Mark Scheme (FINAL)

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GCE

GCE Physics (6732/01)

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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.

Mark scheme notes

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] ✓ **1**
[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.]

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 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'
1.2 Bold lower case will be used for emphasis.
1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
1.4 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] **3**
[Bald answer scores 0, reverse calculation 2/3]

Example of answer:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme, placed as first mark.
5.2 Usually it is part of a max mark.
5.3 In SHAP marks for this are allocated in coursework only but this does not negate the need for candidates to express themselves clearly, using appropriate physics terms. Likewise in the Edexcel A papers.

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.

Question Number	Answer	Mark
1 (a)	Current decrease Temperature (of fuse) increase **(1)** Resistance (of fuse) increases **(1)**	2
(b)	Charge calculation Use of charge = current x time **(1)** Attempt to find area of graph **(1)** Charge = 45 C **(1)** [accept As for unit] [answer of 50 C i.e. 2.5 × 20, scores 1st mark only] **Example of answer** Charge = area under graph Charge = ½ (2.5 A + 2.0 A) × 20 s Charge = 45 C	3
	Total for question	**5**

Question Number	Answer	Mark
2 (a) (i)	Resistance of lamp working normally Use of $V=IR$ **(1)** Resistance of lamp = 12 Ω **(1)** **Example of answer** $R_{lamp} = 3.0\ V \div 0.25\ A$ $R_{lamp} = 12\ \Omega$	**2**
(ii)	Resistance of R pd across R = 6 V **(1)** Resistance of R = 24 Ω **(1)** **OR** resistance calculation whole circuit = 36 Ω **(1)** $R = 36 - 12 = 24\ \Omega$ (ecf candidates' R_{lamp}) **(1)** **Example of answer** $V_R = 9.0\ V - 3.0\ V = 6\ V$ $R = 6\ V \div 0.25\ A$ $R = 24\ \Omega$	**2**
(b) (i)	Total resistance Use of $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ with 20 Ω and their answer to (a)(i) **(1)** Resistance of parallel combination (7.5 Ω) **(1)** Addition of 15 Ω to a parallel combination attempt **(1)** **(** correct answer is 22.5 Ω)	**3**
(ii)	Explanation Second circuit has lower total resistance **OR** first circuit has higher total resistance**(1)** $P = V^2/R$ and V constant for both circuits **(1)** First circuit dissipates the lower power **(1)** (3rd mark conditional on one of the other two marks being scored) (candidates who use $P = I^2 R$ score max 1 for the resistance statement) OR Second circuit has larger total current **OR** first circuit has lower total current**(1)** P = VI and V constant for both circuits **(1)** First circuit dissipates the lower power **(1)** (3rd mark conditional on one of the other two marks being scored) OR Correct calculation of powers 2.25 W and 3.6 W scores max 1 (Candidates' answer for (b)(ii) must be consistent with the numerical calculations in earlier parts)	**3**
	Total for question	**10**

Question Number	Answer	Mark
3 (a)	• Component A: Any one; metallic resistor, wire, fuse wire, lamp **(1)** • Component B: thermistor, diode **(1)**	**2**
(b)	• Increasing temperature leads to increase in ions/atoms/particles/molecules vibrations/oscillations **(1)** • reducing drift velocity (of charge carriers) **(1)** (first two marks can be scored even if candidate thinks this only applies to component A) • (But for) component B the increase in temperature increases the number of charge carriers **(1)** • Increase in n greater than decrease in v **(1)** • Qowc **(1)**	**5**
	Total for question	**7**

Question Number	Answer	Mark
4(a) (i)	<u>Diagram</u> Labelled trapped mass of gas **(1)** Volume scale OR means of varying the pressure **(1)** Pressure gauge **(1)** (only mark experiment setups that would work)	3
(ii)	<u>Constants</u> Mass of gas OR number of moles OR number of molecules **(1)** Trapped in container OR sealed apparatus **(1)** [**NOT**; same amount of oil each time] Temperature (of gas) **(1)** Experiment done slowly/ readings taken after time to allow temperature to adjust **(1)** **[NOT;** experiment done at room temperature]	4
(b)(i) and (ii)	<u>graph</u> Plot V against 1/p OR p against 1/V **(1)** Graph should pass through the origin **(1)** **OR** Plot pV against V or pV against p **(1)** Horizontal line **(1)** **OR** lg p against lg V **(1)** Gradient = -1 and finite intercept **(1)**	2
	Total for question	**9**

