Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced Subsidiary/Advanced

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
Uwch Gyfrannol/Uwch

543/01-A

PHYSICS

Assessment Unit PH 3 : EXPERIMENTAL PHYSICS

TEST 1 - WEDNESDAY, 16 May 2007

Sessions 1 & 2

Time Allowed 2 hours

For Examiner's use only	
1	
2	
3	
Total	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

For supervisor's use only.
Experiment 3:
M = ... kg
Changes to specifications:
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INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of the page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 60.

The number of marks is given in brackets at the end of each question or part question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

SPECIFIC ADVICE FOR CANDIDATES

- Before commencing any question read the **whole** question through completely.
- You will be allowed **30 minutes** to use the apparatus for each of these questions. You will have a further **10 minutes** to complete writing up each question before moving on to the next.
- Where possible, readings should always be repeated and the averages taken in order to reduce uncertainty. If repeat readings are **not** required the question will state so.
- The estimated uncertainty, ***u***, in a set of repeated readings should be taken as half the spread:

$$u\,(x) = \frac{x_{\max} - x_{\min}}{2}$$

- The percentage uncertainty $= \dfrac{\text{Estimated uncertainty}}{\text{Average value}} \times 100\%$
- Ensure that all readings, including repeat readings, are recorded and that you have not neglected to quote the appropriate units.
- Any gradients of graphs which are measured should be expressed to sensible significant figures and accompanied by the appropriate units.
- Any fundamental constant which may be required will be given in the appropriate question.

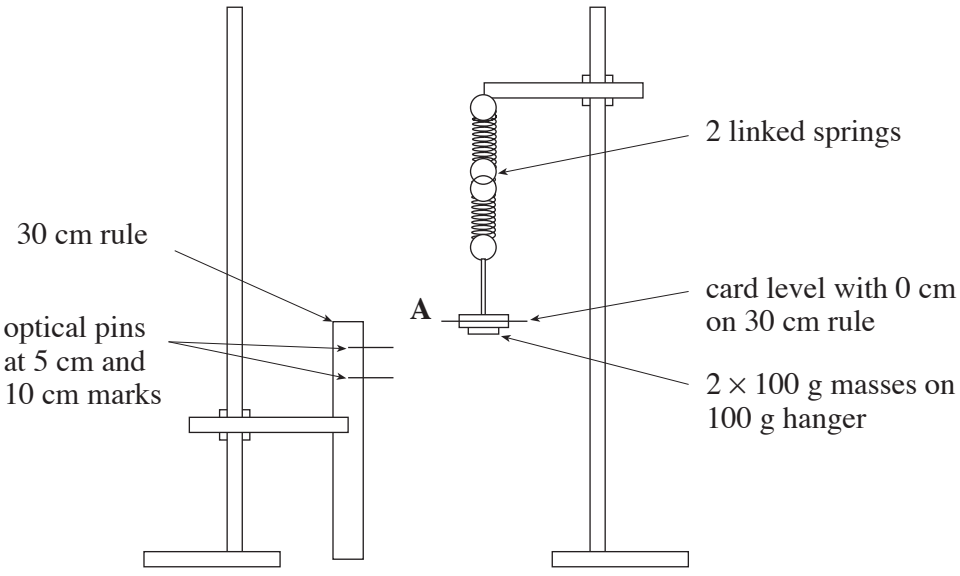
Question 1

In this experiment you are going to use a number of different size cards to investigate the effect of air resistance on the motion of a spring–mass system.

(a) You have been provided with four circles of cardboard all of different sizes. These are labelled **A**, **B**, **C**, & **D**. Find the area of **each** circle giving the appropriate unit. Ignore the small hole in the centre. [3]

CARDBOARD	AREA *(A)*
A	
B	
C	
D	

(b) Use the apparatus shown, with card **A** sandwiched between the two 100 g masses on a 100 g hanger.



