edexcel
advancing learning, changing lives

Mark Scheme (Standardisation) Summer 2007

GCE

GCE Physics (6751/01)

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) 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:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

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.

1. a) Describe propagation of longitudinal waves

Particles oscillate / compressions/rarefactions produced ✓

oscillation/vibration/displacement parallel to direction of propagation ✓ **2**

b) Calculation of wave speed

Recall of $v = f\lambda$ ✓

Correct answer [7.2 km s^{-1}] ✓ **2**

Example of calculation:

$v = f\lambda$

v = 9 Hz × 0.8 km

= 7.2 km s^{-1} [7200 m s^{-1}]

c) Determine if elephants can detect waves more quickly

Recall of $v = s / t$ ✓

Correct answer for t in minutes or hours [about 6 minutes] or relevant comment with 347 s or calculation of tidal wave speed [0.35 km s^{-1}] with comment [allow ecf] ✓ **2**

Example of calculation:

$v = s / t$

t = 2500 km ÷ 7.2 km s^{-1} OR v = 2500 km ÷ (2 × 60 × 60 s)

t = 347 s OR v = 0.35 km s^{-1}

t = about 6 minutes (stated) / much less than hours / 2 h is 7200 s
OR 7.2 km s^{-1} >> 0.35 km s^{-1} **6**

2. a) i) Show that resistance is about 0.006 □

Use of ratio of lengths and total resistance to find correct answer [0.0056 □□□[no ue] ✓ **1**

Example of calculation:

R = 0.05 m × 0.11 □ / 0.99 m

= 0.0056 □ (5.6 × 10^{-3} □) [no ue]

a) ii) Suggest why full length used

More accurate / resistance larger / smaller percentage uncertainty/error ✓ **1**

b) i) Calculate rate of heat generation

Recall of $P = IV$ and $V = IR$ (accept $P = I^2R$) ✓

Correct answer [2.2 W] [allow ecf for a) i) answer if not 0.006 □] ✓ **2**

Example of calculation:

$P = I^2R$

= 20 A × 20 A × 0.0056 □

= 2.2 W

b) ii) Calculate energy to raise wire to melting point

Use of $\Delta Q = mc\Delta$□ ✓

Correct answer [= 35.5 J] ✓ **2**

Example of calculation:

$\Delta Q = mc\Delta$□

= 8.7 × 10^{-5} kg × 385 J kg^{-1} °C^{-1} × (1080 °C – 20 °C)

= 35.5 J

b) iii) Calculate time to raise wire to melting point

Use of power = energy/time to find correct answer [16.1 s] [ecf] ✓ **1**

Example of calculation:

time = energy / power

= 35.5 J / 2.2 W

= 16.1 s

b) iv)Explain increase in resistance

(Temperature increase) causes increased vibrations of (lattice) ions/ atoms ✓

with an increase in the scattering of flowing electrons / increased rate of collisions with electrons / harder for electrons to pass ✓ **2**

9

3. a) i) Show that acceleration is about 1.7 m s^{-2}

Use of appropriate equation(s) of motion ✓

Correct answer [a = 1.73 m s^{-2}] [no ue] ✓ **2**

Example of calculation:

$s = {}^1/_2\, at^2$

1.35 m = $^1/_2$ × a × (1.25 s)^2 OR a = 2 × 1.35 m / (1.25 s)^2

a = 1.73 m s^{-2}

a) ii) Explain constant acceleration

No air resistance ✓

Accelerating force on each is constant / Resultant force remains just weight ✓ **2**

b) Calculate weight

Recall of $W = mg$ ✓

Correct answer [179 N] ✓ **2**

Example of calculation:

$W = mg$

= 105 kg × 1.7 N kg^{-1}

= 179 N

c) i) Time of flight of ball

Recall of trigonometrical function	✓	
Recall of $v = u + at$	✓	
Correct answer [t = 18.1 s]	✓	**3**

Example of calculation:

vertical component of velocity = 45 m s^{-1} × sin 20°

= 15.4 m s^{-1}

$v = u + at$
15.4 m s^{-1} = -15.4 m s^{-1} + 1.7 m s^{-2} × t

t = 30.8 m s^{-1} ÷ 1.7 m s^{-2}

t = 18.1 s

c) ii) Horizontal distance

Use of trigonometrical function	✓	
Correct answer [766 m] [ecf]	✓	**2**

Example of calculation:

horizontal component of velocity = 45 m s^{-1} × cos 20°

= 42.3 m s^{-1}

distance = 42.3 m s^{-1} × 18.1 s

= 766 m

c) iii) Comment on this distance

[766 m ÷ 1600 m/mile = 0.48 mile] [ecf] – This is only about half a mile (N.B. answer for c) ii) required to get this mark)	✓	**1**
		12

