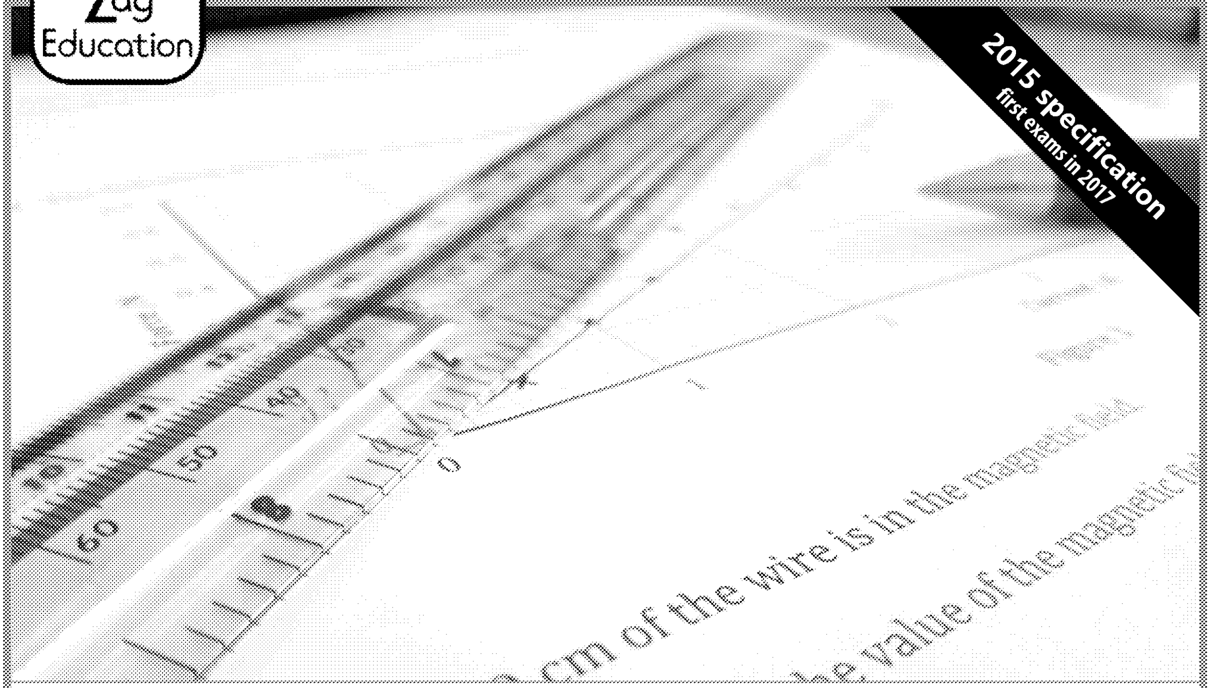
Physics

A Level | AQA | 7408



Practice Exams for A Level AQA Physics

Paper 3A

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POD 7607

Contents

Teacher's Introduction

This collection of four practice papers has been written to support the AQA A-level physics specification 7408 (first examination 2016). The pack consists of four sets of paper 3A. The papers are designed to be taken in conjunction with a 3B paper, for which the combined time is 2 hours.

Each paper consists of 3 questions of 15 marks each, totalling 45 marks, which cover the practical skills set by the exam board.

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

Each paper follows a similar format to AQA papers. Every item listed in the specification is covered, with most aspects visited several times in the pack. Each set of papers matches the weightings of assessment objectives, maths skills and practical skills set out by the exam board.

The mark schemes are written in a similar format to those written by AQA. The individual marking points are on separate lines with additional guidance to clarify points and indicate alternative acceptable answers.

Suggested Uses

1. Set as a mock examination under exam conditions, marked by the teacher. This provides the most reliable summative assessment.
2. Set as a complete paper under exam conditions which is then marked by the student. This provides a good formative assessment as the student gets a good understanding of how the mark schemes work and what they need to do to score. Such a session could be reinforced by a lesson on exam technique.
3. Set as a complete paper under exam conditions which is then peer marked. This could be by the teacher assigning scripts to students to mark or by students swapping amongst themselves. Group marking can be particularly helpful as the students get the chance to develop their ideas by discussing why things do and don't score.
4. Go through a question at a time in a lesson. Get students to discuss their answers before revealing the mark scheme for that question.
5. Set a paper as a homework for the student to answer and mark. This would be an ideal activity for study leave, when the student could come to a tutorial to go through their script. They should be briefed to list questions that need addressing as a result of their marking of their script.

