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Mark Scheme Final
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GCE

GCE Physics (6732/01)

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These instructions should be the first page of all 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 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 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:

'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 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]	✓	**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

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)(i)	Resistance of ammeter is zero/0/0Ω [do not accept negligible or a low numerical value]	**1**
(ii)	Current passes through ammeter **or** ammeter in series in circuit. (1) p.d. **or** power loss across ammeter needs to be zero, negligible or <u>very</u> small **or** it does not reduce the current it is measuring (1) **OR** If A had resistance it would reduce the current it is meant to be measuring (1)	**2**
(b)(i)	Resistance of voltmeter is infinite (symbol acceptable) [do not accept very high or large numerical value]	**1**
(ii)	Voltmeter in parallel **or** across component **or** it provides alternative path. (1) Current in voltmeter needs to be zero, negligible or <u>very</u> small **or** it does not reduce the pd it is measuring(1) **OR** If V had a lower resistance it would reduce the pd it is meant to be measuring (1)	**2**
	total	**(6)**

Question Number	Answer	Mark
2(a)	*n* is (number of) charge carriers per unit volume **or** number density **or (**number of) charge carriers m^{-3} **or** charge carrier density(1) [allow electrons] *v* is drift speed **or** average velocity **or** drift velocity (of the charge carriers) (1) [just speed or velocity scores zero]	**2**
(b)	*I* A and *Q* A s **or** *I* C s^{-1} and *Q* C (1) *n* m^{-3} (1) *A* m^2 and *v* m s^{-1} (1) [If no equation written assume order is that of equation]	**3**
(c)(i)	*n I* and *Q* Need all three	**1**
(ii)	Ratio v_A / v_B less than 1 following sensible calculation (1) Ratio = ¼ //0.25 // 1:4 (1) (ratio 4:1 scores 1) [$4v_A$:$1v_B$ scores 1]	**2**
	Total	**8**

Question Number	Answer	Mark
3(a)	Use of $P = IV$ (1) Current in lamp A = 2 A (1) [0.5 A scores zero unless 24 = I x 12 seen for 1st mark]	 **2**
	Example of answer $I = P \div V$ = 24 W ÷ 12 V I = 2 A	
(b)(i)	Voltmeter reading = 12 V (1)	**1**
(ii)	p.d. across R_2 = 6 V **or** their b(i) minus 6V(1) Use of $R = V/I$ (1) conditional on first mark R_2 = 2 Ω (1) Answer to this part must be consistent with voltmeter reading and if voltmeter reading is wrong this part has a max 2. If b(i) = 15 V then need to see 9/3=3Ω. (2/3) If b(i) = 6V or less they are going to score zero for this section.	 **3**
(iii)	current through R_1 = 5 A (1) ecf answers from (a)	**1**
	Example of answer Current through R_1 = 2 A + 3 A = 5 A	
(iv)	p.d. across R_1 = 3 V (1) ecf (15V minus their b(i))	**1**
	Example of answer p.d. across R_1 = 15 V – 12 V = 3 V	
(v)	R_1 = 0.6 Ω (1) ecf from (iii) and (iv)	**1**
	Example of answer R_1 = 3 V ÷ 5 A = 0.6 Ω [accept fraction 3/5Ω for this mark]	
		9

Question Number	Answer	Mark
4(a)(i)	EI (1)	**1**
(ii)	I^2R (1)	**1**
(iii)	I^2r (1)	**1**
(b)	$EI = I^2 R + I^2 r$ **or** $E = IR + Ir$ ecf Must use values a(i)-(iii)	**1**
(c)	Any value greater than or equal to 1 MΩ (1) I for circuit given by $I_{max} = E / r$ **or** substitution of 5000V into the equation(1) (for safety) need I to be as small as possible (1)	**3**
		9

