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Mark Scheme (Results)
June 2010

GCE

GCE Physics (6PH04/01)

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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.
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:

'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] ✓
[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.

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	B	**(1)**
3	C	**(1)**
4	D	**(1)**
5	D	**(1)**
6	A	**(1)**
7	B	**(1)**
8	A	**(1)**
9	B	**(1)**
10	C	**(1)**

Question Number	Answer	Mark
11	Use of $W=mg$ Use of $F=BIL$ B = 0.04 T	**(1)** **(1)** **(1)**
	Total for question 11	**3**

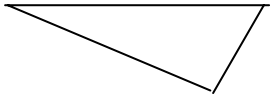
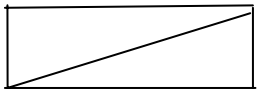
Question Number	Answer	Mark
12(a)	(Magnetic) Flux linkage	**(1)** **(1)**
12(b)	QWC (i and iii) – spelling of technical terms must be correct and the answer must be organised in a logical sequence Lenz's law / conservation of energy induced current/emf (direction) Opposes the change (that produced it)	 **(1)** **(1)** **(1)**
	Total for question	**5**

Question Number	Answer	Mark
13(a)	Conversion from per minute to per second Conversion from revolutions to radians Example of calculation 20 revolutions = 20 x 2π /60 (= 2.1 rads s^{-1})	**(1)** **(1)**
13(b)	Use of $r\omega^2$ Answer in range 6 – 13 ms^{-2}	**(1)** **(1)** **(1)**
	Total for question 13	**5**

Question Number	Answer	Mark
14	QWC i and iii – Spelling of technical terms must be correct and the answer must be organised in a logical sequence Momentum conservation Total/initial momentum = 0 Momentum of slime equal momentum of bacteria (Bacteria) moves in <u>opposite</u> direction [backwards or forwards OK] OR Force on slime Equal and opposite force (on bacteria) Cause rate of change of momentum / $\Delta mv/t$ /ma to bacteria (Bacteria) moves in <u>opposite</u> direction [backwards or forwards OK]	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(max 4)**
	Total for question 14	**4**

Question Number	Answer	Mark
15(a)	At least 3 parallel straight lines <u>ALL</u> Equispaced (except ignore a large gap in middle) [be firm] Arrow left to right	**(1)** **(1)** **(1)**
15(b)	Use of eV [eg 1.6 x10^{-19} or 2000/4000] (=) ½ mv^2 Use of 2000	**(1)** **(1)** **(1)**
15(c)	Use of $v = s/t$ [eg = 1.5 / 23 (x 10^{-6})] (= 65000) Sub into previous equation m = 1.5 x 10^{-25} kg	**(1)** **(1)** **(1)**
15(d)	Some of the molecules in sample will travel further/less/not midway Duration of laser pulse Might emerge not horizontal Molecules may be doubly/integer ionised Time very small Not perfect vacuum / collides with other molecules	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(max2)**
	Total for question 15	**11**

Question Number	Answer	Mark
16(a)	(Trace) always positive/not negative/not below 0/ if it was AC the graph would be positive and negative Indicating one/same direction	**(1)** **(1)**
16(b)(i)	Capacitor stores charge/charges up (If voltage is constant) capacitor doesn't discharge	**(1)** **(1)**
16(b)(ii)	Recall of $E = ½ CV^2$ or use of $Q=CV$ and $QV/2$ Substitution of C and any reasonable V [ignore power of 10 for C] eg $= ½ 10 \times 10^{-6} \times 5.5^2/5.6^2$ $= 1.5 \times 10^{-4}$ - 1.6×10^{-4} J	**(1)** **(1)** **(1)**
16(c)(i)	Capacitor charges up From the supply (then) Capacitor discharges Through circuit / exponentially	**(1)** **(1)** **(1)** **(1)** **(max 3)**
16(c)(ii)	Corresponding time interval for a change in V eg 6-7 ms for $\Delta V = 2V$ $V = V_o e^{-t/RC}$ or rearrangement seen [eg Ln $0.7 = 6 \times 10^{-3}/RC$] R approx 1700 Ω (allow 1600 – 1800) or Time constant = 14 – 20 ms T = RC seen R approx 1700 Ω (allow 1600 – 1800) or Corresponding time interval for a change in V eg 6-7 ms for $\Delta V = 2V$ $Q = C V$ and $I = Q/t$ seen R approx 1700 Ω (allow 1600 – 1800)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**
16(c)(iii)	Use larger capacitor	**(1)**
	Total for question 16	**14**

Question Number	Answer	Mark
17(a)	(Total / sum of) Kinetic energy conserved	**(1)**
17(b)	These diagrams could appear in part c and should be credited in (b)   [allow first mark for any triangle or parallelogram ie do not insist on right angle] right angle labelled or approximately by eye / diagonal should be labelled "before" or "initial" or appropriately recognisable as incoming particle	**(1)** **(1)**
17(c)	KE as formula eg ½ mu^2 = ½ mv^2 + ½ ms^2 / $p^2/2m = p^2/2m + p^2/2m$ Recognition of "Pythagoras"	**(1)** **(1)**
17(d)(i)	Electric field Does work on proton/applies a force /repel/attract qV / Fd / Eq	**(1)** **(1)** **(1)**
17(d)(ii)	Mass of incoming proton larger (than rest mass) Due to moving near speed of light/high speed/high energy/relativistic Alt answer : image not in plane of two protons after the event	**(1)** **(1)** **(2)** **(max 2)**
17(e)	Out of the plane of paper	**(1)**
	Total for question 17	**11**

Question Number	Answer	Mark
18(a)	2/3 that of a proton / 2/3 x 1.6 x 10^{-19} (C)	**(1)**
18(b)	Mass = 80 MeV/c^2 charge = +1/3	**(1)** **(1)**
18(c)	Recognition M means 10^6 Convert eV to J or divide by c^2 eg 4 x 10^6 x1.6 x 10^{-19} or /9x10^{16} Answer 7.1 x 10^{-30} (kg)	**(1)** **(1)** **(1)**
18(d)(i)	Kaon Meson Omega baryon	**(1)** **(1)**
18(ii)	K^- + p = K^+ + K^o + Ω^- [accept p or p^+ ;do not accept K for K^o ;signs must be top right]	**(1)** **(1)**
18(iii)	Kaon plus = u $\bar{s}$ Kaon neutral = d $\bar{s}$ or s $\bar{d}$ [both marks can be inferred if equation in d(ii) is fully written in quark combinations)	**(1)** **(1)**
18(iv)	QWC i and iii – Spelling of technical terms must be correct and the answer must be organised in a logical sequence Momentum conserved Charge conserved Energy / mass conserved E =mc^2 <u>Kinetic</u> Energy (of kaon minus) is responsible Momentum of three particles after = momentum of kaon before Total charge 0 / charge before and after is 0 Conservation of Baryon no, quark no, strangeness	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(allow only 1 mark max from these 3)**
		5 max
	Total for question 18	**17**

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