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Mark Scheme
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GCE

GCE Physics (6751/01)

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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] **3**
[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

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)	<u>Calculate maximum current</u> Recall of $P = IV$ (1) Correct answer [0.49 A] (1) Example of calculation: $P = IV$ I = 5.9 W / 12.0 V = 0.49 A	**2**
(ii)	<u>Show that resistance is about 24 Ω</u> Recall of $V = IR$ (1) Correct answer to 3 s.f. [24.5 Ω] [no u.e.] (1) Example of calculation: R = 12 V / 0.49 A = 24.5 Ω	**2**
(b) (i)	<u>Calculate current</u> Use of correct circuit resistance (1) Correct answer [0.45 A] (1) Example of calculation: $I = V / R$ = 12 V ÷ (24.5 Ω + 2 Ω) = 0.45 A	**2**
(b) (ii)	<u>Calculate power</u> Recall of $P = IV$ and $V = IR$ (accept $P = I^2R$) (1) or $P=\frac{V^2}{R}$ Correct answer [5.0 W] (1) Example of calculation: $P = I^2 R$ = $(0.45\ A)^2$ x 24.5 Ω = 5.0 W	**2**
(c)	<u>Increase in power available to pump</u> e.g. lower resistance in wire thicker wire, panel nearer to motor (1) (accept relevant answers relating to panels, e.g. more panels)	**1**
	Total	**9**

Question Number	Answer	Mark
2 (a) (i)	<u>Explain upward force is about 0.1 N</u> Correct answer for force to 2 s.f. [(-)0.092 N] [no ue] (1) Explanation that negative means upwards (1) Example of calculation: $W = mg$ = 0.0094 kg x 9.81 N kg^{-1} = -0.092 N	**2**
(ii)	<u>Label balloon diagram ands show that weight is about 0.07 N</u> Tension + arrow (1) Weight + arrow (1) Weight = 0.068 N (1) (Do not accept 'gravity' for 'weight')	**3**
(b) (i)	<u>Label 2nd balloon diagram</u> Weight (1) Air resistance (1)	**2**
(ii)	<u>Expression for vertical component</u> *T* cos 43° / upthrust – weight / 0.16 N – 0.068 N / (1) (accept T sin 47°)	**1**
(iii)	<u>Calculate tension in string</u> Correct expression showing vertical forces on balloon (1) Correct answer (0.13 N) (1) Example of calculation: *T* cos 43° = 0.16 N – 0.068 N *T* cos 43° = 0.092 N *T* = 0.13 N	**2**
(c)	<u>Explain change in angle</u> Air resistance increases (1) Horizontal component of tension increases (while vertical component stays the same) (1)	**2**
	Total	**12**

Question Number	Answer	Mark
3 (a)	Show that heat energy lost is about 15 000 J Correct substitution of values in $\Delta Q = mc\Delta T$ (1) Correct answer to 3 s.f. [14 600 J] [no ue] (1) Example of calculation: $\Delta Q = mc\Delta T$ = 0.25 kg x 4180 J kg^{-1} $°C^{-1}$ x (93 °C - 79 °C) = 14 630 J	**2**
(b) (i)	Calculate specific heat capacity of stainless steel Correct rearrangement of $\Delta Q = mc\Delta T$ (1) Correct answer [650 J kg^{-1} $°C^{-1}$] [no ue] (1) Example of calculation: $c = \Delta Q/m\Delta T$ = 14 600 J / 0.41 kg x (79 °C – 24 °C) = 647 J kg^{-1} $°C^{-1}$	**2**
(ii)	State assumption All energy transferred from water to pot OR no heat lost to the surroundings (1)	**1**
(iii)	Compare values calculated value too high (1) heat energy transferred to pot less than 14 600 J / some heat energy from water or pot to the air (1)	**2**
	Total	**7**

