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Sample Assessment Materials
For international centres only

GCE Physics

Edexcel Advanced Subsidiary GCE in Physics (8PH07)
First examination 2009

Edexcel Advanced GCE in Physics (9PH07)
First examination 2010

International Alternative to Internal Assessment
(Units 3B and 6B)

January 2008

A PEARSON COMPANY

Contents

A Introduction

These sample assessment materials have been prepared to support the specification.

Their aim is to provide the candidates and centres with a general impression and flavour of the actual question papers and mark schemes in advance of the first operational examinations.

B Sample question papers

Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 P H 0 7 / 0 1	Signature	

Paper Reference(s)

6PH07/01

Edexcel GCE

Physics

Unit 3

Specimen Assessment Material

International Alternative to Practicals

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Some questions must be answered with a cross in a box (☒). If you change your mind, put a line through the box (☒) and then mark your new answer with a cross (☒).
Do not use pencil. Use blue or black ink.
In calculations you should show all the steps in your work, giving your answer at each stage.
Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper. The total mark for this paper is 40.
There are 16 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.

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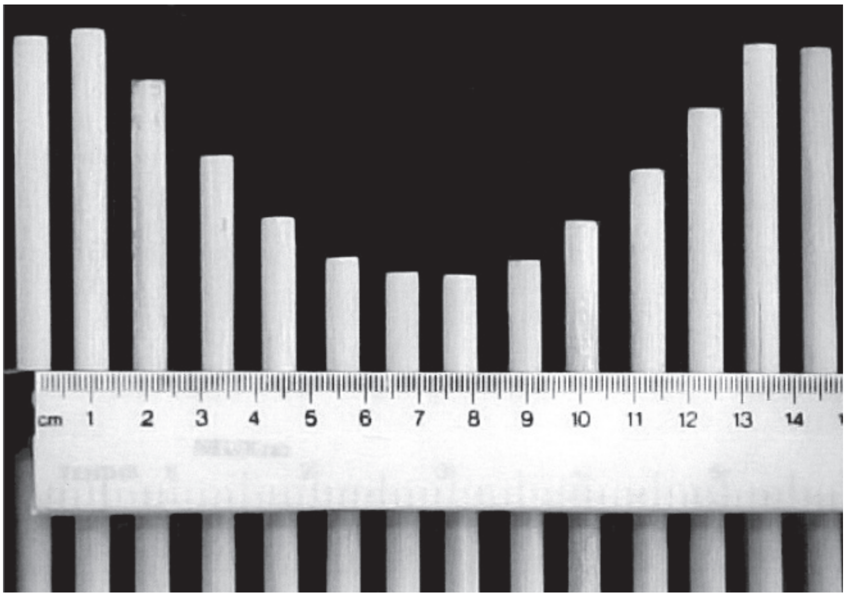
Leave blank

Answer ALL the questions.

For questions 1–4, select one answer from A to D and put a cross in the box (☒). If you change your mind, put a line through the box (☒) and then mark your new answer with a cross (☒).

1. The photograph shows a laboratory machine for illustrating a transverse wave. Beside the machine is a rule.



The best value of wavelength of this wave, in cm, is

☒ **A** 1.2

☒ **B** 7.0

☒ **C** 13.4

☒ **D** 14.0

Q1

(Total 1 mark)

Leave blank

2. A student checks the diameter of a ball bearing to verify the manufacturer's value. He records the following values:

5.1 mm, 5.0 mm, 5.0 mm

(i) the average value should be recorded as

☒ **A** 5.0 mm

☒ **B** 5.03 mm

☒ **C** 5.033 mm

☒ **D** 5.1 mm

(ii) The manufacturer's value for the diameter is 5.4 mm. This suggests

☒ **A** the student carrying out these measurements made random errors

☒ **B** the equipment used had a systematic error

☒ **C** the student needed to take more measurements with the same piece of equipment

