

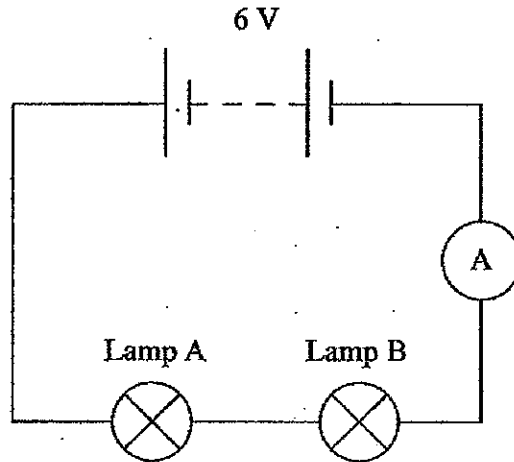
6733/02 Practical Test PHY3

Group 1

Question 1A

- (a) (i) Set up the circuit as shown in the diagram below. Note at this stage the voltmeter with which you have been provided is not used.

Before you connect your circuit to the power supply, have your circuit checked by the Supervisor. You will be allowed a short time to correct any faults. If you are unable to set up the circuit, the Supervisor will set it up for you. You will only lose two marks for this.



Ignore lamps reversed, but answers must be consistent throughout

Circuit set up correctly without help. (2)

2.

- (ii) Connect the power supply and measure the current I in the circuit.

$I = 0.055 \text{ A}$

I to 1 mA or better between 50 mA and 65 mA with unit (1)

(Allow centre value if low voltage supply)

- (iii) Observe lamps A and B. State and explain your observations.

Lamp B is brighter than lamp A.
Temperature of lamp B must be greater than temperature of lamp A.

(1) Must be comparison. Not allow lamp A not working.

(1)

2.

Or Power / Voltage / Resistance greater for B. (2)

- (iv) Use the voltmeter to measure the potential difference V_A across lamp A and then the potential difference V_B across lamp B. If you do not know how to connect the voltmeter into the circuit, ask the Supervisor for assistance. You will only lose one mark for this.

$V_A = 0.22 \text{ V}$

$V_B = 5.66 \text{ V}$

Both measured to 0.01V or better with unit (1)

$V_B \gg V_A$ with

$5.0 \text{ V} \leq V_A + V_B \leq 6.5 \text{ V}$

Disconnect the power supply.

No indication that Supervisor gave help (1)

3



The normal operating voltage of both lamps is 6 V. Explain the relevance of your values of V_A and V_B to your observations in (iii).

Comment on V_B related to the brightness of B (1)

Comment on V_A related to the brightness of A. (1)

$P_B \gg P_A$ ^{stated after calc.} $V_B \gg V_A$ or $R_B \gg R_A$ ^{stated after calculation} V_B at operating voltage, V_A not. (1)

Current is the same in both lamps seen here on in (a)(iii) or in calculations (1) (3) Max

(b) (i) You have been provided with an inclined runway. Determine the time taken for the sphere to travel a distance x of 0.800 m down the runway. ^{Sensible}

$t = 1.41, 1.41, 1.41, 1.38, 1.43$ s | t from ≥ 3 results \pm unit (2)

All readings to nearest second or systematic error e.g. 0.01415 (2) or 1 reading 0 marks. More than $\frac{1}{2}$ readings to 0.1 s or better else 2

(ii) The final speed v of the sphere at the end of the distance x is given by -1

$v = \frac{2x}{t}$. Calculate v .

$v = \frac{2 \times 0.8}{1.41} = 1.13$ m/s.

Correct calc.

≥ 2 s.f. \pm unit (1)

(iii) Use the top pan balance to measure the mass m of the sphere. Hence find the linear kinetic energy of the sphere after travelling 0.800 m down the runway.

Mass = 4.78 g.

K.E. = $\frac{1}{2} \times 4.78 \times 10^{-3} \times 1.13^2 = 3.05 \times 10^{-3}$ J.

Use of $\frac{1}{2} m v^2$ (1)

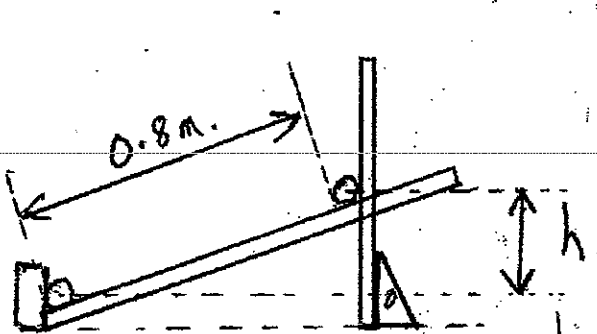
Correct calc

≥ 2 s.f. \pm unit (1)

J or $\text{Kg} \cdot \text{m}^2 \text{s}^{-2}$ (2)



(iv) In the space below draw a diagram of the inclined runway. Show carefully on your diagram the vertical height h through which the sphere moved when it travelled a distance of 0.800 m down the runway.



