Write your name here

Surname		Other names

Pearson Edexcel
International
Advanced Level

Centre Number

Candidate Number

Physics
Advanced
Unit 7: Physics Practical Examination (SET A)

Monday 8 May 2017 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
WPH07/01

You must have:
Ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name,
  centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The paper consists of two 20-minute questions and one 40-minute question.
  There will be 10 minutes at the end to complete the write up of all the questions.
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Supervisor's data and comments

Question 1	Time taken t	
	Change in height Δh	
Question 3	Resistance R of unknown resistor	
Brief description of any assistance provided:		

Turn over ▶

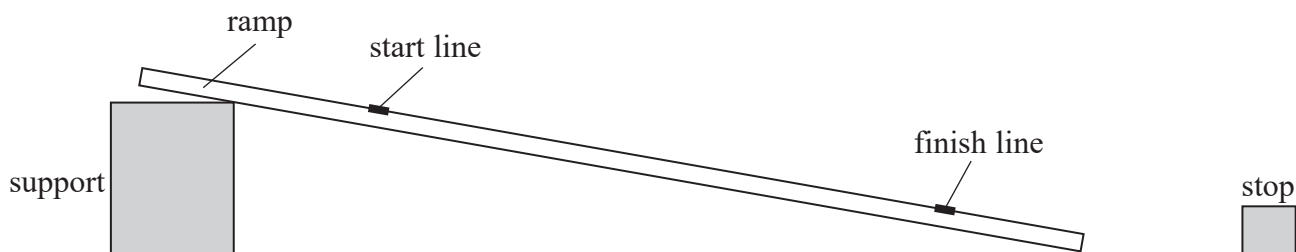Pearson

Answer ALL questions in the spaces provided.

1 You are going to determine a value for the acceleration of free fall g by measuring the time it takes for a hollow cylinder to roll down a ramp.

The following apparatus has been set up for you. Do not adjust the ramp.

(a) (i) By placing the cylinder at the start line, take an accurate measurement of the time taken t for the cylinder to roll to the finish line.

(1)

....

....

$t = $ ....

(ii) Calculate the percentage uncertainty in the measurement of t.

(2)

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....

Percentage uncertainty in $t = $ ....

(b) The time taken t is given by the equation

$$t^2 = \frac{4s^2}{g\Delta h}$$

where s is the distance between the start line and the finish line and Δh is the change in height between the start line and the finish line.

(i) Measure Δh.

(1)

....

$\Delta h = $ ....

(ii) Calculate the percentage uncertainty in the measurement of Δh.

(1)

....

Percentage uncertainty in Δh = ...

(iii) Calculate a value for g.

(1)

$s = 80.0\,\text{cm} \pm 0.1\,\text{cm}$

....

....

g = ...

(iv) Calculate the percentage uncertainty in your value for g.

(2)

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Percentage uncertainty in g = ...

(v) Comment on the accuracy of your value for g.

(2)

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(Total for Question 1 = 10 marks)

2 You are going to plan an experiment to investigate resonance.

(a) Explain what is meant by resonance.