T Brown & S Khonji, April 2017

Specification Cross-refere

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
1 Measurements and their errors						
1.1 Measurements and their errors						
1.1.1 Use of SI units and their prefixes			3			3
1.1.2 Limitation of physical measurements	3	3, 6		6, 27	2	
1.1.3 Estimation of physical quantities				4, 6	1, 15	1
2 Particles and radiation						
2.1 Particles						
2.1.1 Constituents of the atom	1	9	9	9	5, 6, 29	
2.1.2 Stable and unstable nuclei	1, 10					
2.1.3 Particles, antiparticles and photons	6		11	5		
2.1.4 Particle interactions	1, 6	10	8, 10	7		
2.1.5 Classifications of particles	6	5	8	29		3
2.1.6 Quarks and antiquarks	6	11		7		
2.1.7 Applications of conservation laws	6	[illegible]	8, 10			
2.2 Electromagnetic radiation and quantum phenomena						
2.2.1 The photoelectric effect	7, 8	7	4			
2.2.2 Collisions of electrons with atoms		5	7			
2.2.3 Energy levels and photon emission	9	8				
2.2.4 Wave–particle duality		5,7	4	10	6	

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
3 Waves						
3.1 Progressive and stationary waves						
3.1.1 Progressive wave	15		1	[illegible], 13		
3.1.2 Longitudinal and transverse waves	11, [illegible]	[illegible]	1	11, 14		
3.1.3 Principle of superposition of waves and formation of stationary waves	[illegible]	2	13			
3.2 Refraction, diffraction and interference						
3.2.1 Interference	5, 13	15	5	12		
3.2.2 Diffraction	5	5, 16	5, 15	10		
3.2.3 Refraction at a plane surface		12, 13, 14	12, 14, 16	3, 15		
4 Mechanics and materials						
4.1 Force, energy and momentum						
4.1.1 Scalars and vectors	2, 16, 19	20	6, 19		7	
4.1.2 Moments	17	18	22	6		
4.1.3 Motion along a straight line	2, 19, 21	1, 6	6, 17, 20, 21	1, 17, [illegible], 21	21	3
4.1.4 Projectile motion	2, 20	20	6			3,
4.1.5 Newton's laws of motion	2, 16	[illegible]2	6		7, 9, 10	3
4.1.6 Momentum	[illegible]	17, 19	18	1, 16, 19		
4.1.7 Work, energy and power	18	1, 6, 21, 22	6	2, 18	10	
4.1.8 Conservation of energy	18, 19	1, 3, 17	4	6	3, 5	6
4.2 Materials						
4.2.1 Bulk properties of solids	3, 23, 24, 25	3, 23, 24	2, 23	2, 22, 23, 24	2	

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
4.2.2 The Young modulus	3	25	2, 23, 24	22		
5 Electricity						
5.1 Current electricity						
5.1.1 Basics of electricity	3	2[illegible], 27		4	18	
5.1.2 Current–voltage characteristi[illegible]	26	4	3	25, 27		
5.1.3 Resistivit[illegible]	27		3	28	2	
5.1.4 Circuits	4, 28	4, 28	25, 26	4, 26	24	1
5.1.5 Potential divider		4	28			
5.1.6 Electromotive force and internal resistance	4		27	4, 26		
6 Further mechanics and thermal physics						
6.1 Periodic motion						
6.1.1 Circular motion	29				6, 7, 8, 9, 10	
6.1.2 Simple harmonic motion	30			1	4, 17	6,
6.1.3 Simple harmonic system	31			1	4	6, 8
6.1.4 Forced vibrations and resonance					4	
6.2 Thermal physics						
6.2.1 Thermal e[illegible]sfer		1, 29			19	1
6.2.2 Ideal gases		30				6, 1 11,

