Mark Scheme (SAM)

Pearson Edexcel International Advanced Subsidiary in Physics

Unit 3: Exploring Physics

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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.

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Further notes

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.

Mark scheme format

1. You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the mark scheme has specified specific words that must be present. Such words will be indicated by underlining, e.g. '<u>resonance</u>'.
2. Bold lower case will be used for emphasis.
3. Round brackets ( ) indicate words that are not essential, e.g. '(hence) distance is increased'.
4. Square brackets [ ] indicate advice to examiners or examples, e.g. [Do not accept gravity] [ecf].

Unit error penalties

1. A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.
2. Incorrect use of case, e.g. 'Watt' or 'w' will **not** be penalised.
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, for example in a spreadsheet.
4. The same missing or incorrect unit will not be penalised more than once within one question (one clip in e-pen).
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.
6. The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

Significant figures

1. Use of an inappropriate number of significant figures (sf) 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.
2. The use of g = 10 m s^{-2} or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will be penalised by one mark (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}.

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Calculations

1. Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
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.
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. **Recall** of the correct formula will be awarded when the formula is seen or implied by substitution.
5. The mark scheme will show a correctly worked answer for illustration only.
6. Example of mark scheme for a calculation:

'Show that' calculation of weight Use of L × W × H Substitution into density equation with a volume and density Correct answer [49.4 (N)] to at least 3 significant figures [No ue] [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)**

Graphs

1. A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.
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.
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.
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.
5. For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

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Section A

Question Number	Answer	Mark
1	B	**(1)**
2	D	**(1)**
3	C	**(1)**
4	B	**(1)**
5	C	**(1)**

Total for Section A = 5 Marks

Section B

Question Number	Answer	Mark
6	**Student A** Micrometer can measure to 0.01 mm **or** 0.001 mm **(1)** This gives uncertainty of 0.01/20 (0.05%) **or** 0.001/20 (0.005%) **(1)** **Student B** The idea that uncertainty is 1 mm in 200 mm (0.5%) **(1)** [allow ecf in calculation for marks 2 and 3] **Any one from** Measuring 10 gives average for all coins **or** measuring one coin several times across different diameters gives an average **(1)** One coin may be abnormal **or** all coins may not be identical **(1)** [Do not allow comments about cost, complexity, parallax, zero error or skill]	**(4)**
	Total for Question 6	**(4)**

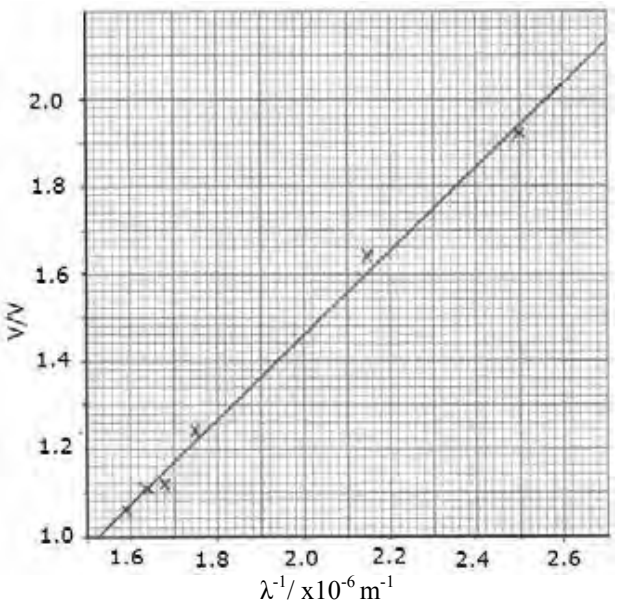
Question Number	Answer	Mark
7(a)	*Draw a labelled diagram of the experimental set-up to be used* Diagram of a workable set-up **(1)** [will include spring, mass/weight and support] rule [shown on diagram or mentioned in text] **(1)**	**(2)**
7(b)	*List any additional apparatus you might need* Appropriate additional apparatus **(1)** [e.g. set square, pin, balance] [This may appear later or earlier in the answer.]	**(1)**
7(c)	*State what quantity is the independent variable and what quantity is the dependent variable* **(1)** Mass/weight/force **and** extension/length **(1)**	**(2)**
7(d)	*Describe how you would take your measurements and explain your choice of measuring instruments* Describes measuring length/distance using metre rule **(1)** Describes how to determine extension **(1)** Explanation of how force is varied **Or** Explanation of how mass varied and hence force determined **(1)** Choice of a measuring instrument with reference to scale (precision or range) **(1)**	**(4)**