Question Number	Answer	Mark
4(a)(i)	Name process Refraction (1)	**1**
(ii)	Explanation of refraction taking place change in speed / density / wavelength (1)	**1**
(b) (i)	Draw ray from butterfly to fish refraction shown (1) refraction correct (1)	**2**
(ii)	Explain what is meant by critical angle Identify the angle as that in the denser medium (1) Indicate that this is max angle for refraction OR total internal reflection occurs beyond this (1) [angles may be described in terms of relevant media]	**2**
(iii)	Explain two paths for rays from fish A to fish B direct path because no change of medium/refractive index/density (1) (total internal) reflection along other path / angle of incidence > critical angle (1) direct ray correctly drawn with arrow (1) total internal reflection path correctly drawn with arrow (1) [lack of ruler not penalised directly] [arrow penalised once only]	**4**
	Total	**10**

Question Number	Answer	Mark
5(a)	Show that E_p lost is about 37 000 J Recall of $E_p = mgh$ (1) Correct answer to 3 s.f. [37 300 J] [no ue] (1) Example of calculation: $E_p = mgh$ E_p = 760 kg x 9.81 N kg^{-1} x 5 m = 37278 J	**2**
(b) (i)	Show that E_k of projectile and counterweight is about 26 000 J Correct calculation of E_p gained by projectile [10 800 J] [no ue] (1) Correct calculation of E_k to 3 s.f. [26 200 J] [no ue] (1) Example of calculation: E_p gained by projectile = 55 kg x 9.81 N kg^{-1} x 20 m = 10 800 J E_k = 37 000 J – 10 800 J = 26 200 J	**2**
(ii)	State assumption All lost gpe → ke of projectile and counterweight OR Mass of moving arms negligible OR No loss of energy to /work done against friction/air resistance (1)	**1**
(iii)	Explain term 1/2 x 760 kg x $(v/4)^2$ 2 points from: E_k of counterweight $E_k = {}^1/_2\, mv^2$ Counterweight has speed $v/4$ Due to lever arm ratio 1:4 (2)	**2**
(c) (i)	Calculate time of flight Use of $s = ut + {}^1/_2\, at^2$ (1) Correct answer [2.1 s] Example of calculation: for vertical motion, $s = ut + {}^1/_2\, at^2$ 21 m = 0 + $^1/_2$ x 9.81 m s^{-2} x t^2 (1) $t = \sqrt{}$ (21 m x 2 / 9.81 m s^{-2}) t = 2.07 s (1)	**2**
(ii)	Calculate distance travelled Recall of $s = vt$ (1) Correct answer [46.6 m] (1) Example of calculation horizontal motion, $s = vt$ = 22.5 m s^{-1} x 2.07 s = 46.6 m (1)	**2**
	Total	**11**

Question Number	Answer	Mark
6(a)	<u>State relationship between wavelength and length of band</u> wavelength = 2 x length (1) (accept symbols, accept alternative arrangement accept ($\propto \lambda$)	**1**
(ii)	<u>Explain standing wave production</u> wave (produced by plucking) reflected at ends (1) upward and downward waves/waves in opposite direction superpose/interfere (1) where in phase, constructive interference/antinode OR where in antiphase, destructive interference/node OR points of constructive interference and points of destructive interference OR nodes and antinodes formed (1)	**3**
(b) (i)	<u>Formula for speed calculation</u> Recall of $v = f\lambda$ (1) v = f x 2*l or v =2 lf* (accept D = C x 2B)	**2**
(ii)	<u>Calculate missing value for E5</u> Correct answer [0.00117 kg m^{-1}] [no ue] (1) Example of calculation: $\mu = m/l$ = 0.0011 kg / 0.94 m = 0.00117 (kg m^{-1})	**1**
(iii)	<u>Calculate missing value for F6</u> Correct answer [134.2 m s^{-1}] [no ue] (1) Example of calculation: $c = \sqrt{T/\mu}$ = $\sqrt{}$ (20 N / 0.00111 kg m^{-1}) = 134.2 (m s^{-1})	**1**
(iv)	<u>Compare and comment on values in columns D and F</u> 2 valid competitive comments (1) (1) fairly good agreement / of same order except line 4 / tension 10 N / 2nd reading quantitative comment, e.g. percentage difference between any pair (1)	**3**

	Total	**11**
	Total for paper	**60**