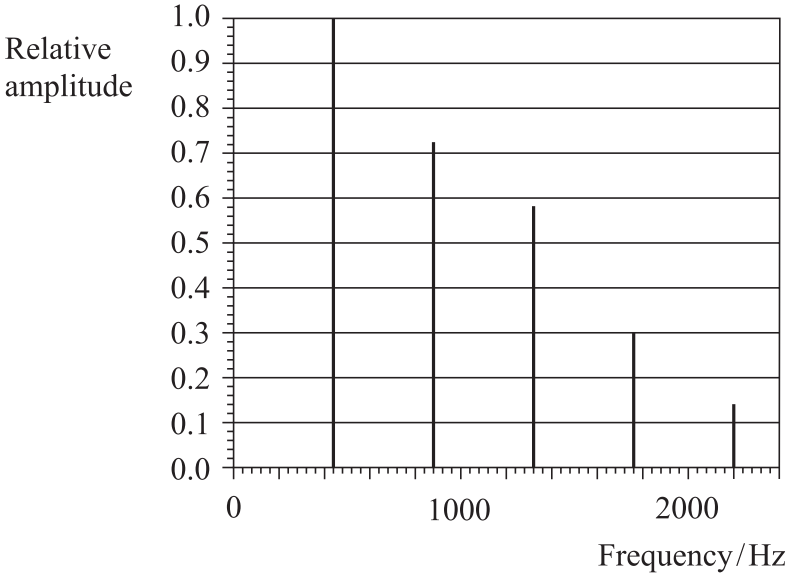
☒ **D** the equipment was not able to read better than 0.1 mm

Q2

(Total 2 marks)

Leave blank

3. The following frequency spectrum is displayed for a note played on a recorder.



The lowest frequency component of this note in Hz is

☒ **A** 100

☒ **B** 220

☒ **C** 420

☒ **D** 440

Q3

(Total 1 mark)

4. A voltmeter is specified as being accurate to within 2%.
The reading on the voltmeter is 3.50 V.
The maximum voltage represented by this reading is

☒ **A** 3.52 V

☒ **B** 3.57 V

☒ **C** 3.70 V

☒ **D** 7.00 V

Q4

(Total 1 mark)

Leave blank

5. A student wishes to design an experiment to compare the viscosity of two different types of engine oil. He only needs to decide which oil is more viscous. He does **not** need to measure their viscosities.

(a) Describe a simple experiment to achieve this aim.

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(2)

(b) State one variable you would have to keep constant in order to make this a fair test.

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(1)

(c) Suggest why it would be better to use the oil of lower viscosity to lubricate engines in vehicles used in a polar expedition.

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(1)

Q5

(Total 4 marks)

Leave blank

6. A student needs to determine the thickness of a coin. Describe an accurate method of achieving this.

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....

....

(Total 4 marks)

Q6

7. A student wishes to investigate how the speed of a wave along a slinky spring varies with the tension in the spring. She stretches the spring over a fixed distance. She then flicks the spring to produce a wave pulse and times how long the pulse takes to travel from one end to the other. She also measures the tension in the spring with a spring balance.

The student then increases the tension by reducing the number of coils of the slinky spring in the same fixed distance and repeats her measurements. She continues to repeat this procedure until she has several different sets of results of tension and timing for the wave.

(a) State how the student will calculate the speed of the wave from her results.

....

....

(1)

(b) State two improvements you could make to increase the accuracy of the time measurements.

1 ....

....

2 ....

....

(2)

Leave blank

(c) The equation relating speed of a wave with tension is

$$v = \sqrt{\frac{T}{\mu}}$$

where μ is the mass per unit length of the spring.

Even when the student's measurements are very accurate, she finds that a graph of v against $\sqrt{T}$ is not a straight line. Explain why the experiment as described cannot be used to confirm the expected relationship between speed of wave and tension.

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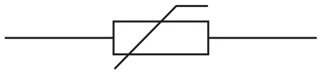
(2) **Q7**

(Total 5 marks)

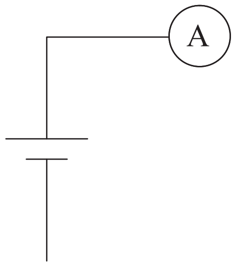
Leave blank

8. A student wishes to investigate how the electrical resistance of a thermistor changes with temperature.
The diagram shows the symbol for a thermistor.



(a) A student begins to draw a circuit diagram which could be used to determine the resistance of the thermistor.

(i) Complete this diagram.



(2)

(ii) State the measurements that you would take and show how you would use them to determine the resistance.

....

....

....

....

(2)

Leave blank

(b) (i) Draw a labelled diagram of the apparatus you would use to vary and measure the temperature of the thermistor.