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
6.2.3 Molecular kinetic theory model		31				12, 15
7 Fields and their consequences						
7.1 Fields						
Fields					11, 15	19
7.2 Gravitation						
7.2.1 Newton's			29		3	
7.2.2 Gravitational field strength					11, 12	
7.2.3 Gravitational potential					3, 11, 12, 13	16,
7.2.4 Orbits of planets and satellites					3, 14	17,
7.3 Electric fields						
7.3.1 Coulomb's law					1, 16	3, 2
7.3.2 Electric field strength			30		1, 17	3
7.3.3 Electric potential						3, 20
7.4 Capacitance						
7.4.1 Capacita						4
7.4.2 Parallel pla pacitor						4
7.4.3 Energy stored by a capacitor					2	24

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2
7.4.4 Capacitor charge and discharge					2, 18, 19, 20	23,
7.5 Magnetic fields						
7.5.1 Magnetic flux density						5
7.5.2 Moving charges in a magnetic field			31	29	6	27
7.5.3 Magnetic flux and flux linkage						5
7.5.4 Electromagnetic induction					21, 22	5, 2
7.5.5 Alternating currents				*4*	23	26
7.5.6 The operation of a transformer					24, 25	
8 Nuclear physics						
8.1 Radioactivity						
8.1.1 Rutherford scattering					5	31
8.1.2 α, β and γ radiation					26, 28	2
8.1.3 Radioactive decay	1, 9		[illegible]		29	2, 2
8.1.4 Nuclear instability		3			27, 30	
8.1.5 Nuclear radius					5	
8.1.6 Mass and energy			31			
8.1.7 Induced fission					31	30
8.1.8 Safety aspects	1				31	2

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 3A

Set 2

Name	

Time allowed

2 hours (for sections A **and** B)

Instructions

Answer **all** of the questions and use the space provided.

Information

The total marks available for this paper is [illegible]5. The number of marks available for each question is shown on the right.

For this paper you will need:

- Data and formulae booklet

Additional materials required

- Pencil
- Electronic calculator
- Ruler (cm/mm)

1. **Figure 1** shows a J-shaped tube that is similar to the device that was used investigate the relationship between pressure and volume – Boyle's law. diameter of 5.80 mm and is sealed at one end and open at the other, and f purpose of the investigation. Initially, the amount of fluid contained in th fluid is the same at each end. When more fluid is added, there is a differe *h*, as shown.

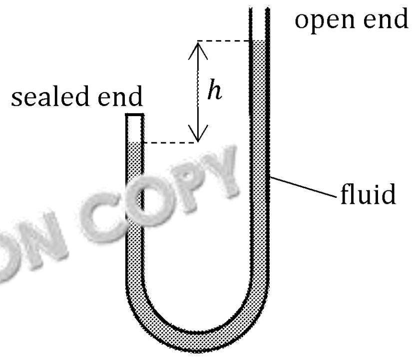
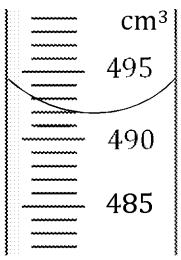


Figure 1

1.1 Give the reading of the volume shown below.



Vo

1.2 State **two** variables that must be controlled in order to determine the pressure and volume using the above apparatus.

1 ....

2 ....

1.3 The mass of fluid added that causes a height difference of *h* is 200 g. diameter of 3.85 mm. Show that the pressure inside the sealed end a 169 kPa, additional to the atmospheric pressure present.

1.4 State a suitable piece of apparatus to measure the internal diameter

....

1.5 The volume contained within the sealed end is 6.00×10^{-5} m³ when
of the tube.

Calculate the volume contained inside the sealed end when the extra
[Atmospheric pressure = 101 kPa]

1.6 Suggest why the procedure above requires a J-shaped tube instead of
open ends.

....

....

1.7 Suggest how the procedure would need to be different for a U-shaped

....

....

1.8 In an experiment to investigate Charles law for a fixed quantity of gas
always independent, dependent and controlled in all versions of the

Independent variable: ....

Dependent variable: ....

Control variable: ....

2. **Figure 2** shows the set-up for Young's double slit experiment.

