MARK SCHEME for the October/November 2010 question paper
for the guidance of teachers

9702/22 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.

• CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2010 question papers for most IGCSE,
GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level
syllabuses.
1 (a) (i) scalar quantity has magnitude (allow size) \( B1 \)  
vector quantity has magnitude and direction \( B1 \) \([2]\)  

(ii) 1. temperature: scalar \( B1 \) \([1]\)  
2. acceleration: vector \( B1 \) \([1]\)  
3. resistance: scalar \( B1 \) \([1]\)  

(b) either triangle / parallelogram with correct shape \( C1 \)  
tension = 14.3 \( N \) \((allow \pm 0.5 N)\) \( A2 \) \([3]\)  
\((if > \pm 0.5 N \ but \leq \pm 1 N, allow 1 mark)\)  

or \( R = 25 \cos 35^\circ \) \((C1)\)  
\( T = R \tan 35^\circ \) \((C1)\)  
\( T = 14.3 \text{N}\) \((A1)\)  
or \( R = 25 \sin 35^\circ \) \((C2)\)  
\( T = 14.3 \text{N}\) \((A1)\)  
or \( R \) and \( T \) resolved vertically and horizontally leading to \( T = 14.3 \text{N}\) \((C2)\) \((A1)\)  

2 (a) (i) \( V_H = 12.4 \cos 36^\circ (= 10.0 \text{m s}^{-1}) \) \((C1)\)  
distance = 10.0 \( \times 0.17 \)  
\( = 1.7 \text{m}\) \((A1) \) \([2]\)  

(ii) \( V_H = 12.4 \sin 36^\circ (= 7.29 \text{m s}^{-1}) \) \((C1)\)  
\( h = 7.29 \times 0.17 - \frac{1}{2} \times 9.81 \times 0.17^2 \) \((C1)\)  
\( = 1.1 \text{m}\) \((A1) \) \([3]\)  

(b) smooth curve with ball hitting wall below original \( B1 \)  
smooth curve showing rebound to ground with correct reflection at wall \( B1 \) \([2]\)  

3 (a) point at which (whole) weight (of body) \((allow mass for weight)\) \( M1 \)  
appears / seems to act ... (for mass need ‘appears to be concentrated’) \( A1 \) \([2]\)  

(b) (i) point C shown at centre of rectangle ± 5 mm \( B1 \) \([1]\)  
(ii) arrow vertically downwards, from C with arrow starting from the same margin of error as in (b)(i) \( B1 \) \([1]\)  

(c) (i) reaction / upwards / supporting / normal reaction force \( M1 \)  
friction \( M1 \)  
force(s) at the rod \( A1 \) \([3]\)  
(ii) comes to rest with (line of action of) weight acting through rod allow C vertically below the rod \( B1 \)  
so that weight does not have a moment about the pivot / rod \( B1 \) \([2]\)
4 (a) energy = average force × extension
   = \( \frac{1}{2} \times F \times x \)
   (Hooke's law) extension proportional to (applied) force
   hence \( F = kx \)
   so \( E = \frac{1}{2}kx^2 \)

(b) (i) correct area shaded
(ii) 1.0 cm² represents 1.0 mJ or correct units used in calculation
   \( E_s = 6.4 \pm 0.2 \) mJ
   (for answer > ±0.2 mJ but ≤ ±0.4 mJ, then allow 2/3 marks)
(iii) arrangement of atoms / molecules is changed

5 (a) (i) distance (of point on wave) from rest / equilibrium position
(ii) distance moved by wave energy / wavefront during one cycle of the source or minimum distance between two points with the same phase or between adjacent crests or troughs

(b) (i) \( T = 0.60 \) s
(ii) \( \lambda = 4.0 \) cm
(iii) either \( v = \frac{\lambda}{T} \) or \( v = f \lambda \) and \( f = \frac{1}{T} \)
   \( v = 6.7 \) cm s⁻¹

(c) (i) amplitude is decreasing
   so, it is losing power
(ii) intensity ~ (amplitude)²
   ratio = \( \frac{2.0^2}{1.1^2} \)
   = 3.3

6 (a) (i) at 22.5 °C, \( R_T = 1600 \) Ω or 1.6 kΩ
   total resistance = 800 Ω
(ii) either use of potential divider formula or current = 9 / 2000 (4.5 mA)
    \( V = (0.8/2.0) \times 9 \)
    \( = 3.6 \) V
    \( V = (9/2000) \times 800 \)
    \( = 3.6 \) V

(b) (i) total resistance = 4/5 × 1200
    = 960 Ω
(ii) for parallel combination, \( \frac{1}{960} = \frac{1}{1600} + \frac{1}{R_T} \)
    \( R_T = 2400 \) Ω / 2.4 kΩ
    temperature = 11 °C
(c) e.g. only small part of scale used / small sensitivity
    non-linear
    (any two sensible suggestions, 1 each, max 2)

7  (a) (i)  most $\alpha$-particles were deviated through small angles
           (allow 1 mark for ‘straight through’ / undeviated)

    (ii) small fraction of $\alpha$-particles deviated through large angles
         greater than 90° (allow rebound back)

(b) e.g. $\beta$-particles have a range of energies
     $\beta$-particles deviated by (orbital) electrons
     $\beta$-particle has (very) small mass
     (any two sensible suggestions, 1 each, max 2)

    Do not allow $\beta$-particles have negative charge or $\beta$-particles have high speed