(2)

(ii) Describe **one** safety precaution you would take when using this apparatus.

....

....

(1)

(c) State **one** application for a circuit which includes a thermistor.

....

....

(1)

Q8

(Total 8 marks)

Leave blank

9. A student investigates skateboarding down a slope. She times how long it takes her to skateboard between two lines on a sloping pavement. She varies the distance between the two lines and records her results in a table.

Distance s / m	Time t / s	
2	2.32	
4	4.23	
9	8.22	
11	9.53	

The student read that the equation which might relate to the motion of the skateboard is

$$s = ut + \frac{1}{2}at^2$$

(a) Criticise her set of measurements.

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....

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....

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....

....

(3)

Leave blank

(b) Plot a graph of *s*/*t* against *t*. Use the extra column in the table for your values of *s*/*t*.

(6)

(c) Use the equation to show that this graph should produce a straight line.

(1)

(d) Use your graph to calculate *a* and *u*.

(4)

Q9

(Total 14 marks)

TOTAL FOR PAPER: 40 MARKS

END

Formulae

Unit 1

Mechanics

Kinematic equation of motion	$v = u + at$
	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
Forces	$\Sigma F = ma$
	$g = F/m$
	$W = mg$
Work and energy	$\Delta W = F\Delta s$
	$E_k = \frac{1}{2}mv^2$
	$\Delta E_{grav} = mg\Delta h$

Materials

Stoke's law	$F = 6\pi\eta rv$
Hooke's law	$F = k\Delta x$
Density	$\rho = m/V$
Pressure	$p = F/A$
Young's modulus	$E = \sigma/\varepsilon$ where
	Stress $\sigma = F/A$
	Strain $\varepsilon = \Delta x/x$
Elastic strain energy	$E_{el} = \frac{1}{2}Fx$

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	$P = VI$
	$P = I^2R$
	$P = V^2/R$.
	$W = VIt$
	% efficiency = [useful energy (or power) output/total energy (or power) input] × 100%
Resistivity	$R = \rho l/A$
Current	$I = \Delta Q/\Delta t$
	$I = nqvA$

Quantum physics

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

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Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 P H 0 8 / 1	Signature	

Paper Reference(s)

6PH08/1

Edexcel GCE

Physics

Advanced

Unit 6B: Experimental Physics

Sample Assessment Material

International Alternative to Internal Assessment

Time: 1 hour 20 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
In calculations you should show all the steps in your working, giving your answer at each stage.
Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 4 questions in this question paper. The total mark for this paper is 40.
There are 16 pages in this question paper. Any blank pages are indicated.
The list of data, formulae and relationships is printed at the end of this booklet.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

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Answer ALL questions.

1. (a) A student is asked to determine the density of a wooden metre rule.

He is provided with

- vernier callipers, which measure to a precision of 0.01 cm
- an electronic balance which measures to a precision of 0.1 g.

The student records his measurements as follows:

Length of rule	$l = 1$ m
Width of rule	$w = 2.54$ cm
Thickness of rule	$t = 6.1$ mm
Mass of rule	$M = 127.4$ g

(i) Comment critically on these measurements.

....

....

....

(3)

(ii) Use this data to determine a value for the density of the rule.

Answer ....

(2)

(b) An aluminium cooking foil manufacturer states that the thickness of the foil is 15 µm.

You have a micrometer which can read to a precision of 0.01 mm.

(i) Describe how you would try to find an accurate value for the thickness of a sheet of the foil.

....

....

....

(2)

(ii) Estimate the percentage uncertainty of your value.

Answer .... %

(1)

Q1

(Total 8 marks)

Leave blank

2. (a) A mass of 200 g is suspended from the bottom end of a vertical spring.

Draw a diagram of the arrangement you would use to determine the extension x of the spring. You should indicate precisely how you determined the extension x.

(3)

(b) In such an experiment, the 200 g mass produces an extension of 214 mm. For the arrangement you have drawn above, estimate the percentage uncertainty in this extension.

Answer ....

(1)

Leave blank

(c) The 200 g mass is given a small vertical displacement and 20 oscillations are timed with a stopwatch. The table shows the results obtained.

$20T$/s	$20T$/s	Mean T/s
18.66	18.62	0.932

(i) Estimate the percentage uncertainty in the value for the period T.

