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

Edexcel GCE

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test
Group 1

Tuesday 16 May 2006 – Morning

Time: 1 hour 30 minutes

For Examiner's use only

For Team Leader's use only

Question numbers	Leave blank
1A	
1B	
Total	

Supervisor's Data and Comments		
1A	Tick if circuit set up by Supervisor (Give details below)	
1B	Weight of rule	
Comments		

Instructions to Candidates

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

PHY3 consists of questions 1A and 1B. 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.

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Question 1A

(a) (i) Measure the length l and the width w of the aluminium foil. State any special precaution that you took to ensure that accurate values of l and w were obtained.

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(4)

(ii) Fold the foil in half four times to create a total foil thickness of $16t$ where t is the thickness of the foil. Measure $16t$ and hence determine t. State any special precautions that you took to ensure that an accurate value of $16t$ was obtained.

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(4)

(iii) Estimate the percentage uncertainty in your value for t.

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(2)

(iv) Using the top pan balance provided, measure the mass m of the foil. Hence determine a value for the density of the foil.

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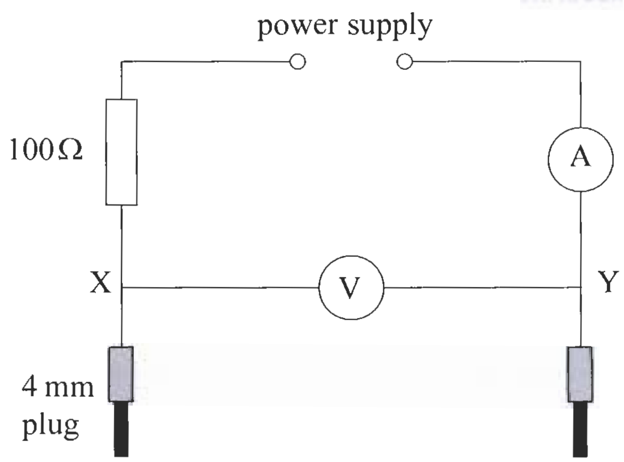
(3)

(b) (i) Set up the circuit as shown in the diagram below using the $100\,\Omega$ resistor. 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 lose only two marks for this.**



(2)

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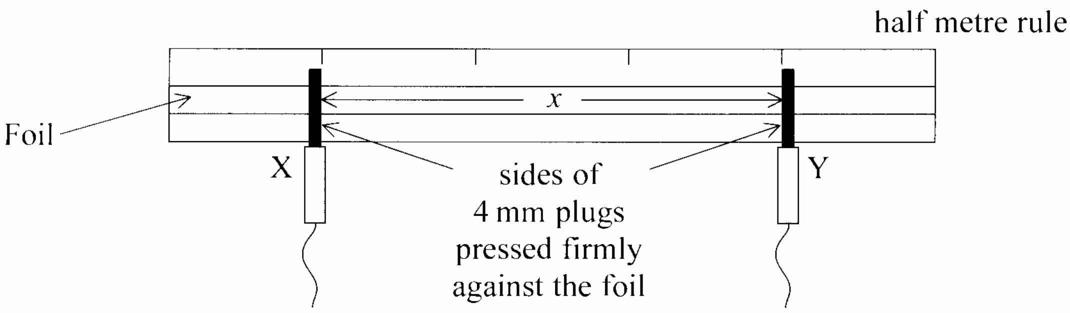
(ii) Connect the power supply and use the 4-mm plugs to make connections to a length $x = 30.0$ cm of the strip of foil which is attached to the half metre rule. In order to make good electrical contact with the foil the **sides** of the 4-mm plugs should be pressed **firmly** against the foil as shown in the diagram below.



Measure the current I in the circuit and the potential difference V across the 30.0 cm length of foil.

I = ...

V = ...

(3)

(iii) Hence calculate the resistance R of the foil.

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(2)

(iv) Determine an average value for the width b of the foil. Hence determine a value for the resistivity ρ of the foil given that $\rho = \dfrac{Rbt}{x}$.