Ensure that the card is initially level with the 0 cm mark on the 30 cm rule.
Pull down the weights until the card is level with the pin at the 10 cm mark.
Release the weight and count how many oscillations *(n)* it takes for the card, at its lowest point, to be level with the pin only 5 cm below its original position.
One oscillation is the distance the spring moves from when you release it to the top of its motion and back to the bottom again.

Repeat this for **each** of the cards and **record your results** in a suitable table below.

Include and complete a column headed 1/Area in your table. [6]

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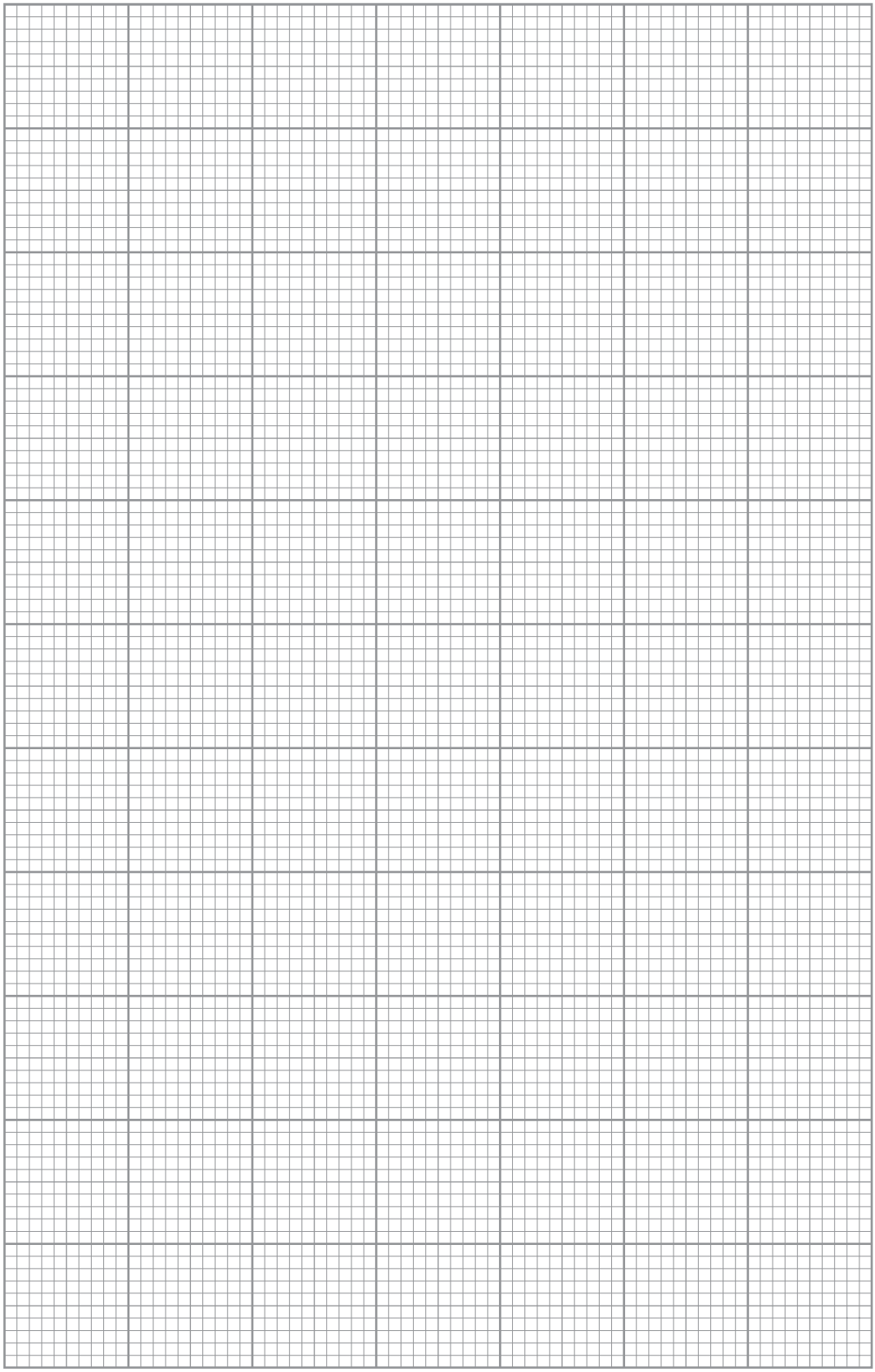
(c) A fellow Physics student suggests that the number of oscillations, n is inversely proportional to the area of the card, A. Plot a suitable graph to check if this suggestion is correct. [5]