4. a) Meaning of superposition

When vibrations/disturbances/waves from 2 or more sources coincide at same position ✓

resultant displacement = sum of displacements due to individual waves ✓ **2**

b) i) Explanation of formation of standing wave

description of combination of incident and reflected waves/waves in opposite directions ✓

described as superposition or interference ✓

where in phase, constructive interference / antinodes
OR where antiphase, destructive interference / nodes
OR causes points of constructive and destructive interference
OR causes nodes and antinodes ✓ **3**

b) ii) Calculate wavelength

Identify 2 wavelengths ✓

Correct answer [2.1×10^{-9} m] ✓ **2**

Example of calculation:

(NANANANAN) X to Y is 2 × □

□□□□4.2×10^{-9} m ÷ 2

= 2.1×10^{-9} m

b) iii) Explain terms

amplitude – maximum displacement (from mean position) ✓
(can use diagram with labelled displacement axis)

antinode – position of maximum amplitude ✓ **2**
OR position where waves (always) in phase **9**

5. a) i) calculate resistance

Recall of $R = V/I$ ✓

Correct answer [8.65 Ω] ✓ **2**

Example of calculation:

$R = V/I$

R = 2.68 V ÷ 0.31 A

= 8.65 Ω

a) ii) Show that internal resistance is about 0.4 □

Recall of relevant formula [V = □ - Ir OR lost volts = $(□ - V)$ OR □ = $I(R + r)$] including emf ✓

Correct answer [0.39 Ω] [no ue] [allow ecf if □ = $I(R + r)$] ✓ **2**

Example of calculation:

V = □ - Ir

$r = (□ - V)/I$

= (2.8 V – 2.68 V)/0.31 A

= 0.39 Ω

a) iii) Comment on match to maximum power

Not matched [ecf for R in a) i) and r in a) ii)] ✓

Max power when internal resistance = load resistance ✓ **2**

b) i) Show that charge is about 14 000 C

Recall of $Q = It$ ✓

Correct answer [14 400 C] [no ue] ✓ **2**

Example of calculation:

$Q = It$

$= 2 \times 2\ A \times 60 \times 60\ s$

$= 14\ 400\ C$

b) ii) Calculate time for which battery maintains current

Use of $Q = It$ OR use of $W = Pt$ ✓

Correct answer [46 450 s or 12.9 h] ✓ **2**

Example of calculation:

$t = Q/I$

$= 14\ 400\ C / 0.31\ A$

$= 46\ 450\ s$

c) Explain effect on efficiency

Efficiency = $I^2R / I^2(r + R)$ / Efficiency depends on $R/(r + R)$ / more heat dissipated in cells / Efficiency is $V/\square$ and V decreases ✓

so efficiency is less ✓ **2**

[Must attempt explanation to get 2nd mark] **12**

---

6. a) i) Calculate ave speed from D8

Use of equations of motion to find correct answer [15.2 m s^{-1}][no ue] ✓ **1**

Example of calculation:

$v = 7.6\ m / 0.5\ s$

$= 15.2\ m\ s^{-1}$ [No ue]

a) ii) Formula for E7

✓ **1**

E6 + B7 OR 35.5 + 9.1 OR B4 + B5 + B6 + B7 OR sum(B4:B7) OR 35.3 + 9.1

a) iii) Use graph to find ave deceleration

line drawn – full width, 0 s to 2 s ✓

substitution of values in gradient formula ✓

correct answer [5.5 m s^{-2} (± 0.3 m s^{-2})] ✓ **3**

Example of calculation:

gradient = (28 m s^{-1} – 17 m s^{-1}) / 2 s

= 5.5 m s^{-2} (± 0.3 m s^{-2}) [ignore any negative sign]

b) i) Calculate average braking force

Recall of $F = ma$ ✓

Correct answer [3300 N] [ecf] ✓ **2**

Example of calculation:

$F = ma$

= 600 kg × 5.5 m s^{-2}

= 3300 N

b) ii) State origin of force

friction between brake pad and disc ✓ **1**

[frictional force of road on tyres]

c) i) Calculation of kinetic energy from F6

Recall of $E_k = {}^1/_2\, mv^2$ ✓

Correct answer [132 kJ] [no ue] ✓ **2**

Example of calculation:

$E_k = {}^1/_2\, mv^2$

$E_k = {}^1/_2 \times 600\text{ kg} \times (21\text{ m s}^{-1})^2$

= 132 kJ

c) ii) Explain gradient = braking force

Change in kinetic energy = work done by braking force ✓

work/distance = force ✓

OR

gradient = change in kinetic energy / distance ✓

= work done by braking force / distance = force ✓

(Showing units/dimensions of gradient consistent with force gains 1 mark) **2**

12