Answer .... %

(1)

(ii) Use the data and the equation

$$g = \frac{4\pi^2 x}{T^2}$$

to determine a value for the gravitational field strength g.

Answer ....

(1)

(iii) Comment on this value for g in the context of the experimental uncertainties.

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....

....

(2)

Q2

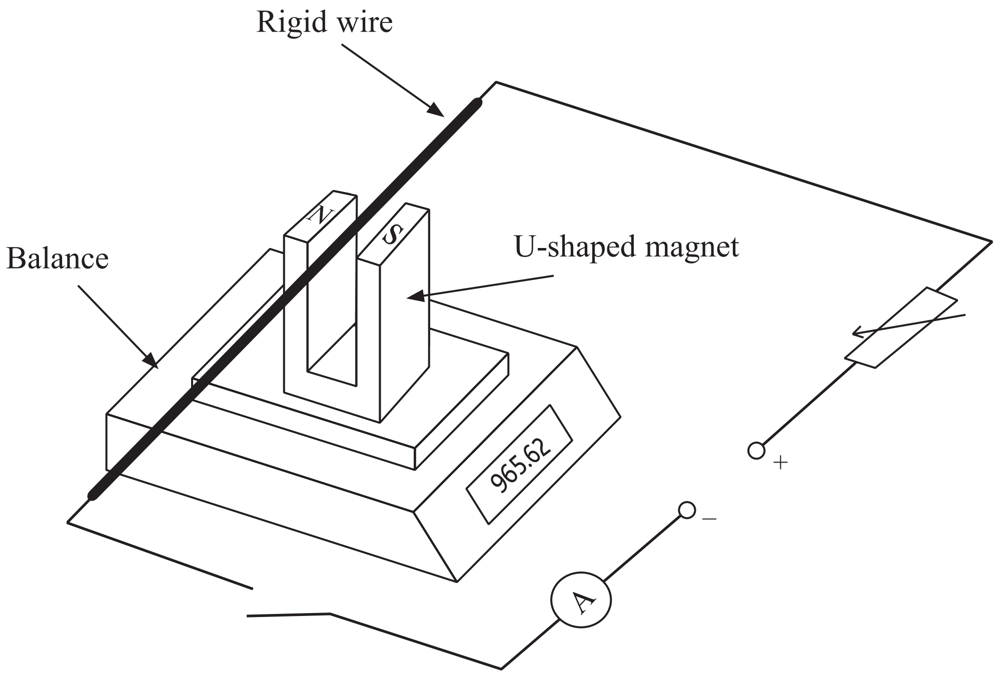
(Total 8 marks)

Leave blank

3. The force F acting on a length l of wire carrying a current I in a magnetic field of flux density B is given by

$$F = BIl\sin\theta$$

The diagram shows an arrangement for investigating this relationship. For clarity, the clamps supporting the rigid wire have been omitted.



(a) Add to the diagram to show

(i) precisely the length l that you would need to measure

(ii) that the angle θ is 90° in this arrangement.

(2)

(b) State what measurements you would need to take to determine the force F acting on the wire when there is a current I in the wire, and how you would use these measurements to calculate F.

....

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....

(2)

Leave blank

(c) The table shows data obtained from this arrangement.

I / A	1.0	1.5	2.0	2.5	3.0	3.5
F/ mN	18.6	27.3	35.7	44.1	52.3	60.5

(i) Plot a graph of *F* against *I* on the grid below.

(3)

(ii) Discuss the extent to which your graph confirms that $F \propto I$.

....

....

....

(1)

Q3

(Total 8 marks)

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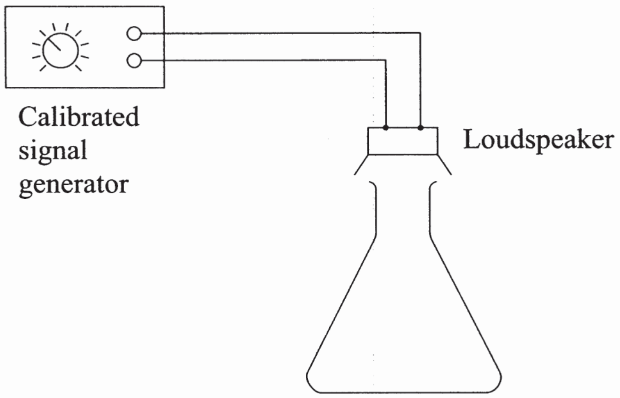
4. *You are to plan an investigation of how the frequency of vibration of air in a conical flask depends on the volume of air. You are then to analyse a set of data from such an experiment.*

A student blows directly into the neck of a conical flask and listens to the sound of the air vibrating. She then pours water into the flask until it is approximately half filled and blows into the flask as before. She observes that the pitch (frequency) of the vibrating air is noticeably higher when the flask is half full of water.

