MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers

9702 PHYSICS
9702/23 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Cambridge is publishing the mark schemes for the October/November 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) scalar has magnitude/size, vector has magnitude/size and direction
   B1 [1]

   (b) acceleration, momentum, weight
   (−1 for each addition or omission but stop at zero)
   B2 [2]

   (c) (i) horizontally: \(7.5 \cos 40^\circ / 7.5 \sin 50^\circ = 5.7(45) / 5.75\) not 5.8 N
   A1 [1]

   (ii) vertically: \(7.5 \sin 40^\circ / 7.5 \cos 50^\circ = 4.8(2)\) N
   A1 [1]

   (d) either correct shaped triangle
   M1
   or correct labelling of two forces, three arrows and two angles
   A1
   or correct resolving:
   \[T_2 \cos 40^\circ = T_1 \cos 50^\circ\] (B1)
   \[T_1 \sin 50^\circ + T_2 \sin 40^\circ = 7.5\] (B1)
   \[T_1 = 5.7(45)\) (N)
   A1
   \[T_2 = 4.8\) (N)
   (allow ± 0.2 N for scale diagram)

2 (a) 1. constant velocity / speed
   B1 [1]

   2. either constant / uniform decrease (in velocity/speed)
   or constant rate of decrease (in velocity/speed)
   B1 [1]

   (b) (i) distance is area under graph for both stages
   C1
   stage 1: distance \((18 \times 0.65) = 11.7\) (m)
   stage 2: distance \((9 \times (3.5 – 0.65)) = 25.7\) (m)
   total distance = 37.(4) m
   A1 [2]
   (−1 for misreading graph)
   {for stage 2, allow calculation of acceleration \((6.32 \text{ m s}^{-2})\)
   and then \(s = (18 \times 2.85) + \frac{1}{2} \times 6.32 (2.85)^2 = 25.7\) m}

   (ii) either \(F = ma\)
   or \(E_K = \frac{1}{2}mv^2\)
   C1
   \[a = (18 – 0)/(3.5 – 0.65)\]
   \[E_K = \frac{1}{2} \times 1250 \times (18)^2\]
   C1
   \[F = 1250 \times 6.3 = 7900\) N
   or \(F = \frac{1}{2} \times 1250 \times (18)^2 / 25.7 = 7900\) N
   A1 [3]
   or initial momentum = 1250 \times 18
   \[F = \text{change in momentum} / \text{time taken}\]
   (C1)
   \[F = (1250 \times 18) / 2.85 = 7900\]
   (A1)

   (c) (i) stage 1: either half / less distance as speed is half / less
   or half distance as the time is the same
   or sensible discussion of reaction time
   B1 [1]

   (ii) stage 2: either same acceleration and \(s = v^2 / 2a\) or \(v^2\) is \(\frac{1}{4}\)
   \(\frac{1}{4}\) of the distance
   B1 [2]
3 (a) (i) power = work done per unit time / energy transferred per unit time / rate of work done  
B1 [1]

(ii) Young modulus = stress / strain  
B1 [1]

(b) (i) 1. \( E = \frac{T}{A \times \text{strain}} \) (allow strain = \( \varepsilon \))  
C1
\[ T = E \times A \times \text{strain} = 2.4 \times 10^{11} \times 1.3 \times 10^{-4} \times 0.001 = 3.12 \times 10^4 \text{N} \]  
M1
A0 [2]

2.  \( T - W = ma \)  
C1
\[ [3.12 \times 10^4 - 1800 \times 9.81] = 1800a \]  
C1
A1 [3]

(i) 1. \( T = 1800 \times 9.81 = 1.8 \times 10^4 \text{N} \)  
A1 [1]

2. potential energy gain = \( mgh \)  
C1
\[ = 1800 \times 9.81 \times 15 = 2.7 \times 10^5 \text{J} \]  
A1 [2]

(iii) \( P = Fv \)  
C1
\[ = 1800 \times 9.81 \times 0.55 \]  
C1
input power = \( 9712 \times (100/30) = 32.4 \times 10^3 \text{W} \)  
A1 [3]

4 (a) p.d. = energy transformed from electrical to other forms  
unit charge  
B1

e.m.f. = energy transformed from other forms to electrical  
unit charge  
B1 [2]

(b) (i) sum of e.m.f.s (in a closed circuit) = sum of potential differences  
B1 [1]

(ii) \( 4.4 - 2.1 = I \times (1.8 + 5.5 + 2.3) \)  
M1
\[ I = 0.24 \text{ A} \]  
A1 [2]

(iii) arrow (labelled) I shown anticlockwise  
A1 [1]

(iv) 1. \( V = I \times R = 0.24 \times 5.5 = 1.3(2) \text{V} \)  
A1 [1]

2. \( V_A = 4.4 - (I \times 2.3) = 3.8(5) \text{V} \)  
A1 [1]

3. either \( V_B = 2.1 + (I \times 1.8) \) or \( V_B = 3.8 - 1.3 = 2.5(3) \text{V} \)  
C1
A1 [2]
5 (a) transverse waves have vibrations that are perpendicular / normal to the direction of energy travel B1
longitudinal waves have vibrations that are parallel to the direction of energy travel B1 [2]

(b) vibrations are in a single direction M1
either applies to transverse waves
or normal to direction of wave energy travel
or normal to direction of wave propagation A1 [2]

(c) (i) 1. amplitude = 2.8 cm B1 [1]
2. phase difference = 135° or 0.75\pi\text{ rad} or \frac{3}{4}\pi\text{ rad} or 2.36 radians (three sf needed) numerical value M1
unit A1 [2]

(ii) amplitude = 3.96 cm (4.0 cm) A1 [1]

6 (a) (i) greater deflection greater electric field / force on \(\alpha\)-particle A1 [1]
(ii) greater deflection greater electric field / force on \(\alpha\)-particle A1 [1]

(b) (i) either deflections in opposite directions M1
because oppositely charged A1
or \(\beta\) less deflection (M1)
\(\beta\) has smaller charge (A1) [2]

(ii) \(\alpha\) smaller deflection M1
because larger mass A1 [2]

(iii) \(\beta\) less deflection because higher speed B1 [1]

(c) either \(F = ma\) and \(F = Eq\) or \(a = Eq / m\) C1
ratio = either \(\frac{2 \times 1.6 \times 10^{-19}}{(1.6 \times 10^{-19}) \times 4 \times (1.67 \times 10^{-27})}\)
or \(\frac{2e \times 1}{2000u} / (e \times 4u)\) C1
ratio = 1 /4000 or \(2.5 \times 10^{-4}\) or \(2.7 \times 10^{-4}\) A1 [3]