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(4)

(Total 24 marks)

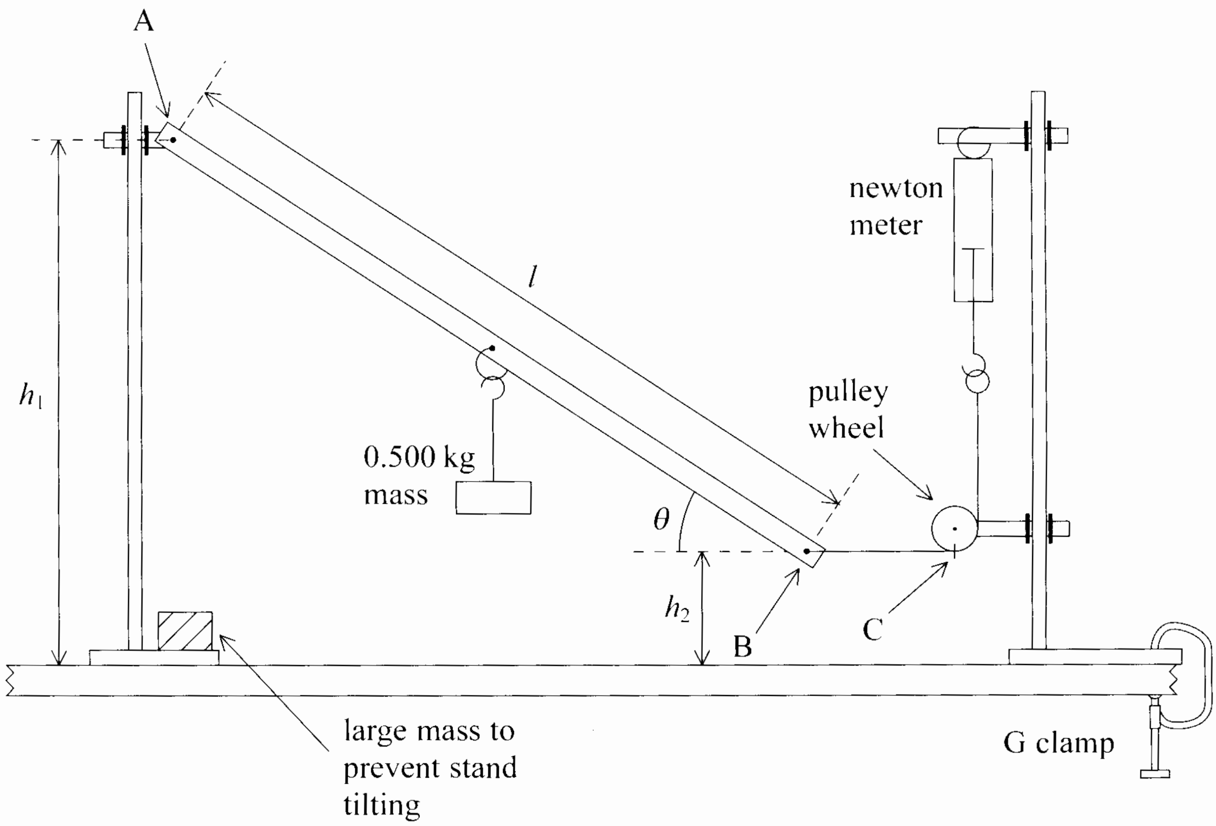
Leave blank

Q1A

Question 1B

Leave blank

(a) The Supervisor has set up the apparatus shown in the diagram below. The newton meter is clamped vertically but the Supervisor has not made the section BC of the string horizontal.



Do not move the stand that is clamped to the bench. Adjust the separation of the stands and the height of the nail at A until the section BC of the string is horizontal and the angle θ is between 20° and 40°. You have been provided with a 30° set square so that you can easily estimate an angle in this range. Explain how you checked that BC was horizontal. You may add to the above diagram if you wish.

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(2)

(b) Measure the vertical height h_1 of the point A above the bench and the vertical height h_2 of the point B above the bench. Also record the distance, l, between the points A and B. Hence calculate a value for the angle θ using:

$$\sin\theta = (h_1 - h_2)/l$$

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(4)

(c) If the string is horizontal the principle of moments may be used to show that

$$W = 2T\tan\theta - mg$$

where W = the weight of the metre rule,
T = the reading on the newton meter,
m = the mass which is suspended from the rule, which may be taken as 0.500 kg,
and g = the gravitational field strength.

Record T.

T = ...

Hence, using your result from part (b), calculate the weight of the metre rule.

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Weight = ...