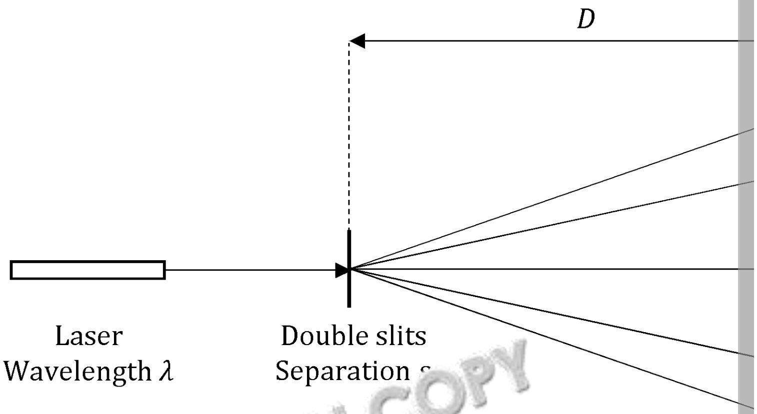


Figure 2

An opaque card with two slits, spaced at a distance s apart, is placed betwee

The screen is at a distance D from the double slits.

When the laser is turned on, a pattern is seen on the screen.

2.1 How do the double slits create the pattern on the screen?

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2.2 The uncertainties in the wavelength of laser light and the separation by the manufacturer.

Suggest how the uncertainty for D can be estimated.

....

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....

....

2.3 The following data is collected.

Variable	Value
Distance between double slits and screen, D /m	6.00
Wavelength of laser light, λ /nm	530
Separation of double slits, s /mm	0.20

Calculate the distance between fringes of the pattern.

Include an uncertainty in your answer.

2.4 The distance between fringes is measured and is found to lie outside
given by the uncertainty calculated in 2.3.

Suggest **one** reason why the measured distance lies outside of the ex

....

....

2.5 Explain why it is important that the laser beam is exactly perpendicu
at an angle.

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2.6 Describe how the experiment could be adapted to show the wave nat
experiment would show the wave nature of electrons.

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3. A capacitor, with capacitance C, is charged by a battery. When the capaci
allowed to discharge across a resistor, with resistance R.

The table below shows the value of the current through the resistor as th

Time, t /s	Current, I /A	
0.00	75.90	
8.00	23.80	
16.00	16.80	
24.00	[illegible]16	
32.00	3.39	
[illegible]	1.43	
48.00	0.51	
56.00	0.25	

3.1 Sketch a set-up that would allow the data in the table to be collected.

3.2 Capacitors can hold large charges, presenting a safety hazard.

Describe a precaution that would reduce the risk from large charges

....

3.3 Using an equ[illegible] the data booklet, show that

$$\ln I = -\frac{t}{RC} + \ln I_0$$

3.4 Plot the data from the table on **Figure 3** below, including a line of bes

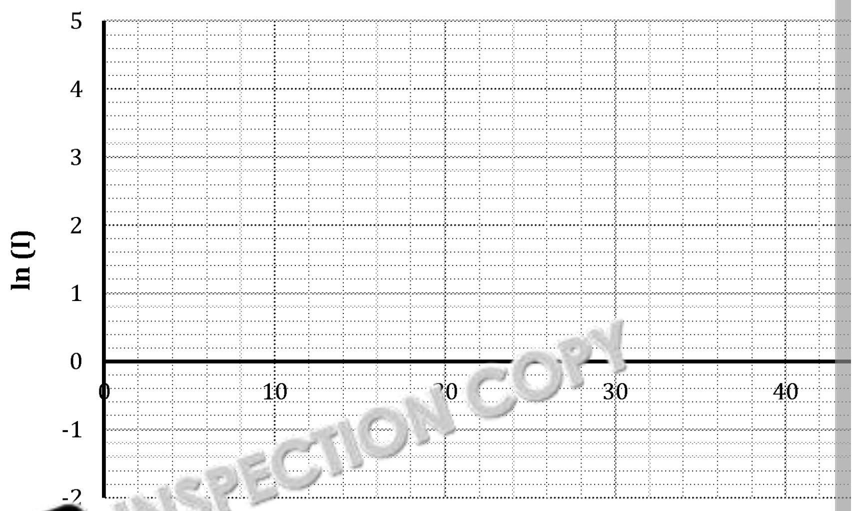


Figure 3

3.5 Use your graph to calculate a value for the time constant of the capac

Determine the percentage uncertainty in your answer.