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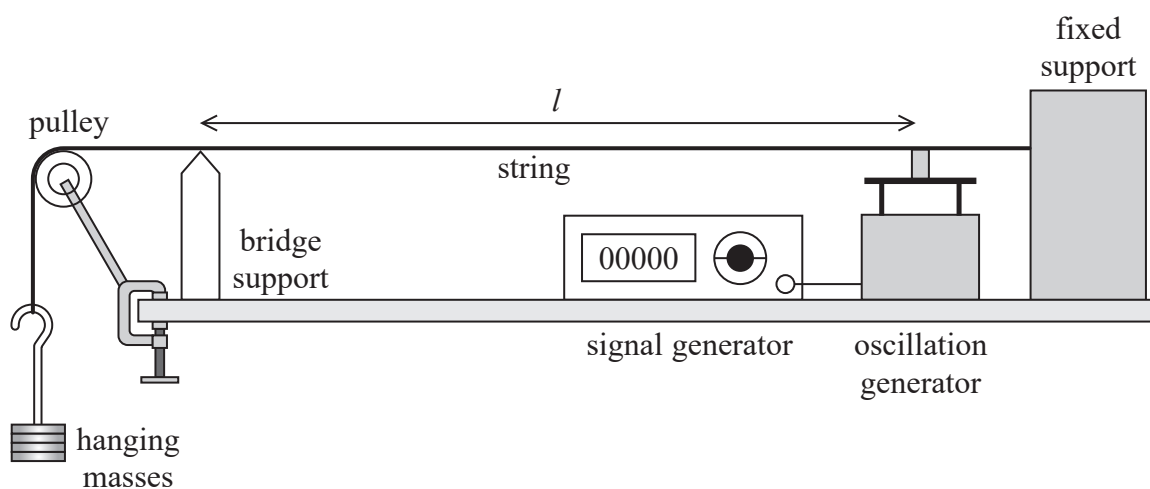
(b) The apparatus shown can be used to study resonance.

When the signal generator is switched on the string oscillates. The signal generator can be adjusted so that the string resonates.

When the string resonates at its fundamental frequency f,

$$f = \frac{1}{2l}\sqrt{\frac{mg}{\mu}}$$

where m is the mass of the hanging masses, l is the length of the string between the oscillation generator and the bridge support and μ is a constant.

Write a plan to determine a value for μ using a graphical method.

Your plan should include:

(i) the measurements you would make and the measuring instruments you would use,

(2)

(ii) a justification of your choice of **one** of the measuring instruments,

(2)

(iii) the graph you would plot and how it would be used to determine a value for μ,

(2)

(iv) a statement of the main source of uncertainty and/or systematic error and how you would minimise this.

(2)

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(Total for Question 2 = 10 marks)

3 You are going to determine the resistance R of an unknown resistor by measuring the time constant of a capacitor discharge circuit.

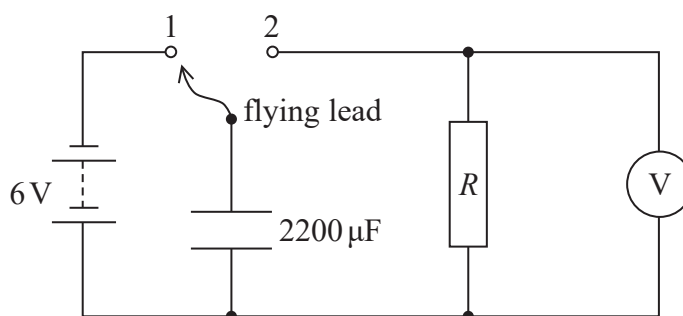(a) Explain what is meant by the time constant of a capacitor discharge circuit.

(2)

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(b) (i) Set up the circuit as shown using a resistor of resistance R.

(2)

If you are unable to set up the circuit ask the supervisor for help.
You will only lose, at most, 2 marks for this.

Before connecting the power supply ask the supervisor to check your circuit.
If necessary, you will be given a few minutes to make any corrections.

(ii) Connect the flying lead to position 1 for a few seconds to charge up the capacitor. Move the flying lead to position 2 and measure the potential difference V at corresponding times t over a period of $60\,\text{s}$. Record your results in the table below. There is no need to repeat your readings.

(3)

t / s	V / V	

(iii) The variation of potential difference V as the capacitor discharges is given by

$$V = V_0 e^{(-t/RC)}$$

Explain why a graph of $\ln V$ against t will be a straight line.

(2)

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(iv) Use your values to plot a graph of $\ln V$ against t on the grid. Use the extra column in the table to record any processed data.