Correct diagram with runway of finite thickness (1) and 0.8 m or 2 sphere positions hence h shown correctly (1)

Determine the height h . State any techniques you used to obtain an accurate value for h .

$$h = 10.2 \text{ cm}$$

h recorded to nearest mm or better with unit (1) in range 5.0 cm to 15.0 cm.

Vertical rule checked with set square / Eye level with reading (1)

Can be scored from diagram but allow statement, Hence find the gravitational potential energy lost by the sphere as it moved down the runway.

$$mgh = 4.78 \times 10^{-3} \times 9.81 \times 0.102$$

$$= 4.78 \times 10^{-3} \text{ J}$$

Correct calc $\geq 2 \text{ s.f.} + \text{unit (1)}$

5.

e.c.f. mass conversion and unit error. Allow $g = 10 \text{ N.kg}^{-1}$



(v) Calculate the value of $\frac{\text{Kinetic energy gained by the sphere}}{\text{Gravitational potential energy lost}}$

$$\frac{3.05 \times 10^{-3}}{4.78 \times 10^{-3}} = 0.64$$

Value with no unit, 0.60 → 0.80 (2)

Value must be obtained from correct calculations

Calculate the percentage difference between your value of this ratio and the theoretical value which is 0.71.

$$\% \text{ diff} = \frac{0.64 - 0.71}{0.71} \times 100\% = 9.9\%$$

Correct calc with 0.71 as denominator (1)

3

(3)

Q1A

(Total 24 marks)

24



Question 1B

- (a) Many modern road bridges have a single pillar from which the bridge is suspended. You are to investigate a model of this arrangement using the extension of a spring to measure the force.

An identical spring to the one used in the experimental arrangement must first be calibrated. Measure the unstretched length l of the coiled part of the vertically suspended spring.

$l = 47.3 - 45.0 = 2.3 \text{ cm}$

recorded to nearest mm or better and in range with unit. (1)

Add the 100 g mass hanger to the spring and determine the extension x of the spring. Add further 100 g masses and determine the corresponding extensions.

The force F extending the spring is given by:

$$F = mg$$

where m = total mass suspended from the spring and g = gravitational field strength.

Use the table below for your results. The force F has been calculated for you. You may use the additional column to assist in the recording of your results.

m/kg	F/N	Position of lowest point/cm	x/mm
0.00	0.00	45.0	0
0.10	0.98	42.4	26
0.20	1.96	38.7	63
0.30	2.94	35.1	99
0.40	3.92	31.6	134
0.50	4.91	28.0	170

(4)

4

- (b) Using the grid on page 7 plot a graph of x against F .