(4)

Leave blank

(d) Set up the apparatus as shown in the diagram below using the second metre rule, which is identical to the suspended rule. Use one of the 100 g masses from the first experiment. Adjust the position of the pivot so that the system rests in equilibrium with the metre rule horizontal.

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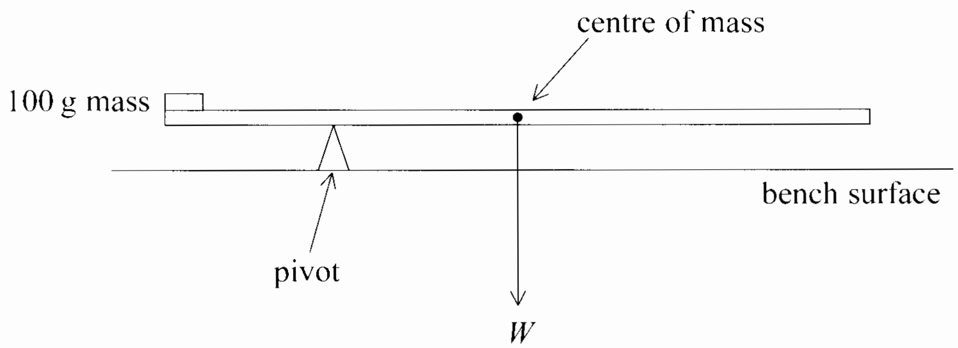

The centre of mass of the rule may be taken to lie at the 50.0 cm mark. Take such measurements as are necessary to find the weight W of the rule. **Show these measurements on the diagram.**

Now use the principle of moments to calculate W.

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(5)

Leave blank

(e) The equation in part (c) may be rewritten in the form

$$T \tan \theta = \tfrac{1}{2} mg + \tfrac{1}{2} W$$

A student suggests that the value of W may be found by a graphical method if the value of m is varied. Plan an experiment to investigate this suggestion. Your plan should include

(i) a description of how the experiment would be performed;

(ii) a sketch of the graph to be plotted;

(iii) how you would use the graph to find a value for W.

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(9) **Q1B**

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	
Acceleration of free fall	$g = 9.81\ \text{m s}^{-2}$	(close to the Earth)
Gravitational field strength	$g = 9.81\ \text{N kg}^{-1}$	(close to the Earth)
Elementary (proton) charge	$e = 1.60 \times 10^{-19}\ \text{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
Electronvolt	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Molar gas constant	$R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$	

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

$$x = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2ax$$

Forces and moments

Moment of F about O = $F \times$ (Perpendicular distance from F to O)

Sum of clockwise moments about any point in a plane = Sum of anticlockwise moments about that point

Dynamics

Force $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $\quad F\Delta t = \Delta p$

Mechanical energy

Power $\quad P = Fv$

Radioactive decay and the nuclear atom

Activity $\quad A = \lambda N \quad$ (Decay constant λ)

Half-life $\quad \lambda t_{\frac{1}{2}} = 0.69$

Electrical current and potential difference

Electric current $I = nAQv$

Electric power $P = I^2R$

Electrical circuits

Terminal potential difference $V = \mathcal{E} - Ir$ (E.m.f. $\mathcal{E}$; Internal resistance r)

Circuit e.m.f. $\Sigma\mathcal{E} = \Sigma IR$

Resistors in series $R = R_1 + R_2 + R_3$

Resistors in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Heating matter

Change of state: energy transfer $= l\Delta m$ (Specific latent heat or specific enthalpy change l)

Heating and cooling: energy transfer $= mc\Delta T$ (Specific heat capacity c; Temperature change ΔT)

Celsius temperature $\theta/°\text{C} = T/\text{K} - 273$

Kinetic theory of matter

$T \propto$ Average kinetic energy of molecules

Kinetic theory $p = \frac{1}{3}\rho\langle c^2\rangle$

Conservation of energy

Change of internal energy $\Delta U = \Delta Q + \Delta W$ (Energy transferred thermally ΔQ; Work done on body ΔW)

Efficiency of energy transfer $= \frac{\text{Useful output}}{\text{Input}}$

For a heat engine, maximum efficiency $= \frac{T_1 - T_2}{T_1}$

Experimental physics

$$\text{Percentage uncertainty} = \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$$