The student thinks that there might be a relationship between the natural frequency of vibration f of the air in the flask and the volume V of air in the flask of the form $f \propto V^n$ where n is a constant.

She sets up the following equipment to test this relationship.



(a) Describe how you would carry out this experiment to determine the natural frequency of vibration f for different volumes V of air in the flask. Explain clearly how you would determine V. Normal laboratory apparatus is also available.

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(4)

Leave blank

(b) The following data were obtained in such an investigation.

V/ cm^3	f/Hz		
554	219		
454	242		
354	274		
254	324		
204	361		
154	415		

(i) Explain how a graph of ln f against ln V can be used to test the proposed relationship, $f \propto V^n$, and to determine a value for the constant n.

....

....

....

....

(2)

(ii) Use the blank columns provided to tabulate values of ln f and ln V.

(2)

(c) Plot a graph of ln f against ln V on the axes opposite.

(4)

(d) (i) Use your graph to determine a value for n.

....

....

....

(2)

(ii) Explain **qualitatively** whether your value for n is consistent with the student's observations at the beginning of the question.

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Leave blank

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....

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....

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....

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(2)

Q4

(Total 16 marks)

TOTAL FOR PAPER: 40 MARKS

END

List of data, formulae and relationships

Mechanics

Kinematic equations of motion	$v = u + at$
	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
Forces	$\Sigma F = ma$
	$g = \frac{F}{m}$
	$W = mg$
Work and energy	$\Delta W = F\Delta s$
	$E_k = \frac{1}{2}mv^2$
	$\Delta E_{grav} = mg\Delta h$

Materials

Stokes' law	$F = 6\pi\eta rv$
Hooke's law	$F = k\Delta x$
Density	$\rho = \frac{m}{V}$
Pressure	$p = \frac{F}{A}$
Young's modulus	$E = \frac{\sigma}{\varepsilon}$ where
	Stress $\sigma = \frac{F}{A}$
	Strain $\varepsilon = \Delta\frac{x}{x}$
Elastic strain energy	$E_{el} = \frac{1}{2}Fx$

Waves

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

Electricity

Potential difference	$V = \dfrac{W}{Q}$
Resistance	$R = \dfrac{V}{I}$
Electrical power, energy and efficiency	$P = VI$
	$P = I^2R$
	$P = \dfrac{V^2}{R}$.
	$W = VIt$

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

Resistivity	$R = \dfrac{\rho l}{A}$
Current	$I = \dfrac{\Delta Q}{\Delta t}$
	$I = nqvA$

Quantum physics

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

Mechanics

Momentum	$p = mv$
Kinetic energy of a non-relativistic particle	$E_k = \frac{p^2}{2m}$
Motion in a circle	$v = \omega r$
	$T = \frac{2\pi}{\omega}$
	$F = ma = \frac{mv^2}{r}$
	$a = \frac{v^2}{r}$
	$a = r\omega^2$

Fields

Coulomb's law	$F = kQ_1Q_2/r^2$ where $k = \frac{1}{4}\pi\varepsilon_0$
Electric field	$E = \frac{F}{Q}$
	$E = \frac{kQ}{r^2}$
	$E = \frac{V}{d}$
Capacitance	$C = \frac{Q}{V}$
Energy stored in capacitor	$W = \frac{1}{2}QV$
Capacitor discharge	$Q = Q_0 e^{-t/RC}$
In a magnetic field	$F = BIl \sin\theta$
	$F = Bqv \sin\theta$
	$r = \frac{p}{BQ}$
Faraday's and Lenz's Laws	$\varepsilon = -d(N\Phi)/dt$

Particle physics

Mass-energy	$\Delta E = c^2\Delta m$
de Broglie wavelength	$\lambda = \frac{h}{p}$