(d) Using your results, explain whether or not the Physics student was correct. [3]

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(e) Determine the gradient of your graph and use it to state a mathematical relationship between n, the average number of oscillations, and A the area of card used. [3]

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Question 2

You are going to carry out an experiment to determine the internal resistance of a power supply.

(a) Draw a diagram of the circuit that has been set up for you. [2]

(b) Without closing the switch record the reading on the voltmeter. This is the e.m.f., E, of the power supply. [1]

E = ... V

(c) Close the switch and record the voltage, V across the power supply with the 3·3 Ω resistor in place. Repeat this for **each** of the resistors provided, and also for every possible **series** combination. Record your results in a suitable table. [5]

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(d) For the circuit provided it can be shown that

$$E = I(R + r)$$

Where R = resistance of the combination of resistors
r = internal resistance of the power supply

Using the above equation and the definition of resistance, which should be stated, show that

$$r = R\left(\frac{E}{V} - 1\right)$$

[3]

(e) (i) From your results calculate a value for r using **each** of your results obtained in *(c)*. [2]

(ii) Hence determine an average value for the internal resistance of the cell. [1]

(iii) Using the expressions given on page 2 calculate the uncertainty in your result. [2]

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(iv) Where do you think the main error arose in your experiment? Explain what you could do to reduce error. [2]

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(f) The resistors chosen for this experiment have a power rating of 1 W. Use your results to calculate the maximum power that was dissipated in the resistors during your experiment. [2]

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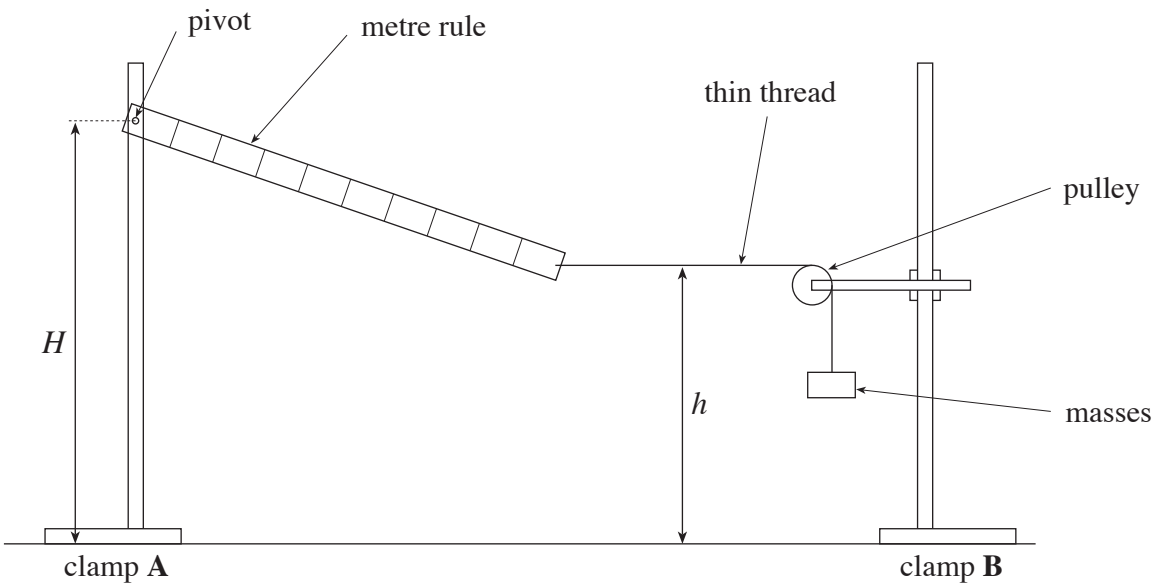
Question 3