Question Number	Answer	Mark
5(a)	Use of energy = power x time (1) 6000 J (1)	**2**
	Example of answer Energy = 200 W × 30 s Energy = 6000 J	
(b)	Conversion g to kg (1) Use of $E = mc\Delta\theta$ (1) $\Delta\theta$ = 784 °C / K (1) Temperature = 804 ^{0}C (1) full ecf their value E [subtract 20 →764 ^{O}C 3/4]	**4**
	Example of answer $\Delta\theta = 6000 \text{ J} \div (15 \times 10^{-3} \text{ kg} \times 510 \text{ J kg}^{-1} \text{ K}^{-1})$ $\Delta\theta$ = 784 °C Max temperature = 784 °C + 20 °C = 804 °C	
	Assumption: a statement that implies that all of the energy has been transferred to the drill bit	**1**
(c)	A statement that implies that some of the energy is being transferred to the wall, the motor, the rest of the drill, the air or to sound (1) [NOT KE of the drill bit or comment that negates assumption Do not allow energy goes to the surroundings]	**1**
		8

Question Number	Answer	Mark
6(a)(i)	Reference to a temperature related gas law (1) [V/T = constant **or** p/T = constant **or** pV/T = constant **or** pV = nRT; just symbols acceptable or word equivalent but not Pressure law or Charles' law] At absolute zero, V = zero **or** p = zero **or** pV = zero (1)	**2**
(ii)	Kinetic energy of molecules is proportional/α to temperature **or** at absolute zero the molecules have no kinetic energy (1) [do not accept depends on, is related to etc] (implies) at absolute zero molecules stationary **or** not moving **or** still **or** speed / rms of molecules is zero(1) [If particles/atoms used for both statements 1/2]	**2**
(b)	Kelvin [absolute thermodynamic scale]	**1**
(c)(i)	Use of $pV = nRT$ (1) Use of 300 K (1) n = 4.0 moles (1) mass of air = 0.12 kg (1) ecf their n [If no temp conversion n = 45 moles, mass = 1.3 kg scores 2/4]	**4**
	Example of answer $n = (1.0 \times 10^5\ \text{Pa} \times 0.10\ \text{m}^3) \div (8.31\ \text{J K}^{-1}\ \text{mol}^{-1} \times 300\ \text{K})$ n = 4.0 moles mass of air = 4.0 moles × 0.029 mole kg^{-1} = 0.12 kg	
(ii)	nT = constant **or** ρT = constant **or** calculation of initial density (1) correct use of above equations using Kelvin temperatures **or** calculation of final density (1) ratio = 3/5 or 0.6 (1) consequent on gaining method marks [ratio of 1.7 or 5/3 could score 2]	**3**

	• [calculation of new mass in oven = 0.072 kg scores 1] • • [If Kelvin not used in (c)(i) do not penalise here. Ratio is 0.12 – again consequent on method marks] •	
•	• Example of answer • $227^{o}C = 500\ K \quad 27^{o}C = 300\ K$ • ρT = constant • $\rho_{500} / \rho_{300} = 300 \div 500 = 0.6$	•
•	•	• **12**

Question Number	Answer	Mark
7(a)(i)	Volume of gas (1) amount of gas **or** mass of gas **or** number of moles of gas(1)	**2**
(ii)	**Suitable diagram** to include following **labelled** items (Trapped) mass of gas (1) method of indirectly heating gas (1) pressure gauge/reader/scale/mercury manometer (1) thermometer (1) [wrong experiment e.g. Boyle's Law 0/4]	**4**
(iii)	**precaution;** Minimise amount of gas not in water bath, stirring, allowing time for gas to reach temp, parallax errors, ANY ONE [not insulating the beaker or the water bath] [not repeat readings]	**1**
b	Axes labelled with variables and units (1) Straight line graph with positive gradient (1) +ve intercept on pressure axis and meeting temp axis at -273 ^{O}C OR graph through origin if Kelvin scale used and zero written where axes cross. (1) [if variables other than *p* and *T* used 0/3]	**3**
		10
	Total for paper	**60**