Question Number	Answer	Mark
5(a)(i)	<u>Current</u> Current in one lamp 0.5 A **(1)** Current in battery 2.0 A (ecf current for 1 lamp) **(1)** **Example of answer** $I = P \div V = 6\text{ W} \div 12\text{ V} = 0.5\text{ A}$ Current in battery = 4 × 0.5 A = 2.0 A	**2**
(ii)	<u>Combined resistance</u> Method 1 Calculation of current through one lamp **(1)** Substitution of 2× candidates current in $R = V/I$ **(1)** Answer = 1.5 Ω **(1)** **OR** Method 2 Total power = 96 W **(1)** Use of $R = V^2/P$ **(1)** Answer = 1.5 Ω **(1)** **OR** Method 3 Use of $R = V^2/P$ to find resistance of one lamp **(1)** Use of resistors in parallel formula (ecf their value for one lamp)**(1)** Answer = 1.5 Ω **(1)** **Example of answer** Total power = 2 × 48 W = 96 W $R = V^2 \div P = (12\text{ V})^2 \div 96\text{ W}$ $R = 1.5\ \Omega$	**3**
(b)	<u>Small internal resistance of car</u> Large current needed (to start car) **(1)** Small internal resistance reduces the lost volts **OR** maximises terminal p.d. **OR** reference to I = E / (R +r) equation to justify max I (can be rearranged) **OR** reference to V = E – Ir to justify max V.**(1)** (do not credit reference to I = V/R)	**2**
	Total for question	**7**

Question Number	Answer	Mark
6(a)	Specific latent heat Energy/unit mass required **(1)** to change a solid to a liquid **(1)** At constant temperature **(1)** (equation with symbols defined scores 1st mark)	3
(b)(i)	Labelled diagram Heater connected to power supply and switch **(1)** Ammeter in series and voltmeter in parallel OR use of joulemeter **(1)**	2
(ii)	Apparatus Balance or measuring cylinder **(1)** Stopwatch/ timer/clock **(1)** **(** if more than two items listed mark the first two)	2
(iii)	Heater not turned on To allow heater to reach temperature of the ice **(1)** Or until ice has reached its melting point Or until state of equilibrium is reached	1
(iv)	Calculation (Turn on heater and) record current, potential difference and time**(1)** Find the masses of water collected from both funnels **(1)** Subtract mass collected from funnel without a heater from the one with a heater **(1)** Use $\Delta m\, L = V\, I\, t$ **(1)** **(2nd and 3rd marks:** candidates who ignore 2nd beaker and find mass of ice before and after heating can score 1 mark)	4
	Total for question	**12**

Question Number	Answer	Mark
7(a)(i)	Symbols ΔU increase/gain in internal energy (of system) **(1)** ΔQ thermal energy given to (system) or energy gained by heating **(1)** ΔW work done on the system **(1)** **(**ΔU is change in internal energy, ΔQ is energy due to heating and ΔW is energy due to work i.e. **all three correct** but underlined words missing can score max 1)	3
(ii)	Effect on ΔQ and ΔW ΔQ and ΔW are equal and opposite **(1)** (ΔQ = - ΔW)	1
(b)(i)	Temperature calculation Record a pair of values from the graph and convert kPa to Pa **(1)** Use of $pV = nRT$ **(1)** Temperature = 297 K (accept 290 K to 300 K) **(1)** (use of 50 kPa and 0.025 m^3, i.e. finding ΔP and ΔV, gives 206K; scores 1/3) **Example of answer** $T = (pV) \div (nR)$ $T = (90 \times 10^3 \text{ Pa} \times 0.020 \text{ m}^3) \div (0.73 \text{ mol} \times 8.31 \text{ J K}^{-1} \text{ mol}^{-1})$ T = 296.7 K	3
(b)(ii)	Temperature at Z Record two values of volume from horizontal part of graph **(1)** Use $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ **(1)** Temperature = 644 K to 667 K **(1)** OR Takes P and V values at Z (40 kPa, 0.1 m^3) **(1)** Use of $pV = nRT$ **(1)** Temperature = 659K **(1)** OR use $\frac{P_1V_1}{T_2} = \frac{P_2V_2}{T_2}$ for any point on graph + Z Temperature = 644 K to 667 K Temperature = 644K to 667K **Example of answer** $T_2 = (V_2 T_1) \div V_1$ $T_2 = (0.100 \text{ m}^3 \times 297 \text{ K}) \div 0.045 \text{ m}^3$ T_2 = 660 K	3
	Total for question	**10**