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Mark Scheme (Results)
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GCE

GCE Physics (6PH04) Paper 1

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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] [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 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.
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.

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] [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. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.

5.2 Usually it is part of a max 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.

Question Number	Answer	Mark
1	B	**1**
2	A	**1**
3	D	**1**
4	C	**1**
5	C	**1**
6(i)	B	**1**
6(ii)	C	**1**
7(i)	C	**1**
7(ii)	A	**1**
7(iii)	D	**1**

Question Number	Answer	Mark
8	QWC i and iii – Spelling of technical terms must be correct and the answer must be organised in a logical sequence Observations: Most alpha went straight through **(1)** Some deflected **(1)** (Very) few came straight back/large angle **(1)** Conclusions: Atom mainly (empty) space **(1)** Nucleus contains most of the mass **(1)** (Nucleus) very small/tiny **(1)** (Nucleus) charged /positive **(1)**	**QWC** **5 max**
	Total for question	**5**

Question Number	Answer	Mark
9	Current in coil generates magnetic field **(1)** Current drops/decreases **(1)** Change of flux [accept flux cut] **(1)** Rapid/quick/short time **(1)** Large emf/200 V <u>induced</u>**(1)** Field/flux linkage large due to many turns **(1)**	**4 max.**
	Total for question	**4**

Question Number	Answer	Mark
10(a)	Use of $E = V/d$ **(1)** Answer = 1.5×10^5 V m^{-1} or N C^{-1} **(1)** Eg $E = 1.5 / 10 \times 10^{-6}$	**2**
10(b)	Opposite forces (act on either end of molecule) **(1)** Molecule rotates / aligns with field **(1)** - at top / + at bottom **(1)**	**3**
	Total for question	**5**

Question Number	Answer	Mark
11(a)	Straight lines (at least 4) touching proton **(1)** Equi spread (by eye) **(1)** Arrow on at least one pointing away from proton **(1)**	**3**
11(b)	Use of $F = k\,QQ/r^2$ [requires 2 subs to qualify as use] **(1)** Know $Q_p = 1.6 \times 10^{-19}$ (C) eg QQ=$(1.6 \times 10^{-19})^2$ **(1)** Answer = 7.9×10^{-8} N **(1)** Eg F = $8.99 \times 10^9 (1.6 \times 10^{-19})^2 / (5.4 \times 10^{-11})^2$	**3**
	Total for question	**6**

Question Number	Answer	Mark
12(a)	Use of F=mv/t or $F = ma$ **(1)** Answer = 2.0×10^5 N **(1)** Eg F = 12000 x 57 / 3.5	**2**
12(b)	Arrow down labelled mg / W **(1)** Arrow up labelled eg R /reaction / force from seat **(1)** Equal length vertical arrows from a clear single point **/** centre of mass and "bottom" **(1)**	**3**
12(c)	$4mg - mg$ OR $3mg$ **(1)** $(m)v^2 / r$ seen **(1)** Answer = 110 (m) **(1)** Eg $3mg = mv^2 / r$ $r = (57)^2 / 3g$	**3**
12(d)	Use of KE / PE conservation **(1)** Answer = 23 (m s^{-1}) **(1)** Eg $\frac{1}{2} m(57)^2 = \frac{1}{2} mv^2 + mg139$ $v^2 = \frac{1}{2} (57)^2 - 9.81 \times 139$	**2**
12(e)	Using $(m)g$ only **(1)** Answer r = 54 m [allow ecf] **(1)** **Eg** $mg = mv^2 / r$ $r = (23)^2 / 9.81$	**2**
	Total for question	**12**

Question Number	Answer	Mark
13(a)	Charges **(1)** Movement of electrons from one plate to the other OR one plate becomes + the other – OR until pd across C equals V_{supply} **(1)**	2
13(b)(i)	Use of $Q = It$ (both 0.74 and 0.1/0.2) **(1)** Recognition of milli and $\Delta t = 0.1$ **(1)** Eg $Q = 0.74 \times 10^{-3} \times 0.1 = 74 \times 10^{-6}$ C	2
13(b)(ii)	Use of $V = Q/C$ **(1)** Explains unit conversion **(1)** Eg $V = 278 \times 10^{-6} / 100 \times 10^{-6} = 2.78$ [accept μ/μ]	2
13(c)(i)	Recall of RC **(1)** Answer = 0.3 (s) **(1)** Eg $T = 3000 \times 0.0001$ **plus either** 1/e or 37% of initial **(1)** =0.23 - 0.27 (s) **(1)** **or** sub in formula $I = I_0 e^{-t/RC}$ **(1)** = 0.23 - 0.27 (s) **(1)** **or** Initial Tangent drawn **(1)** Time constant = 0.2-0.3 (s) **(1)**	4
13(c)(ii)	Plot Ln I **/** Log I **(1)** Against t **(1)** (dependent on first mark) or Gradients of graph (1) Against I (1) (dependent on first mark) should be straight line **(1)** (dependent on previous 2)	3
	Total for question	**13**

Question Number	Answer	Mark
14(a)	$u\bar{d}$ identified **(1)**	**1**
14(b)	Conversion of G **(1)** Conversion of either eV or divided by c^2 **(1)** 2.5×10^{-28} (kg) **(1)** eg $m = 0.14 \times 10^9 \times 1.6 \times 10^{-19}$ / 9×10^{16}	**3**
14(c)	QWC i and iii – Spelling of technical terms must be correct and the answer must be organised in a logical sequence Electric fields: Electric field provides force on the charge/proton **(1)** gives energy to /work done / $E = qV$/ accelerate protons **(1)** Magnetic fields: Force on moving charge/proton **(1)** Produces circular path/centripetal force **(1)** labelled diagram showing Dees with E field indicated across gap OR B field through Dees (1) E field is reversed/alternates (1)	**QWC** **4** **1 max**
14(d)	QWC i and iii – Spelling of technical terms must be correct and the answer must be organised in a logical sequence momentum **(1)** Zero / negligible momentum before **(1)** To conserve momentum **(**fragments go in all directions) **(1)**	**QWC** **3**
	Total for question	**12**

Question Number	Answer	Mark
15(a)(i)	measured thickness of lead 4-5 mm **(1)** measured radius 32 - 38 mm **(1)** Value between 38 – 57 mm **(1)** Eg actual radius = 35 mm x 6 mm/4.5 mm	**3**
15(a)(ii)	Use of $p = Bqr$ [any two values sub] **(1)** Answer range 9.1×10^{-21} - 1.4×10^{-20} N s or kg m s^{-1} [allow ecf]**(1)**	**2**
15(b)	Track gets more curved above lead / r smaller above lead **(1)** Must be slowing down / less momentum / loses energy **(1)** Up [dependent on either answer above] **(1)**	**3**
15(c)	Into page **(1)** [ecf out of page if down in b]	**1**
15(d)(i)	Division by 9.11×10^{-31} kg **(1)** Answer range 1.0 – 1.6 $\times 10^{10}$ m s^{-1} **(1)**	**2**
15(d)(ii)	greater than speed of light **(1)** (impossible) so mass must have increased **(1)**	**2**
	Total for question	**13**

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