3.6 The resistor has a resistance of an order of magnitude of 10 kΩ.

Estimate the order of magnitude of the value of the capacitor.

ZigZag Practice Exam Papers
Supporting A Level AQA Physics

Practice Exam Paper 3A
Set 2

Name	

Time allowed
2 hours (for sections A **and** B)

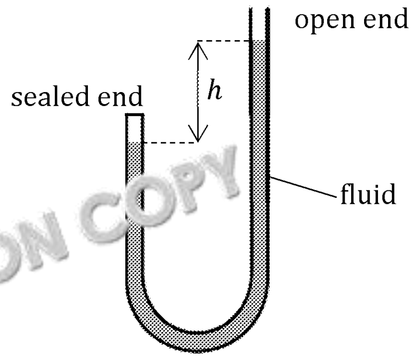
Instructions
Answer **all** of the questions.

Information
The total marks available for this paper is **45**. The number of marks available for each question is shown on the right.

For this paper, you will need:
- Data and formulae booklet

Additional materials required
- Pencil
- Electronic calculator
- Ruler (cm/mm)
- Graph paper

1. **Figure 1** shows a J-shaped tube that is similar to the device that was used investigate the relationship between pressure and volume – Boyle's law. diameter of 5.80 mm and is sealed at one end and open at the other, and f purpose of the investigation. Initially, the amount of fluid contained in th fluid is the same at each end. When more fluid is added, there is a differe *h*, as shown.



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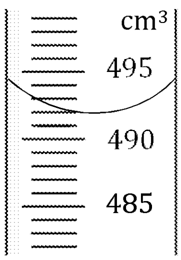

1.2 State **two** variables that must be controlled in order to determine the pressure and volume using the above apparatus.

1.3 The mass of fluid added that causes a height difference of *h* is 200 g. diameter of 3.85 mm. Show that the pressure inside the sealed end a 169 kPa, additional to the atmospheric pressure present.

1.4 State a suitable piece of apparatus to measure the internal diameter o

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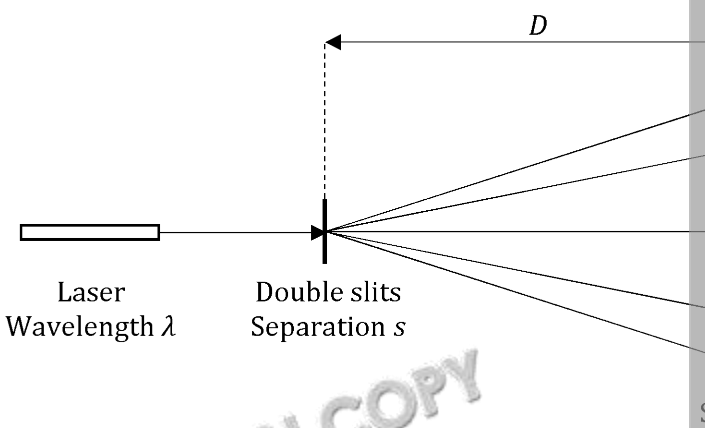

Figure 2

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2.1 How do the double slits create the pattern on the screen?

2.2 The uncertainties in the wavelength of laser light and the separation
by the manufacturer.

Suggest how the uncertainty for D can be estimated.

2.3 The following data is collected.

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Include an uncertainty in your answer

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24.00	5.1[illegible]	
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3.1 Sketch a set-up that would allow the data in the table to be collected.

