Mark Scheme (Results)
January 2009

GCE

GCE Physics (6736/01)

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) <u>Horizontal force of hinge on table top</u>

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. '<u>resonance</u>'
   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 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)	use of $v = s/t$ in the form $t = s/v$ **(1)**	
	$\Rightarrow$ $t = 1.2 \times 10^{-4}$ s / 0.12 ms **(1)**	
(ii)	fraction of rev /$\Delta\theta$ = 400 rev s^{-1} × 0.12 × 10^{-3} s **(1)**	
`	$\Rightarrow$ angle is 0.048 of 360^0 / 0.048 of 2π [e.c.f.] **(1)** (yielding 17^0 /0.30 rad)	
(iii)	spread of atoms / dots along horizontal line **(1)**	
	fast at right <u>and</u> slow at left **(1)** [give 1 on plate for fast/slow]	(6)
(b) (i)	use of $\rho = p / gh$ (ignore powers of ten) **(1)**	
	$\Rightarrow$ ρ = 13 000 / 13 300 kg m^{-3} **(1)**	
(ii)	Pa as N m^{-2} **(1)**	
	p in kg m^{-3} <u>and</u> h in m <u>and</u> g in N kg^{-1} / m s^{-2} **(1)**	(4)
(c) (i)	(half way) between slits C$_1$ and C$_2$ / at peak of parabolic path **(1)**	
(ii)	removes an / loses electron / electrons (from the atom) **(1)**	(2)
(d) (i)	use of $s = \frac{1}{2}gt^2$ **(1)**	
	$\Rightarrow$ $t = 4.7(4)$ ms **(1)**	
(ii)	use of pico as 10^{-12} **(1)**	
	use of 1.6 × 10^{-19} (C per singly ionised atom) **(1)**	
	$\Rightarrow$ number of ions per unit time as 1.1(25) × 10^9 s^{-1} **(1)**	(5)

(e) (i)	$<c>$ as a number between 380 and 440 (no u.e.) **(1)** choose $p = \frac{1}{3}\rho<c^2>$ **(1)** $\Rightarrow \quad p/\rho \approx <c>^2$ (from above) $\div 3$ [e.c.f] **(1)** with unit $m^2\ s^{-2}$ **(1)**	(4)
(ii)	stated attempt to find area under graph **(1)** method apparently successful **(1)** 30 000 to 36 000 **(1)**	(3)
(iii) (iv)	peak to right of existing peak **(1)** peak lower than existing peak **(1)** quality mark – areas $\approx$ equal **(1)** same area means same N **(1)**	(4)
(f) (i) (ii)	any λ between 700 nm and 500 μm (n.b. 500 micrometre) **(1)** select $\Delta\lambda/\lambda = v/c$ **(1)** correct substitution to calculate v/c (yields 2.8×10^{-6}) **(1)** $\Rightarrow$ percentage shift $\Delta\lambda/\lambda = 2.8 \times 10^{-4}$ (%) **(1)**	(4)
	Total	32

Question number	Answer	Mark
2 (a) (i)	mathematical models: spring : $F = kx / x = F \div k / x$ is proportional to F **(1)** capacitor : $V = Q \div C / Q = CV / Q$ is proportional to V **(1)** [Neither F, x and k nor V, Q and C need be explicitly defined] [Pairings must be correct to gain the second mark] the way in which energy is stored: energy stored in spring as $\frac{1}{2}Fx / \frac{1}{2}kx^2 / \frac{1}{2}F^2 \div k$ / as elastic potential energy / mechanical potential energy / strain energy **(1)** energy stored in capacitor as $\frac{1}{2}VQ / \frac{1}{2}Q^2 \div C / \frac{1}{2}CV^2$ / as electric energy / in the electric field **(1)** [Pairings must be correct to gain the second mark] [Accept shaded graph of F against x / V against Q] series and parallel arrangements: *either*: springs in parallel analogous to capacitors in series / capacitors in parallel analogous to springs in series *or*: either on a diagram **(2)** [for one or two correct formula give 1/2]	(6)
(ii)	capacitors have a maximum (working) voltage / leak at high voltage / have insulation that conducts at a high voltage **(1)**	(1)
(b) (i) (ii)	A: metal / conducting (dome) **(1)** B: (insulating) rubber / plastic (belt) **(1)** C: insulating support / plastic / Perspex / column **(1)** the motor / mechanism / person (driving the belt) **(1)** (not 5 kV power supply)	(4)
(iii)	use of $Q = It$ **(1)** use of $C = Q/V$ **(1)** $\Rightarrow$ $C = 9.6 \times 10^{-12}$ F / 9.6 (pF) **(1)** assume no loss of charge **(1)**	(4)
	Total	15