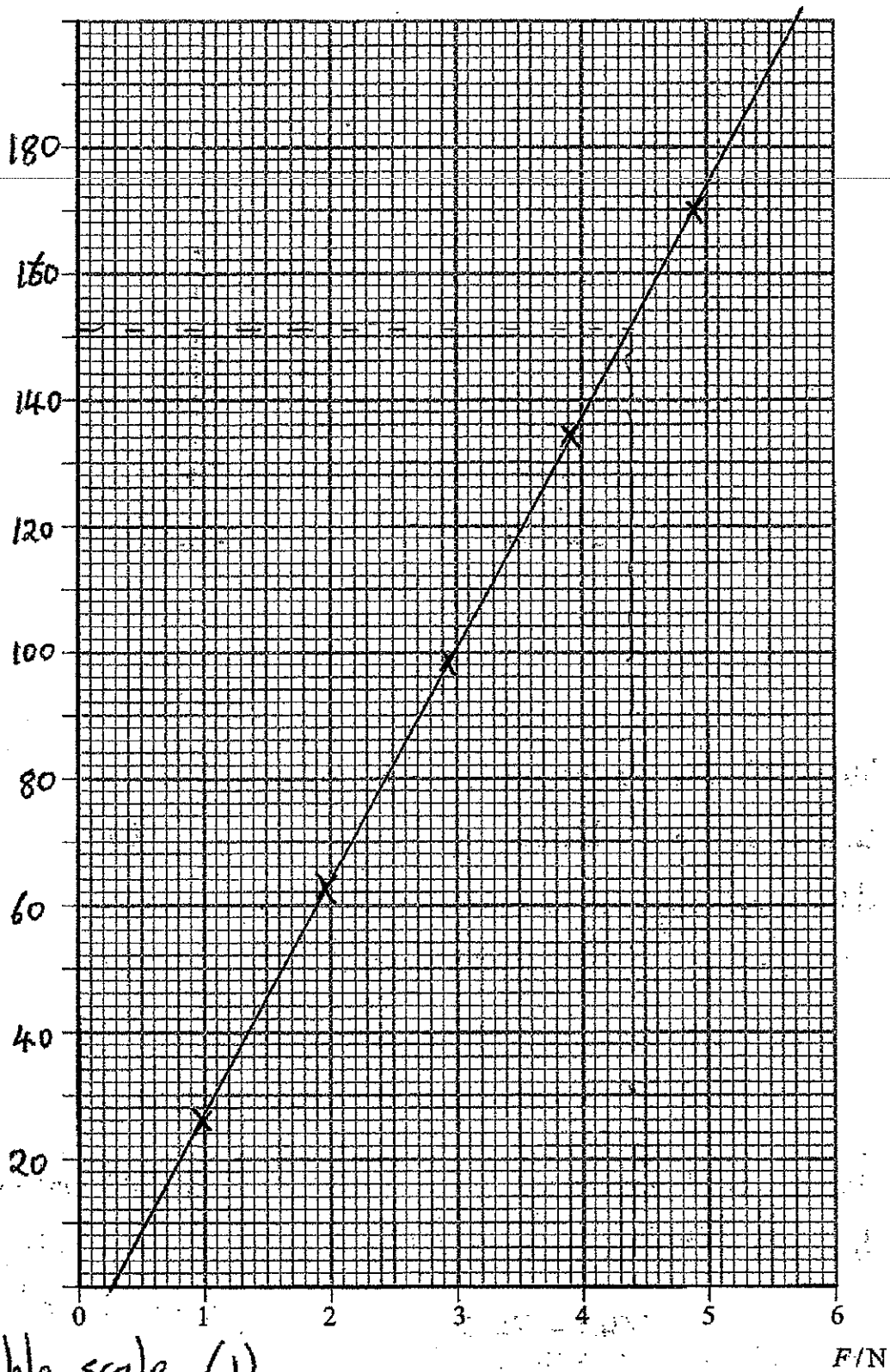
(2)

2

Scale readings shown (1) or length.
 5 correct points $\pm 4\text{mm}$ straight
 examiners best fit line (2) [Ignore 0,0]
 [4 points ---- (1)]



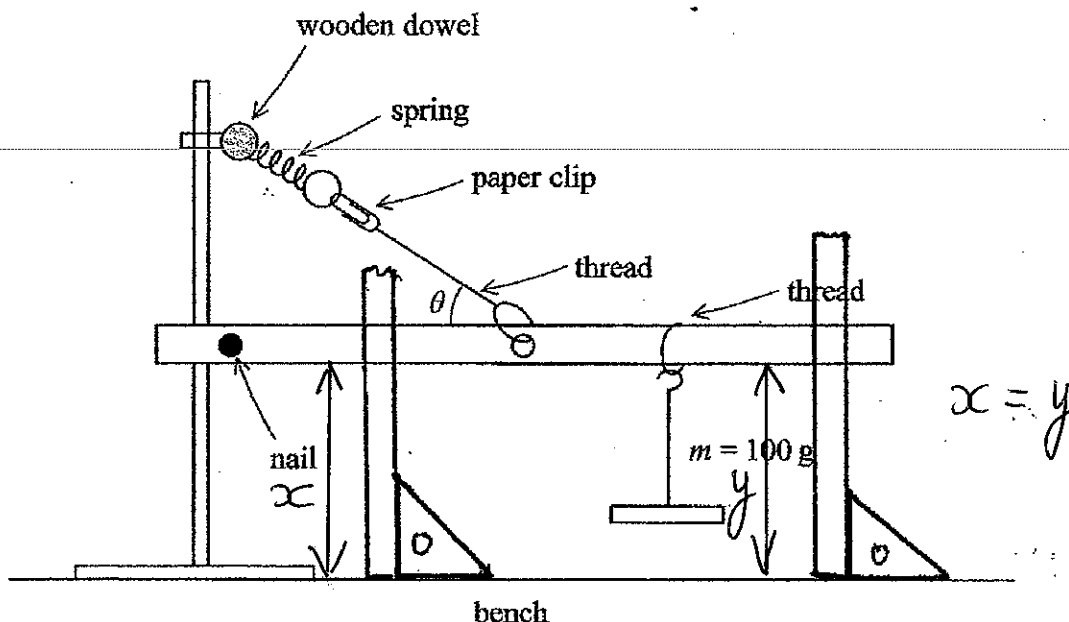
x/mm



Suitable scale (1)
Plots and line (1)



(c) The apparatus shown in the diagram below has already been set up for you. Move the mass $M = 100\text{ g}$ so that it is suspended from the 90.0 cm mark on the rule.