(4)
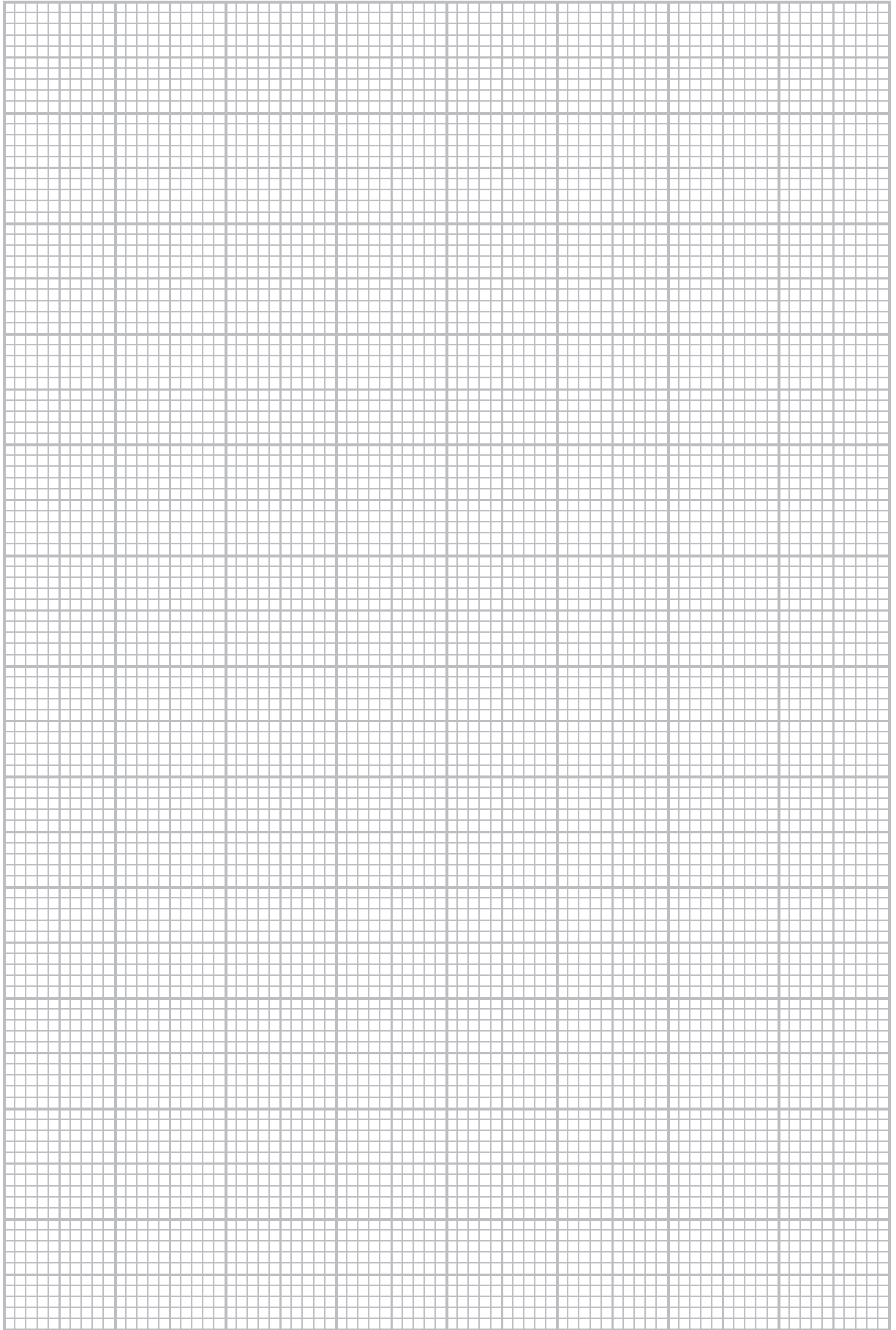
(v) Use your graph to determine a value for R.

(4)

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$R = $ ....

(c) State how using a data logger, rather than a voltmeter and stopwatch, would improve the accuracy of this experiment.

(1)

....

....

(d) The resistor is replaced by a different resistor so that the potential difference decreases to 3.0 V in 5.0 minutes.

