edexcel
advancing learning, changing lives

Mark Scheme
January 2008

GCE

GCE Physics (6754/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

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)	Varying/changing current in primary coil (1) produces changing B field (1) Moving lines of flux cut wires/changing flux in secondary (1) OR change in flux linking secondary Induces an emf (1)	**4**
(ii)	State Vs/Vp = Ns/Np [any correct variation] (1) Answer (38) [Eg 1950 x 4.5 / 230 = 38.15] (1)	**2**
(iii)	State P = IV OR I = P/V OR correct subs of P and V (1) Calculate current = 0.026 A [Eg 6 W/230 V = 0.026 A] (1) State diameter: 0.193 mm [ecf; no ue] (1)	**3**
(b)	Thicker wire => lower resistance (1) (For given current,) less heat generation, so more efficient/less damaging to insulation (1)	**2**
	Total	**11**

Question Number	Answer	Mark
2 (a)	recall of p = mv [eqn or sub] (1) answer (1) p = mv = 2 x 0.024 x 0.88 (N s) = 0.042(24) N s OR kg m s^{-1}	**2**
(b)	recall of KE = $1/2mv^2$ OR $p^2/2m$ [eqn or sub] (1) answer (1) KE = $1/2mv^2$ = 0.5 x 2 x 0.024 x 0.88 x 0.88 (J) = 0.0185(856) (J)	**2**
(c)(i)	provided no external force acts (1) OR balls do not interact with/transfer momentum to anything else	**1**
(ii)	v = momentum/mass = 0.042(24)/0.072 = 0.5833 (0.5867) (m s^{-1}) (1)	**1**
(iii)	0.5 x 0.096 x 0.44^2 OR 0.5 * B9 * C9 * C9 (1)	**1**
(iv)	3 points from: can't be one ball as too much KE (1) collision pretty elastic/not much loss of energy (1) so won't be 3 or 4 or 5 balls (1) 2 balls gives same energy (1)	**Max 3**
(d)	2 points from kinetic energy is lost (as sound/through deformation/to heat) (1) OR collisions not perfectly elastic Momentum still conserved (1) as the total ke decreases (column D) more balls are in motion (1)	**Max 2**
	Total	**12**

Question Number	Answer	Mark
3 (a)	use of Q = CV OR statement or use of $W = CV^2/2$ OR $Q^2/2C$ (1) answer (1) $W = CV^2/2$ = 0.5 x 2500 x 2 x 2 (J) = 5000 J	**2**
(b)	1 correct value (1) All correct values; 1.62, 1.39, 1.16 (1) (1 mark for one correct or inappropriate sig figs)	**2**
(c)	graph of ln (y) v. time (x) (1) appropriate scales and both axes labelled fully (1) points plotted properly (+/- 1 mm) (1) best fit line drawn (1)	**4**
(d)	recognise that gradient = (-)1/RC (1) evaluate gradient (1) conversion days to seconds (1) obtain appropriate value for R (1) gradient = (-) 0.92/(40 (days)) R = 40 x 24 x 3600 (s) / 0.92 x 2500 (F) = 1500 Ω (OR method using graph of V v. t) recognise that time to Vo/e = RC (1) this time estimated (42-45 days) (1) conversion days to seconds (1) obtain appropriate value for R (1)	**Max 4**
	Total	**12**

Question Number	Answer	Mark
4 (a)	energy (of proton) converts to mass (1) 7 TeV > 251 GeV, (so enough energy present to create Higgs particle) (1)	**2**
(b)(i)	calculate rest-mass energy of proton in J (1) comparison with 7 TeV (1) rest mass energy of proton - $E = mc^2 = 1.67 \times 10^{-27} \times c \times c$ $= 1.5 \times 10^{-10}$ J $= 1.5 \times 10^{-10} / 1.6 \times 10^{-19}$ (eV) $= 9.4 \times 10^{8}$ (eV) much less than 7 TeV. OR 7 TeV $= 7 \times 10^{12} \times 1.6 \times 10^{-19}$ (J) $= 1.12 \times 10^{-6}$ (J) $>> 1.5 \times 10^{-10}$ J	**2**
(ii)	Appropriate use of 1.6×10^{-19} OR energy from above in J (1) Answer (1) momentum = energy/c = $7 \times 10^{12} \times 1.6 \times 10^{-19}$ (J)/$(3 \times 10^{8}$ (m/s)) = 3.73×10^{-15} (kg m s^{-1})	**2**
(iii)	Attempt to use r = p/Bq (1) two correct subs into formula OR rearrangement (1) circumference => radius (1) answer (1) r = p/Bq B = p/rQ $= 3.73 \times 10^{-15} / [(27000/2) \times 1.6 \times 10^{-19}]$ (T) = 5.4 T	**4**
(iv)	Yes (stated or clearly implied) (1) because motion and force both horizontal OR motion/force/B must all be perpendicular (1)	**2**
	Total	**12**

Question Number	Answer	Mark
5(a)	five from: 1 starts as continuous voltage signal (1) 2 sampled (1) 3 at fixed time intervals (1) 4 greater than 2 x highest audible/44000 Hz (1) 5 values mapped onto ladder of discrete levels (1) 6 mention of companding with advantage/detail (1) 7 each discrete level represented in binary/1 or 0 (1)	**Max 5**
	two of: 1 original tapes deteriorating (1) 2 saves space (1) 3 preserved for ever (1) 4 quality of digital won't deteriorate (1)	**Max 2**
	Total	**7**

Question Number	Answer	Mark
6(a)	1 equating PE and KE (1) 2 recall of mv^2/r (1) 3 find centripetal force = 2mg (1) 4 force on rider = centripetal force + weight OR force = 3mg (1) 5 hence "g-force" = 3 (1)	**5**
(b)	height not a factor, so B is correct (1) (some will reach this conclusion via much longer routes)	**1**
	Total	**6**
	Total for paper	**60**