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Mark Scheme Summer 2007

GCE

GCE Salters Horners Physics (6751/01)

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6751 Unit Test PSA1 June 2007

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 Ω / 0.99 m

= 0.0056 Ω (5.6 × 10^{-3} Ω) [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 Ω] ✓ 2

Example of calculation:

$P = I^2R$

= 20 A × 20 A × 0.0056 Ω

= 2.2 W

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

Use of $\Delta Q = mc\Delta\theta$ ✓

Correct answer [= 35.5 J] ✓ 2

Example of calculation:

$\Delta Q = mc\Delta\theta$

= 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**

Total 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

Total 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 $2 \times \lambda$

$\lambda = 4.2 \times 10^{-9}$ m ÷ 2

$= 2.1 \times 10^{-9}$ m

b) iii) Explain terms

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

antinode - position of maximum amplitude ✓
OR position where waves (always) in phase

2

Total 9

5. a) i) calculate resistance

Recall of $R = V/I$	✓	
Correct answer [8.65 Ω]	✓	2

Example of calculation:

$R = V/I$

$R = 2.68\ V \div 0.31\ A$

$= 8.65\ \Omega$

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

Recall of relevant formula [$V = \mathcal{E} - Ir$ OR lost volts = $(\mathcal{E} - V)$ OR $\mathcal{E} = I(R + r)$] including emf	✓	
Correct answer [0.39 Ω] [no ue] [allow ecf if $\mathcal{E} = I(R + r)$]	✓	2

Example of calculation:

$V = \mathcal{E} - Ir$

$r = (\mathcal{E} - V)/I$

$= (2.8\ V - 2.68\ V)/0.31\ A$

$= 0.39\ \Omega$

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 $V/$ and V decreases ✓

so efficiency is less ✓

2

[Must attempt explanation to get 2nd mark]

Total 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

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

Total
12
Total for Paper = 60