You are going to use the conditions of equilibrium of forces to determine the mass of a metre rule.

The following apparatus has been set up for you



(a) (i) On the diagram draw in the weight of the rule, labelled ***Mg***, where ***M*** is the mass of the metre rule. [1]

(ii) Label the tension in the thread, ***mg***, where ***m*** is the mass added to the thread. [1]

(b) Using the spare metre rule measure the height, *H*, from the bench to the pivot holding the metre rule. Record the height in metres. **This should not be adjusted for the rest of the experiment**. [1]

H = ... m

(c) Adjust the height of clamp **B** until the thread is horizontal. Explain fully how you did this, and record the height *h*. [2]

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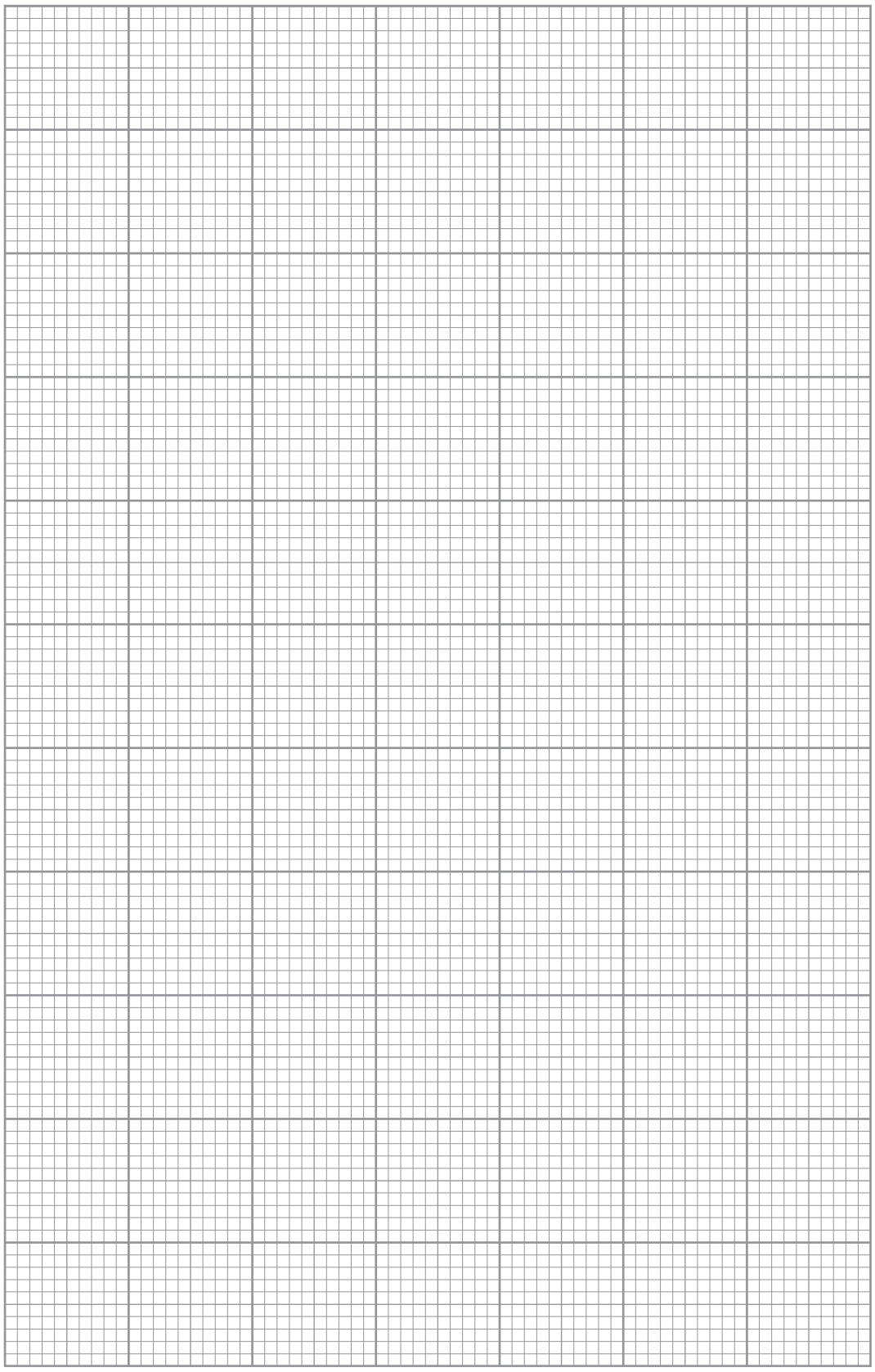
h = ... m