3.2 Capacitors can hold large charges, presenting a safety hazard.

Describe a precaution that would reduce the risk from large charges

3.3 Using an equation from the data booklet, show that

$$\ln I = -\frac{t}{RC} + \ln I_0$$

3.4 On graph paper, copy the axes from figure 3 and plot the data on the t

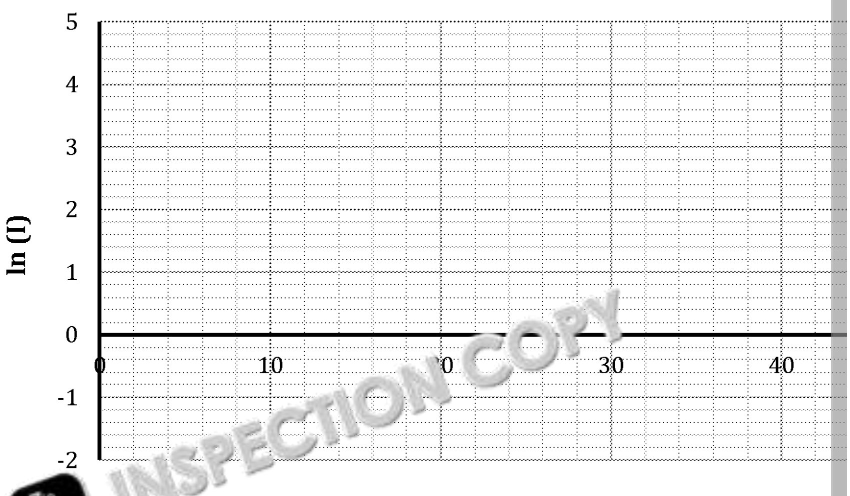


Figure 3

3.5 Use your graph to calculate a value for the time constant of the capac

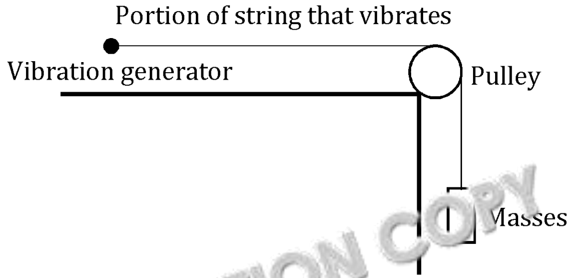
Determine the percentage uncertainty in your answer.

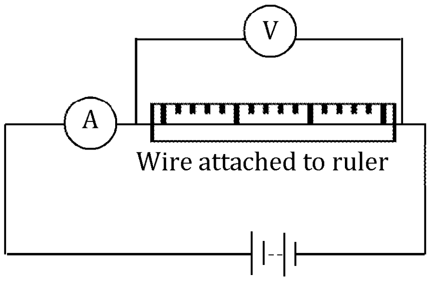
3.6 The resistor has a resistance of an order of magnitude of 10 kΩ.

Estimate the order of magnitude of the value of the capacitor.

