii) Calculate the light intensity L_{lamp} at the LDR due to the lamp alone using $L_{lamp} = L - L_{background}$.

L_{lamp} = 5.5 − 2.3
= 3.2 W m^{-2} — Correct subtraction with unit (1) ecf unit.

(iii) Assuming that the output voltage of the power supply is 6.0 V, use your value for I from part (b) to calculate the electrical power P supplied to the lamp.

P = 0.0536 × 6
= 0.322 W — Correct calculation consistent with unit (1)

(4) 4

(d) **Without changing the position of the LDR or lamp** connect the 4.5 V output of the power supply to the circuit. Record new values for I, R and L.

I = 46.5 mA. — Sensible I < I from part (b) to 0.1 mA + unit (1)

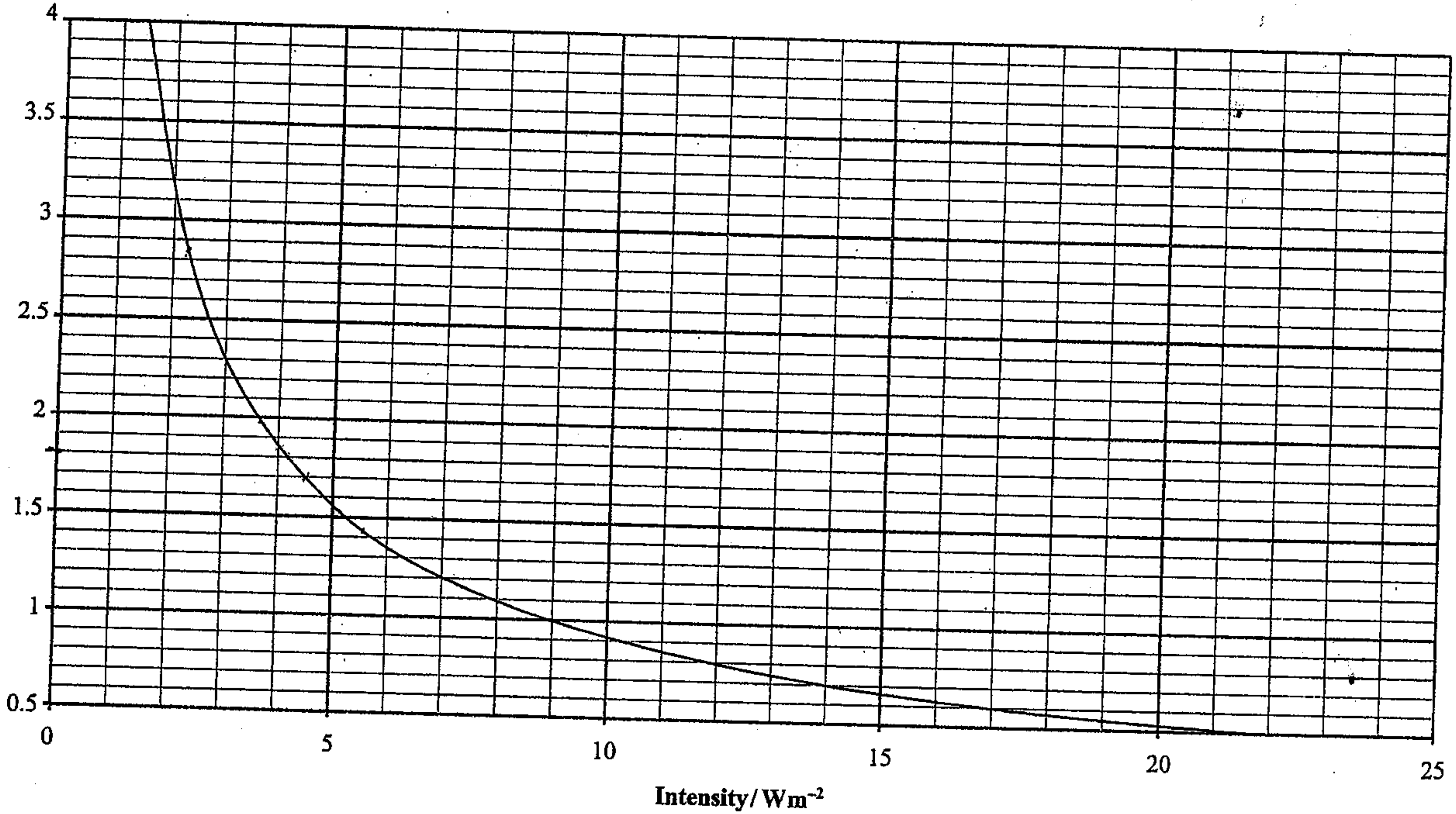
R = 1.98 kΩ. — R > R from part (b) to 2/3 s.f. + unit (1)

L = 3.7 W m^{-2} — L correctly read from graph and < L from part (b) + unit (1) ecf unit.

(See Spreadsheet)

(Allow I in (d) = I in (b) if apparatus only allows currents to 1 s.f.)

Resistance against Intensity for an LDR



Leave blank

Leave blank

Assuming that $L_{background}$ remains the same, calculate the new value of L_{lamp}.

L_{lamp} = 3.7 − 2.3 | Correct subtraction

= 1.4 $W m^{-2}$ | with unit (1) ecf unit.

Calculate the new value of P assuming that the output voltage of the power supply is 4.5 V.

$P = 0.0465 \times 4.5$ | Correct calculation

= 0.209 W. | with unit (1) ecf unit

(5) 5.

(e) A student suggests that L_{lamp} is directly proportional to P.

(i) Write an equation to represent this direct proportionality.

$L_{lamp} = k P$ | (1) Allow seen in (ii)

(ii) Use your two sets of data to determine two values for the constant of proportionality k.

$k = \frac{L_{lamp}}{P} = \frac{3.2}{0.322}$ | Correct

$= 9.9\ m^{-2}$ | calculations (1)

$k = \frac{1.4}{0.209} = 6.7\ m^{-2}$ | 2/3 s.f. + unit (1)

consistent with calculation.

(iii) Calculate the percentage difference between your two values of k and comment on whether this percentage difference supports the student's suggestion.

Either % diff $= \frac{9.9 - 6.7}{\frac{1}{2}(9.9 + 6.7)} \times 100$ | Correct calculation of % diff with

= 39%. | average as denominator (1) } (1) max

or two values of k same to 2/3 s.f. (1)

This is far higher than likely experimental error, hence the suggestion is not valid. | Sensible comment relating % difference to likely experimental error (1)

(5) 5

[≤ 20% – valid
> 20% – not valid] Do not require experimental error comparison if difference ≥ 100%.

N 2 6 7 6 2 A 0 1 2 1 6

Wrong Experiment loses first 2 marks.

(f) You are to plan an experiment to further investigate the student's suggestion. Your plan should include:

- A description of the experiment to be performed.
- A sketch of the graph to be plotted to test the results.
- An indication of how k could be determined from the graph.

Keep distance between LDR and lamp constant (1)

Either: Shield the apparatus / Experiment in dark room (1)

Or: Include voltmeter across power supply for more accurate values of P (1)

Use a variable power supply / variable resistor to give more readings of I through the lamp. (1)

} Max (2)

Measure I, (V) and R. (1)

Either. Plot L_{lamp} against P. (1) or P against L_{lamp}.

Straight line through origin expected with gradient = constant of proportionality (1)

Or. Plot L against P (1) or P against L

Straight line with +vE intercept intercept on L axis with gradient = constant of proportional. (1)

5

(5)

(Total 24 marks)

QB 24

TOTAL FOR PAPER: 48 MARKS

END

Leave blank

N26762A01316