Mathematics

$\sin(90° - \theta) = \cos\theta$

Equation of a straight line $y = mx + c$

Surface area cylinder $= 2\pi rh + 2\pi r^2$

sphere $= 4\pi r^2$

Volume cylinder $= \pi r^2 h$

sphere $= \frac{4}{3}\pi r^3$

For small angles: $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

$\cos\theta \approx 1$

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

Edexcel GCE

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test
Group 2

Wednesday 17 May 2006 – Morning

Time: 1 hour 30 minutes

For Examiner's use only

For Team Leader's use only

Question numbers	Leave blank
2A	
2B	
Total	

Supervisor's Data and Comments			
2A	(a)	Diameter of wire if 30 swg wire is not used	
	(b)	Tick if circuit set up by Supervisor. (Give details below)	
2B	Weight of rule		
Comments			

Instructions to Candidates

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

PHY3 consists of questions 2A and 2B. 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.

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The total mark for this paper is 48.

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

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Question 2A

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(a) (i) You have been provided with a 4.0 m length of constantan wire which has the same diameter as the constantan wire which is attached to the metre rule. Using the top pan balance provided, measure the mass *m* of the 4.0 m length of wire.

m = ...

Carefully separate the turns of the 4.0 m length and measure the diameter *d* of the wire. State any precautions that you took to ensure that an accurate value of *d* was obtained.

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(3)

(ii) Estimate the percentage uncertainty in your value for *d*.

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(2)

Leave blank

(iii) Determine a value for the density of constantan given that

volume of wire = $V = \frac{\pi d^2 l}{4}$

where l = length of wire = 4.0 m.

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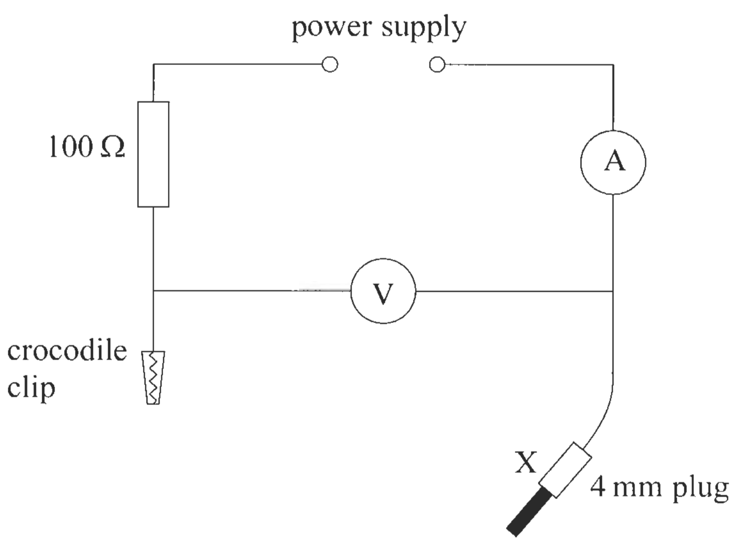
(5)

(b) (i) Set up the circuit as shown in the diagram below using the 100 Ω resistor. 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 lose only two marks for this.



(2)

(ii) Connect the crocodile clip to the wire at the zero end of the rule. Connect the power supply and use the 4-mm plug labelled X to make a connection to the wire at the 20.0 cm mark. To make good electrical contact the 4-mm plug should be pressed **firmly** against the wire.

Measure the current I in the circuit and the potential difference V across the 20.0 cm length of wire.

I = ...

V = ...

(3)

(iii) Hence calculate the resistance R_1 of a 20.0 cm length of wire.

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(2)

(iv) Repeat parts (ii) and (iii) to find the resistance R_2 of an 80.0 cm length of wire.

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(3)

(v) Use your results from parts (iii) and (iv) to determine the resistance R of a length $x = 60.0$ cm of wire, where $R = R_2 - R_1$. Hence determine a value for the resistivity ρ of the wire given that $\rho = \dfrac{R\pi d^2}{4x}$.