Preview of Questions Ends Here

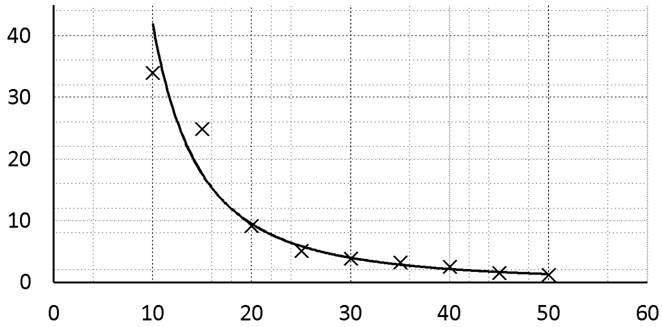
Mark Scheme: Set 1

Question	Answer	Marks
1.1	Masses over pulley as shown ✓ String between vibration generator and pulley as shown ✓ 	1 1
1.2	(Uncertainty for each reading is 0.5 mm) (A measurement consists of two readings) 1 mm / ±0.001 m ✓	1
1.3	$Percentage\ uncertainty = \frac{0.001}{0.740} \times 100\ \%$ ✓ $Percentage\ uncertainty = \pm 0.135\ \%$ ✓	1 1
1.4	Measure mass and length (and divide) ✓	1
1.5	$\mu = \frac{mass}{length}$ $\mu = \frac{6.55 \times 10^{-3}}{0.740}$ ✓ $\mu = 8.85 \times 10^{-3}$ kg m^{-1} ✓	1 1
1.6	$Mean = \frac{sum\ of\ values}{number\ of\ values}$ $Mean = \frac{277+282+281}{3}$ $Mean = 280$ ✓ (Absolute uncertainty is half of range) Absolute uncertainty $= \frac{282-277}{2} = \pm 2.5$ Hz ✓	1 1
1.7	Any two from: ✓✓ • Position of node is not well defined • Difficult to find exact point of resonance • Wire is stretched by tension • String not perfectly horizontal • Vibrations in horizontal direction • Air resistance against movement of string • Parallax in distance measurements • Temperature expansion (of ruler and string)	Max 2
1.8	$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ Hence is f is plotted against $\sqrt{T}$, gradient will be $G = \frac{1}{2l\sqrt{\mu}}$ Hence $\mu = \frac{1}{(2lG)^2}$ ✓	1
1.9	Keep tension OR mass constant ✓ Vary distance between pulley and vibration generator OR change length of portion of string that vibrates ✓	1 1

Question	Answer	Marks
2.1	Ammeter in series with wire ✓ Voltmeter in parallel with battery/cell ✓  	1 1
2.2	Micrometer ✓	1
2.3	Rotate the wire OR change the position of the measurement ✓	1
2.4	$Mean\ diameter = \frac{0.8[illegible]+0.814+0.814}{3} = 0.8127$ ✓ $A = \pi \left(\frac{d}{2}\right)^2$ $A = \pi \times \left(\frac{0.8127\times10^{-3}}{2}\right)^2$ ✓ $A = 5.19 \times 10^{-7}$ m² ✓	1 1 1
2.5	(Absolute uncertainty is half of range) Absolute uncertainty in diameter $= \frac{(0.814-0.812)}{2} \times 10^{-3} = \pm 1 \times 10^{-6}$ m ✓ Percentage uncertainty in diameter $= \frac{1\times10^{-6}}{0.8127\times10^{-3}} \times 100\ \% = 0.123\ \%$ ✓ $\epsilon(A) = 2\epsilon(d)$ ✓ $\epsilon(A) = 2 \times 0.123 = 0.246\ \%$ ✓	 1 1 1 1
2.6	Vary length L of wire and measure resistance R ✓ Plot R against L ✓ $Gradient = \frac{\rho}{A}$ ✓	1 1 1
2.7	High current may cause the wire to melt ✓	1
3.1	Any one from: ✓ Source used GM tube used Location of experiment (same background count rate) Position of source or detector (**not** both) Absorption media between source and detector	Max 1
3.2	Any two from: ✓✓ Use of long-handled tongs Point source away from body Use of a gamma source container Keep source at as great a distance as possible Store source in suitable container when finished with use	Max 2

Question	Answer	Marks
3.3	Actual count rate worked out by subtracting background count rate (0.450 counts min^{-1}) from measured count rate ✓ Actual count rate plotted correctly as shown ✓ Line through points as shown ✓	 1 1 1

Measured count rate / counts min^{-1}	Actual count rate / counts min^{-1}
34.45	34.0
25.35	24.9
9.65	[illegible]
5.56	5.11
4.29	3.84
3.68	3.23
3.00	2.55
1.97	1.52
1.66	1.21



Question	Answer	Marks
3.4	Measure number of counts using a **GM tube** ✓ Divide by number of minutes to obtain count rate ✓	1 1
3.5	Line drawn from 32 cm to line ✓ Value between 3 to 6 counts min^{-1} ✓	1 1
3.6	$count\ rate = \frac{k}{d^2}$ ✓ $\ln(count\ rate) = \ln(kd^{-2})$ $\ln(count\ rate) = -2\ln(d) + \ln k$ ✓ (Which is in the form $y = mx + c$) Hence plot $\ln(count\ rate)$ against $\ln(d)$ ✓ (Which will have a gradient of −2)	1 1 1
3.7	Two from: • Gamma source is inside a container ✓ • GM tube does not detect gamma rays at its end/ electrode at different distance from source as end of tube ✓ • GM tube cannot detect simultaneous photons/ there is a time delay between active periods of detection ✓	Max 2

Preview of Answers Ends Here