Energy and Matter

Heating	$\Delta E = mc\Delta\theta$
Molecular kinetic theory	$\frac{1}{2} m\langle c^2\rangle = {}^3/_2\, kT$
Ideal gas equation	$pV = NkT$

Nuclear physics

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

Mechanics

Simple harmonic motion	$a = -\omega^2 x$
	$a = -A\omega^2 \cos \omega t$
	$v = A\omega \sin \omega t$
	$x = A\cos \omega t$
	$T = \frac{1}{f} = \frac{2\pi}{\omega}$
Gravitational force	$F = Gm_1m_2/r^2$

Observing the universe

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

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C Sample mark schemes

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Physics Specific Marking Guidance

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii)	Horizontal force of hinge on table top 66.3 (N) or 66 (N) **and** correct indication of direction [no ue] [Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]	✓	**1**

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. **Mark scheme format**
   - 1.1 Bold lower case will be used for emphasis.
   - 1.2 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
   - 1.3 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. **Unit error penalties**
   - 2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
   - 2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
   - 2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
   - 2.4 The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
   - 2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
   - 2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. **Significant figures**
   - 3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.
   - 3.2 Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
   - 3.3 Using $g = 10\ \text{m s}^{-2}$ will **not** be penalised.

4. **Calculations**
   - 4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
   - 4.2 If a 'show that' question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.
   - 4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.
   - 4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.
   - 4.5 The mark scheme will show a correctly worked answer for illustration only.

4.6 Example of mark scheme for a calculation:

<u>'Show that' calculation of weight</u> Use of L × W × H Substitution into density equation with a volume and density Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] [Allow 50.4(N) for answer if 10 N/kg used for g.] [If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] [Bald answer scores 0, reverse calculation 2/3] Example of answer: 80 cm × 50 cm × 1.8 cm = 7200 cm^3 7200 cm^3 × 0.70 g cm^{-3} = 5040 g 5040 × 10^{-3} kg × 9.81 N/kg = 49.4 N	 ✓ ✓ ✓	**3**

5. Quality of Written Communication

5.1 Indicated by QWC in mark scheme, placed as first mark.

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.
- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Unit 3B: Exploring Physics

Question Number	Question	
1	The best value of this wavelength, in cm, is	
	Answer	**Mark**
	C	**1**

Question Number	Question	
2 (a)	The average value should be recorded as	
	Answer	Mark
	A	**1**

Question Number	Question	
2 (b)	The manufacturer's value for the diameter is 5.4 mm. This suggests	
	Answer	Mark
	B	**1**

Question Number	Question	
3	The lowest frequency component of this note in Hz is	
	Answer	**Mark**
	D	**1**

Question Number	Question	
4	The maximum voltage represented by this reading is	
	Answer	**Mark**
	B	**1**

Question Number	Question	
5 (a)	Describe a simple experiment to achieve this aim.	
	Answer	**Mark**
	Use of ball bearing falling through fluid Time it takes to fall a certain distance or Method of control outlet of each oil [accept diagram] Eg through a funnel connected to capillary tube (redwood viscometer) Or cylinder of oil lifted abruptly (line spread test) Timing of fluid flow Eg how long it takes to spread out to certain radius Or time to reach certain position in capillary	**1** **1** **1** **1** **2 max**

Question Number	Question	
5 (b)	State one variable you would have to keep constant in order to make this a fair test.	
	Answer	**Mark**
	Temperature / same diameter capilliary tube/ same head of oil	**1**

Question Number	Question	
5 (c)	Suggest why it would be better to use the oil of lower viscosity to lubricate engines in vehicles used in a polar expedition.	
	Answer	**Mark**
	Any sensible comment including temperature	**1**

Question Number	Question	
6	A student needs to determine the thickness of a coin. Describe an accurate method of achieving this.	
	Answer	**Mark**
	Use micrometer Measure thickness of several coins Divide overall thickness / number used Measure thickness in more than one place on coin Check micrometer reading 0	**1** **1** **1** **1** **1** **4 max**

Question Number	Question	
7 (a)	State how the student will calculate the speed of the wave from her results.	
	Answer	**Mark**
	Use speed = (fixed) distance / time	**1**

Question Number	Question	
7 (b)	State two improvements you could make to improve the accuracy of the time measurements	
	Answer	**Mark**
	Start timing the reflection of the wave rather than the outgoing wave Time the wave over more than one fixed distance ie use reflections Repeat measurements and division	**1** **1** **1** **2 max**