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Question Number	Answer	Mark
7(e)	*Explain how the data collected will be used to find the spring constant* Plot force/mass against extension/length **(1)** Explain how **this** graph is used to determine the force constant **(1)**	**(2)**
7(f)	*Identify the main sources of uncertainty and/or systematic error* **Maximum 1** Reference to measurement of length or extension, e.g. parallax, small measurement, zero error **(1)** Comment on not exceeding elastic limit **(1)**	**(1)**
7(g)	*Comment on safety* Sensible identification of risk **and** precaution **(1)** [e.g. risk from falling weights so use foot protection, risk from breaking spring so use goggles]	**(1)**
	Total for Question 7	**(13)**

This question has to be marked holistically and in the context of the experiment described.

Question Number	Answer	Mark
8(a)	Unit which is a reciprocal of length **(1)** Power of 10 corresponding to unit **(1)** Examples **Power of 10** / **Unit** 10^{-3} / nm^{-1} none / μm^{-1} 10^{3} / mm^{-1} 10^{6} / m^{-1} 10^{12} / Mm^{-1} 3 correct values to 3 sig fig (including 2.50) **(1)** Example Wavelength/nm / Potential difference/V / Wavelength^{-1}/ **x10^{6} m^{-1}** 630 / 1.06 / 1.59 610 / 1.11 / 1.64 595 / 1.12 / 1.68 570 / 1.24 / **1.75** 465 / 1.64 / **2.15** 400 / 1.92 / **2.50**	**(3)**
8(b)	Use of $c = f\lambda$ and explicit or implicit comparison to $y = mx$ or $y = mx+c$ **(1)** Statement that *h, c* and *e* are constants therefore straight line (through origin) **(1)** **Or** *hc/e* is constant therefore straight line (through origin) Identification of *hc/e* as gradient **(1)**	**(3)**

Question Number	Answer	Mark
8(c)	Axes labelled **(1)** With units (allow ecf from (a)) **(1)** Sensible scales **(1)** Correct plotting of candidate's data from table **(1)** Best fit line **(1)**  	**(5)**
8(d)	Gradient from triangle using more than half the drawn line in either direction **(1)** Points read correctly from graph **(1)** Correct calculation of gradient (ignore powers of 10) (expect answer in range 0.9 to 1.1) **(1)** Use of gradient = hc/e **(1)** Value for h in range 4.8×10^{-34} to 5.9×10^{-34} (consistent with the power of 10 on the gradient) **(1)** 2 or 3 sig fig and unit **(1)** Example of calculation 0.97×10^{-6} V m x 1.60×10^{-19} C /3.00×10^{8} m s^{-1} = 5.2×10^{-34} J s	**(6)**
8(e)	**Maximum 1** Hard to judge when LED just lights **(1)** No repeated results **(1)** Should have checked/measured wavelengths **(1)** Allow any sensible physics alternatives For example: Systematic/zero error on voltmeter **(1)** Parallax error of (analogue) voltmeter **(1)** Random errors in voltmeter reading **(1)** [Do not allow: resistance of either LEDs or wires as p.d. is measured directly across the LED, unspecified errors in the voltmeter/voltmeter reading]	**(1)**
	Total for Question 8	**(18)**

Total for Section B = 35 Marks

Total for Paper = 40 Marks

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