Question number	Answer	Mark
3 (a) (i)	measure l from centre of bob **(1)** to where cord is clearly / rigidly gripped [e.g. by bits of wood] **(1)** use small amplitude / angle *or* distance **(1)** with a fiducial mark / view swings as cord passes centre **(1)** measure t for 10 or more oscillations **(1)** repeat and average (calculate T, no mark) **(1)** vary l and find new T **(1)** plot l against T^2 / calculate $g = 4\pi^2 l/T^2$ **(1)** find gradient / average g for more than 2 calculated values of l **(1)**	max **(7)**
(ii)	the Earth is spinning / mention of v^2/r centripetal acceleration **(1)** speed varies with latitude / a requires F **(1)**	**(2)**
(b)	awareness of $g = Gm/r^2$ **(1)** correct substitution in $2Gm_E h/r_E^3$ (yielding $2gh/r_E$) **(1)** $\Rightarrow$ $\Delta g = 8.0 / 7.97 \times 10^{-4}$ m s^{-2} / N kg^{-1} (u.e.) **(1)**	**(3)**
(c)(i)	$\Delta l/l = (18 \times 10^{-6}$ K^{-1} / 1.8×10^{-5} K$^{-1})$(temperature rise) **(1)** $\Rightarrow$ $\Delta l = 0.43$ mm **(1)** (no $\times l$ gives 0.36 mm e.o.p.)	**(2)**
(ii)	*either*: $\Delta l \div l = 0.43 \times 10^{-3}$ m $\div 1.2$ m [e.c.f.] **(1)** yielding 3.6×10^{-4} / 3.6×10^{-2} % / 0.036 % **(1)** *or*: $T = 2\pi\sqrt{(l/g)}$ with $l = 1.200$ / 1.2 m <u>and</u> $l = 1.200\ 43$ m (e.c.f.) **(1)** yielding two values for T [2.1975 s and 2.1979 s] **(1)** *both*: comment effect not noticeable (no mark)	**(2)**
	Total	16

Question number	Answer	Mark
4(a)	an e.m.f. / p.d. / voltage is produced / induced (at T_1 and T_2) **(1)** mention of (magnetic) flux / Φ **(1)** through / in / linking / coil changes *or* field (lines) cut **(1)**	(3)
(b) (i)	qowc **(1)** step-up (transformer) means voltage / p.d. / e.m.f. out / in secondary is greater than voltage / p.d. / e.m.f. in / in primary **(1)** high-ratio refers to the turns ratio N_{out} / N_S being greater than N_{in} / N_P **(1)** with numbers in the ratio V_S/V_P *or* $N_S/N_P \geq 100$ as an example **(1)**	(4)
(ii)	(any peak-to-peak in cm) times (50 mV cm^{-1}/ 0.05 V cm^{-1}) **(1)** $\Rightarrow$ amplitude = 50 / 55 mV **(1)** use of > one cycle to determine time period **(1)** (any time period in cm) times (2.0 ms cm^{-1} / 0.002 s cm^{-1}) **(1)** use of frequency = 1/time period **(1)** $\Rightarrow$ frequency = 300 / 320 Hz (no mark)	(5)
(iii)	(superposition means) adding the (vector) displacements **(1)** at a point **(1)** [do not credit simple sketches of pulses adding] demonstration: using spring / ripple tank / speakers / microwaves / light **(1)** description: of what is done (may be a labelled diagram) **(1)** statement: of what is observed (e.g. maxima & minima) **(1)**	(5)
	Total	17