Question Number	Question	
7 (c)	Explain why the experiment described does not confirm the expected relationship between speed of wave and tension.	
	Answer	**Mark**
	Not all other variables have been kept constant μ has changed / mass per unit length has been changed	**1** **2** **2 max**

Question Number	Question	
8 (a) (i)	Complete this diagram.	
	Answer	**Mark**
	Thermistor in series with ammeter Voltmeter in parallel with thermistor	**1** **1**

Question Number	Question	
8 (a) (ii)	State the measurements that you would take and show how you would use them to determine the resistance.	
	Answer	**Mark**
	Voltage and current Resistance = V / I	**1** **1**

Question Number	Question	
8 (b) (i)	Draw a diagram of the apparatus you would use to vary and measure the temperature of the thermistor.	
	Answer	**Mark**
	Beaker and water Heat water with Bunsen / use hot water from kettle Temperature of water with thermometer	**1** **1** **1** **2 max**

Question Number	Question	
8 (b) (ii)	Describe **one** safety precaution you would take with the method you described in b(i).	
	Answer	Mark
	Do not spill hot water Take care with bunsen Do not place apparatus near edge of bench Use appropriate thermometer	**1** **1** **1** **1** **1 max**

Question Number	Question	
8 (c)	State **one** application for a circuit which includes a thermistor	
	Answer	**Mark**
	Temperature sensor	**1**

Question Number	Question	
9 (a)	Criticise her set of measurements.	
	Answer	**Mark**
	Only four sets should be at least six No repeats Large gap between 4 and 9 could insert more values in between Distances measured to nearest m rather than nearest cm	**1** **1** **1** **1** **3 max**

Question Number	Question	
9 (b)	Plot a graph of *s*/*t* against *t*.	
	Answer	**Mark**
	four correct values of s/t units of this column in table or on graph : m/s axes s/t : y axis ; t : x axis x axis scales suitable ie points occupy more than half grid (allow y axis to start at origin in this case) points plotted correctly straight line through points	**1** **1** **1** **1** **1** **1** **6**

Question Number	Question	
9 (c)	Use the equation on page 10 to show that this graph should produce a straight line.	
	Answer	**Mark**
	Show division by t and compare with y = mx +c	**1**

Question Number	Question	
9 (d)	Use the graph to calculate *a* and *u*.	
	Answer	**Mark**
	Attempt to find gradient of graph a = 0.075 – 0.085 u = 0.75 – 0.8 units of u : ms^{-1} and a :ms^{-2}	**1** **1** **1** **1**

Unit 6B: Experimental Physics

Question Number	Question	
1 (a) (i)	Comment critically on these measurements.	
	Answer	**Mark**
	Precision of *l* No zero error No repeats (Allow mixture of units) Any (3)	**3**

Question Number	Question	
1 (a) (ii)	Use this data to determine a value for the density of the rule.	
	Answer	**Mark**
	Consistent substitution into correct equation e.g. $\text{Density} = \dfrac{127.4\text{ g}}{100\text{ cm} \times 2.54\text{ cm} \times 0.61\text{ cm}}$ Value of density correctly calculated to 2 sf with unit e.g. Density = 0.82 g cm^{-3}	**2**

Question Number	Question	
1 (b) (i)	Describe how you would try to find an accurate value for the thickness of a sheet of the foil.	
	Answer	Mark
	fold several times to find *t* Compress to remove air $\geq 8t$ (in description or calculation)	**2**

Question Number	Question	
1 (b) (ii)	Estimate the percentage uncertainty of your value.	
	Answer	Mark
	Correct % uncertainty using 0.01 or 0.02 mm as uncertainty e.g. % uncertainty = $\dfrac{0.01 \times 10^{-3}\text{ m}}{8 \times 15 \times 10^{-6}\text{ m}} \times 100\%$ = 8%	**1**

Question Number	Question	
2 (a)	A mass of 200 g is suspended from the bottom end of a vertical spring. Draw a diagram of the arrangement you would use to determine the extension x of the spring. You should indicate precisely how you determined the extension x.	
	Answer	Mark
	Correct set-up with clamped spring and clamped metre rule Difference method clearly indicated Correct use of set square, *either* to ensure rule vertical *or* for determining the height	**3**