(d) By using each of the masses available, and any combinations, complete the following table including any relevant units. **Repeat readings are not needed for this experiment.** [3]

Mass ***(m)***	Mass^2 (***m***^{2}***)***	height ***(h)***	**1/*(H-h)*^{2}**
Units (.....)	Units (.....)	Units (metres)	Units (.....)

(e) Plot a graph of $\frac{1}{(H-h)^2}$ on the y-axis, against m^2 on the x-axis. [3]



(f) Theory suggests that the quantities in this experiment are related by the equation

$$\frac{1}{(H-h)^2} = 4\,\frac{m^2}{M^2} + 1.$$

By comparing this with the equation for a straight line graph, state what the theory suggests the gradient and the intercept on the vertical axis should be. [2]

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Gradient = ...

Intercept = ...

(g) (i) Use your graph to find the gradient and the intercept. [3]

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(ii) Use your value for the gradient of the graph to calculate the mass, *M*, of the metre rule. [2]

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(iii) An experiment can be considered accurate if the result lies within 5% of the quoted value. **By considering your result for the intercept** of the graph comment on the accuracy of your experiment. Give a full explanation. [2]

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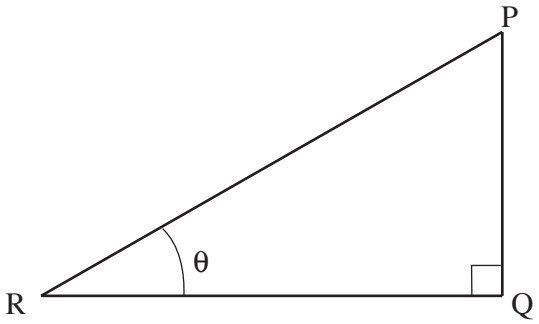
Mathematical Data and Relationships

SI multipliers

Multiple	Prefix	Symbol
10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m

Multiple	Prefix	Symbol
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T
10^{15}	peta	P

Geometry and trigonometry



$$\sin\theta = \frac{PQ}{PR}, \quad \cos\theta = \frac{QR}{PR}, \quad \tan\theta = \frac{PQ}{QR}, \quad \frac{\sin\theta}{\cos\theta} = \tan\theta$$

$$PR^2 = PQ^2 + QR^2$$

Areas and Volumes

Area of a circle $= \pi r^2 = \frac{\pi d^2}{4}$

Area of a triangle = ½ base × height

Solid	Surface area	Volume
rectangular block	$2(lh + hb + lb)$	lbh
cylinder	$2\pi r(r + h)$	$\pi r^2 h$
sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$