Calculate the resistance of the replacement resistor.

(2)

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Resistance = ...

(Total for Question 3 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\varepsilon_0$	
	$= 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$	
Speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$	

Unit 1

Mechanics

Kinematic equations of motion
$$v = u + at$$
$$s = ut + \tfrac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Forces
$$\Sigma F = ma$$
$$g = F/m$$
$$W = mg$$

Work and energy
$$\Delta W = F\Delta s$$
$$E_k = \tfrac{1}{2}mv^2$$
$$\Delta E_{grav} = mg\Delta h$$

Materials

Stokes' law
$$F = 6\pi\eta rv$$

Hooke's law
$$F = k\Delta x$$

Density
$$\rho = m/V$$

Pressure
$$p = F/A$$

Young modulus
$$E = \sigma/\varepsilon \text{ where}$$
Stress $\sigma = F/A$
Strain $\varepsilon = \Delta x/x$

Elastic strain energy
$$E_{el} = \tfrac{1}{2}F\Delta x$$

Unit 2

Waves

Wave speed	$v = f\lambda$
Refractive index	$_1\mu_2 = \sin i / \sin r = v_1 / v_2$

Electricity

Potential difference	$V = W/Q$
Resistance	$R = V/I$
Electrical power, energy and efficiency	$P = VI$
	$P = I^2 R$
	$P = V^2/R$
	$W = VIt$

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

$$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{total power input}} \times 100$$

Resistivity	$R = \rho l / A$
Current	$I = \Delta Q / \Delta t$
	$I = nqvA$
Resistors in series	$R = R_1 + R_2 + R_3$
Resistors in parallel	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

Quantum physics

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \tfrac{1}{2}mv^2_{max}$

Unit 4

Mechanics

Momentum $p = mv$

Kinetic energy of a
non-relativistic particle $E_k = p^2/2m$

Motion in a circle $v = \omega r$
$T = 2\pi/\omega$
$F = ma = mv^2/r$
$a = v^2/r$
$a = r\omega^2$

Fields

Coulomb's law $F = kQ_1Q_2/r^2$ where $k = 1/4\pi\varepsilon_0$

Electric field $E = F/Q$
$E = kQ/r^2$
$E = V/d$

Capacitance $C = Q/V$

Energy stored in capacitor $W = \frac{1}{2}QV$

Capacitor discharge $Q = Q_0e^{-t/RC}$

In a magnetic field $F = BIl \sin \theta$
$F = Bqv \sin \theta$
$r = p/BQ$

Faraday's and Lenz's laws $\varepsilon = -\mathrm{d}(N\emptyset)/\mathrm{d}t$

Particle physics

Mass-energy $\Delta E = c^2 \Delta m$

de Broglie wavelength $\lambda = h/p$

Unit 5

Energy and matter

Heating	$\Delta E = mc\Delta\theta$
Molecular kinetic theory	$\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$
Ideal gas equation	$pV = NkT$

Nuclear Physics

Radioactive decay	$\mathrm{d}N/\mathrm{d}t = -\lambda N$
	$\lambda = \ln 2/t_{\frac{1}{2}}$
	$N = N_0 e^{-\lambda t}$

Mechanics

Simple harmonic motion	$a = -\omega^2 x$
	$a = -A\omega^2 \cos\omega t$
	$v = -A\omega \sin\omega t$
	$x = A\cos\omega t$
	$T = 1/f = 2\pi/\omega$
Gravitational force	$F = Gm_1 m_2/r^2$

Observing the universe

Radiant energy flux	$F = L/4\pi d^2$
Stefan-Boltzmann law	$L = \sigma T^4 A$
	$L = 4\pi r^2 \sigma T^4$
Wien's law	$\lambda_{max} T = 2.898 \times 10^{-3} \text{ m K}$
Redshift of electromagnetic radiation	$z = \Delta\lambda/\lambda \approx \Delta f/f \approx v/c$
Cosmological expansion	$v = H_0 d$