Question Number	Question	
2 (b)	In such an experiment, the 200 g mass produces an extension of 214 mm. For the arrangement you have drawn above, estimate the percentage uncertainty in this extension.	
	Answer	Mark
	Δx = 1 mm or 2 mm and correct % calculation e.g. % uncertainty = $\frac{1\text{ mm}}{214\text{ mm}} \times 100\%$ = 0.5%	**1**

Question Number	Question	
2 (c) (i)	Estimate the percentage uncertainty in the value for the period T.	
	Answer	**Mark**
	$\Delta 20T$ = 0.5 – 1.0 s [reaction time] leading to correct % e.g. % uncertainty = $\frac{0.5\text{ s}}{18.64\text{ s}} \times 100\%$ = 3%	**1**

Question Number	Question	
2 (c) (ii)	Use the data and the equation $$g = \frac{4\pi^2 x}{T^2}$$ to determine a value for the gravitational field strength g	
	Answer	**Mark**
	Correct calculation of g [9.73 N kg^{-1}] to 2/3 sf + unit	**1**

Question Number	Question	
2 (c) (iii)	Comment on this value for g in the context of the experimental uncertainties.	
	Answer	**Mark**
	% uncertainty in T^2 = 2 × % uncertainty in T Add % uncertainties e.g. 2 × 3% + 0.5% = 6.5%	**2**

Question Number	Question	
3 (a) (i)	Add to the diagram to show precisely the length *l* that you would need to measure	
	Answer	**Mark**
	l shown as length of pole pieces	**1**

Question Number	Question	
3 (a) (ii)	that the angle θ is 90° in this arrangement..	
	Answer	**Mark**
	Field lines shown perpendicular to wire	**1**

Question Number	Question	
3 (b)	State what measurements you would need to take to determine the force *F* acting on the wire when there is a current *I* in the wire, and how you would use these measurements to calculate *F*.	
	Answer	**Mark**
	Record balance reading without *I* and then with *I* [or tare] Multiply difference by *g* [or use balance calibrated in N]	**2**

Question Number	Question	
3 (c) (i)	Plot a graph of *F* against *I* on the grid below.	
	Answer	**Mark**
	Sensible scale Axes labelled, with units Accurate plots and neat, straight line *not* through origin	**3**

Question Number	Question	
3 (c) (ii)	Discuss the extent to which your graph confirms that $F \propto I$.	
	Answer	**Mark**
	Graph should be *straight line through origin*, so possibly a small *systematic error* [both points needed]	**1**

Question Number	Question	
4 (a)	Describe how you would carry out this experiment to determine the natural frequency of vibration *f* for different volumes *V* of air in the flask. Explain clearly how you would determine *V*. Normal laboratory apparatus is available is also available.	
	Answer	**Mark**
	Use of measuring cylinder Fill flask with water to find volume Suitable method to find volume of air Adjust frequency until loud note [resonance] is heard	**4**

Question Number	Question	
4 (b) (i)	Explain how a graph of ln *f* against ln *V* can be used to test the proposed relationship, $f \propto V^n$, and to determine a value for the constant n.	
	Answer	**Mark**
	Correct expansion: $F = kV^n \Rightarrow \ln f = n \ln V + \ln k$ Graph of ln *f* against ln *V* is straight line (of gradient *n*)	**2**

Question Number	Question	
4 (b) (ii)	Use the blank columns provided to tabulate values of ln *f* and ln *V*.	
	Answer	**Mark**
	Correct units, e.g. ln (*f* / Hz) ln *f* and ln *V* values correct to 3 or 4 sf	**2**

Question Number	Question	
4 (c)	Plot a graph of ln *f* against ln *V* on the axes opposite.	
	Answer	**Mark**
	Sensible scale Axes labelled with units (ecf) Accurate plots Neat straight line of best fit	**4**

Question Number	Question	
4 (d) (i)	Use your graph to determine a value for n.	
	Answer	**Mark**
	Large triangle (one side at least 8 cm) Correct gradient given to 2 or 3 sf [0.49 – 0.51]	**2**

Question Number	Question	
4 (d) (ii)	Explain **qualitatively** whether your value for n is consistent with the student's observations at the beginning of the question.	
	Answer	**Mark**
	Negative sign for *n* Negative value of *n* related to initial observation	**2**

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