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(4)

(Total 24 marks)

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Q2A

Question 2B

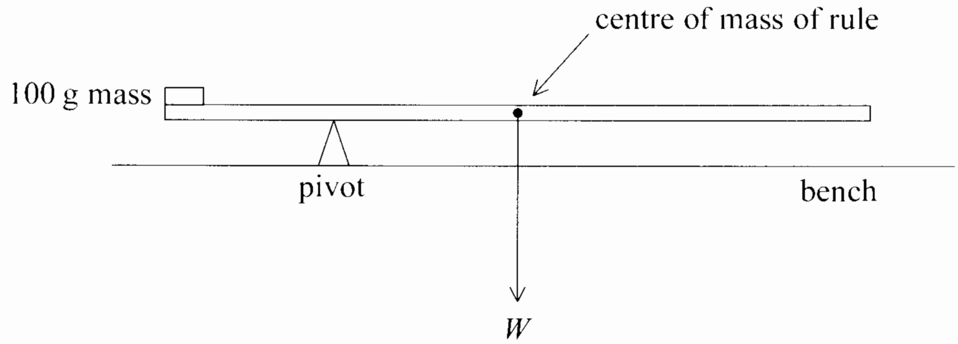
Leave blank

(a) Determine the position of the centre of mass of the metre rule labelled X by balancing it on the pivot so that it is approximately horizontal.

Position of centre of mass = ...

(1)

(b) Set up the apparatus as shown in the diagram below using the metre rule labelled X. The system should rest in equilibrium with the metre rule approximately horizontal.



Take such measurements as are necessary to find the weight *W* of the rule. **Show these measurements on the diagram.**

Now use the principle of moments to calculate *W*.

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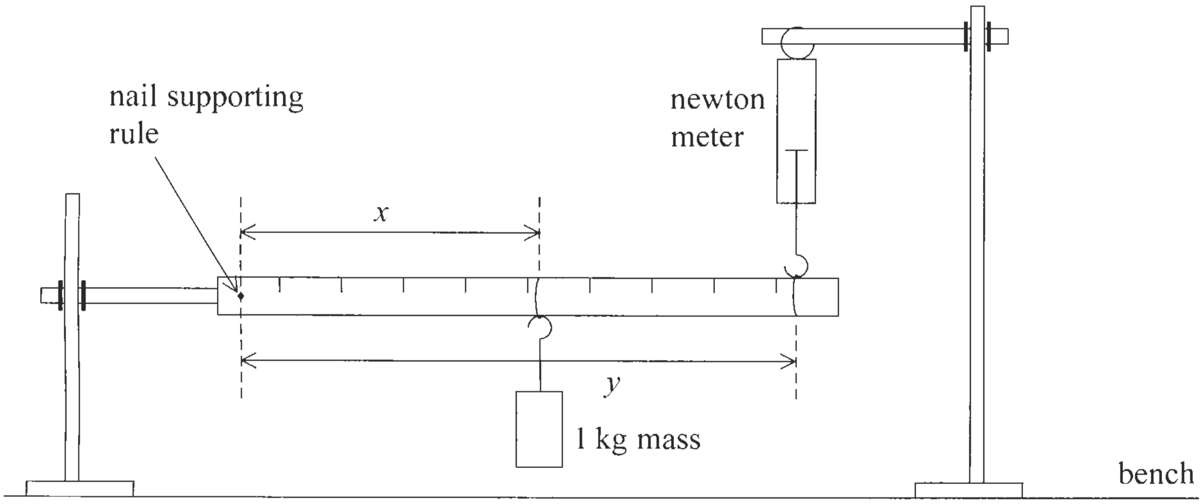
(6)

(c) Set up the apparatus as shown in the diagram below using the metre rule labelled X with the nail passing through the hole at the 1.0 cm mark. The loop of thread from which the 1.00 kg mass is suspended should be placed in the position of the centre of mass of the rule.



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

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(2)

(d) By applying the principle of moments to the horizontal rule it can be shown that:

$$(W + mg)x = Ty$$

where W = the weight of the metre rule,
mg = weight of the 1.00 kg mass = 9.81 N,
T = the reading on the newton meter,
and x and y are the lengths shown in the diagram.

Record the reading on the newton meter and determine values for x and y. Hence calculate a second value for W.

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(4)

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(c) Calculate the percentage difference between your two values for W.

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Which value of W do you consider to be more accurate? Give a reason for your answer.

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(3)

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(f) A student wishes to investigate how the force supporting the rule varies with the distance of the newton meter from the nail. The equation in part (d) may be rewritten in the form

$$T = \frac{(W + mg)x}{y}$$

You are to plan this investigation. Your plan should include

(i) an indication of the values in the equation which would need to be kept 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.

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(8)

(Total 24 marks)

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QB

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