Adjust the height of the boss holding the wooden dowel until the metre rule is horizontal. Explain how you ensured that the metre rule was horizontal. You may add to the above diagram if you wish.

Measured the height above the bench at 2 places.

(1)

Used set square as shown to check metre rule vertical

(1)

[If not shown on diagram, very clear description of use of set square must be given] (2)

(d) Measure the height h_1 of the centre of the nail above the bench and the height h_2 of the centre of the dowel above the bench. Hence calculate the angle θ between the metre rule and the thread.

$$h_1 = 345\text{ mm}$$

$$h_2 = \frac{1}{2}(747 + 735) = 741\text{ mm}$$

$$\tan \theta = \frac{741 - 345}{400}$$

$$= 0.99$$

$$\theta = 44.6^\circ$$

heights recorded to the nearest mm with units seen once (1)

Correct calc of $\theta \geq 2\text{ s.f. unit}$ (1) with base length in range

Note candidates may use $\sin \theta$ by measuring hypotenuse.

390 mm to 410 mm.

390 mm to 410 mm.



- (e) Measure the stretched length s of the coiled part of the spring. Using your value of l from part (a) determine the extension e of the spring.

$s = 174 \text{ mm.}$

$e = 174 - 23 = 151 \text{ mm.}$

s recorded to the nearest mm and in the range 140 mm to 240 mm (1)
 e calculated with unit seen correctly somewhere. (1)

Using the calibration graph from part (b) determine the tension T in the spring

$T = 4.4 \text{ N.}$

Force read off graph correctly with unit (1)
 within 1/2 square of (3)
 candidates line

- (f) When the rule is horizontal and in equilibrium, the following equation applies:

$$T \sin \theta = g \left(\frac{q}{p} \right) M + W \quad \text{where}$$

p = distance from the centre of the nail to the centre of mass of the rule, which may be assumed to be at the 50.0 cm mark,
 q = distance from the centre of the nail to the position on the rule from which mass M is suspended,
 W = weight of the metre rule.

Determine p and q and use the information from parts (d) and (e) to calculate W .

$p = 40.0 \text{ cm.}$

$q = 80.0 \text{ cm.}$

$W = T \sin \theta - Mg \left(\frac{q}{p} \right)$

$= 4.4 \sin(44.6) - 0.1 \times 9.81$

$\times \left(\frac{0.8}{0.4} \right)$

$= 3.09 - 1.96$

$= \underline{\underline{1.13 \text{ N.}}}$

p and q correct (1)
 with q 0.790m to 0.810m
 Correct and p 0.390m to 0.410m
 substitution (1) Allow e.c.f. p, q, T and θ .
 Correct calc of W to 2/3s.f. + unit (1)

3



(g) A student wishes to investigate how $T \sin \theta$ depends on the mass suspended from the rule at the 90.0 cm mark. You are to plan this investigation. Your plan should include:

- (i) an indication of the values in the equation which are constant,
- (ii) a description of how the experiment would be performed,
- (iii) a sketch of the graph to be plotted,
- (iv) an indication of the expected results.

i) $(p) g, (W \text{ and } g) \text{ are constant}$ (1)
 [Not T or θ]

ii) Vary M. (1)

Move dowel or nail (1)

Measure / Determine θ (1)

Measure / Determine extension (1) } Max (3)

Force determined (1)
 [Use Newton meter]

iii) Plot $T \sin \theta$ against M. (1) Plot $T \sin \theta$ against g .
 [or Plot M against $T \sin \theta$]

iv) Straight line +ve intercept (1)

Slope = $g \left(\frac{q}{p}\right)$, Intercept = W. (1) Slope = $\frac{Mg}{p}$

straight line -ve intercept (1) Intercept = $W^{(8)}$

(Total 24 marks)

Q1B
24

slope = $\frac{1}{qg}$, Intercept = $-\frac{Wp}{qg}$

TOTAL FOR PAPER: 48 MARKS

END

