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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.
1 (a) temperature
  current
  (allow amount of substance, luminous intensity)

(b) (i) \( E = \frac{\text{stress}}{\text{strain}} = \frac{\text{force}}{\text{area}} / \frac{\text{extension}}{\text{original length}} \)
  units of stress: kg m s\(^{-2}\) / m\(^2\) and no units for strain
  units of \( E \): kg m\(^{-1}\) s\(^{-2}\)

2. units for \( T \): s, \( t \) m and \( M \): kg
   \( K^2 = T^2 E/M t^3 \) hence units: s\(^2\) kg m\(^{-1}\) s\(^{-2}\) / kg m\(^3\) (= m\(^{-4}\))
   units of \( K \): m\(^{-2}\)

(ii) % uncertainty in \( E = 4\% \) (for \( T^2 \)) + 0.6\% (for \( t^3 \)) + 0.1\% (for \( M \)) + 3\% (for \( K^2 \))
   = 7.7\%

\[ E = \left[ (1.48 \times 10^5)^2 \times 0.2068 \times (0.892)^3 \right] / (0.45)^2 \]
\[ = 1.588 \times 10^{10} \]
\[ 7.7\% \text{ of } E = 1.22 \times 10^9 \]
\[ E = (1.6 \pm 0.1) \times 10^{10} \text{ kg m}^{-1} \text{ s}^{-2} \]

2 (a) ps = 10\(^{-12}\) (s) or \( T = 4 \times 50 \times 10^{-12} \) (s)
   \( v = f \lambda \) or \( v = \lambda / T \)
   \( \lambda = 3.0 \times 10^8 \times 4 \times 50 \times 10^{-12} \)
   = 0.06(0) m

(b) 1500 = 3.0 \times 10^8 \times 4 \times \text{time-base setting} or \( T = 5 \times 10^{-6} \) s
   time-base setting = 1.3 (1.25) \( \mu \)s cm\(^{-1}\)

3 (a) work done is \text{force} \times \text{distance moved in direction of force}
  or
  no work done along PQ as no displacement/distance moved in direction of force
  work done is same in vertical direction as same distance moved in direction of force

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(b) (i) at maximum height $t = 1.5$ s \[ V_v = 0 + 9.81 \times 1.5 \]
\[ = 15 \text{ (14.7) m s}^{-1} \] \[ s = \frac{1}{2} (u + v) t, \ s = 11 \text{ m and } t = 1.5 \text{ s} \] \[ V_v = (11 \times 2) / 1.5 \]
\[ = 15 \text{ (14.7) m s}^{-1} \] 

(ii) straight line from (0,0) to (3.00, 25.5) \[ \text{B1 [1]} \]

(iii) at maximum height $V_h = 25.5 / 3 (= 8.5 \text{ m s}^{-1})$ \[ \text{B1} \]
\[ \frac{mgh}{\frac{1}{2}mv^2} \] \[ = \frac{(2 \times 9.81 \times 11.0)}{(8.5)^2} \]
\[ = 3.0 \text{ (2.99)} \] 

(iv) deceleration is greater/resultant force (weight and friction force) is greater \[ \text{M1} \]
time is less \[ \text{A1 [2]} \]

4 (a) density = mass / volume \[ \text{C1} \]
mass = $7900 \times 4.5 \times 24 \times 10^{-6} = 0.85 \text{ (0.853) kg} \] \[ \text{M1 [2]} \]

(b) pressure = force / area \[ \text{C1} \]
force = $W \cos 40^\circ \] \[ \text{C1} \]
pressure = $(0.85 \times 9.81 \cos 40^\circ) / 24 \times 10^{-4}$ \[ = 2.7 \text{ (2.66)} \times 10^3 \text{ Pa} \] \[ \text{A1 [3]} \]

(c) $F = ma \] \[ \text{C1} \]
$W \sin 40^\circ - f = ma \] \[ \text{C1} \]
$0.85 \times 9.81 \times \sin 40^\circ - f = 0.85 \times 3.8$ \[ f (= 5.36 - 3.23) = 2.1 \text{ N} \] [5.38 – 3.242 if 0.8532 kg is used for the mass] \[ \text{A1 [3]} \]
5 (a) progressive: all particles have same amplitude
stationary: no nodes or antinodes or maximum to minimum/zero amplitude
progressive: adjacent particles are not in phase
stationary: waves particles are in phase (between adjacent nodes)

(b) (i) wavelength 1.2 m (zero displacement at 0.0, 0.60 m, 1.2 m, 1.8 m, 2.4 m)
either peaks at 0.30 m and 1.5 m and troughs at 0.90 m and 2.1 m
or vice versa (but not both)
maximum amplitude 5.0 mm
(ii) 180° or π rad
(iii) at t = 0 particle has kinetic energy as particle is moving
at t = 5.0 ms no kinetic energy as particle is stationary
so decrease in kinetic energy (between t = 0 and t = 5.0 ms)

6 (a) energy converted from chemical to electrical per unit charge

(b) (i) current = \( E / (R + r) \)
\[
= \frac{6.0}{(16 + 0.5)}
= 0.36 \text{ (0.364)A}
\]
(ii) terminal p.d. = (0.36 × 16) = 5.8 V or (6 – 0.36 × 0.5)
\[
= 5.8 \text{ V}
\]

(c) (i) use of \( R = \rho l / A \) or proportionality with length and inverse proportionality with area or \( d^2 \)
\[ d/2 \text{ and } l/2 \text{ gives resistance of } Z = 2R_{y} = 24 \text{ (Ω)} \]
\[ R \text{ = resistance of parallel combination = } [1/24 + 1/12]^{-1}
\]
\[ = 8.0 (Ω) \]
(ii) resistance of circuit less therefore current larger
lost volts greater therefore terminal p.d. less

(d) power = \( I^2 R \) or \( VI \) or \( V^2 / R \)
current in second circuit (= 6.0 / 12.5) = 0.48 (A)
ratio = [(0.36)^2 × 16] / [(0.48)^2 × 12] = 0.75 [0.77 if full s.f. used]
7  (a)  (i) curved path towards negative (–) plate (right-hand side)  

(ii) range of $\alpha$-particle is only few cm in air/loss of energy of the $\alpha$-particles due to collision with air molecules/ionisation of the air molecules  

(iii) $V = E \times d$

$= 140 \times 10^6 \times 12 \times 10^{-3} = 1.7 (1.68) \text{MV}$

(b) $\beta$ have opposite charge to $\alpha$ therefore deflection in opposite direction  

$\beta$ has a range of velocities/energies hence number of different deflections  

$\beta$ have less mass or $q/m$ is larger hence deflection is greater  

or  

$\beta$ with (very) high speed (may) have less deflection

(c) |
<table>
<thead>
<tr>
<th>emitted particle</th>
<th>change in $Z$</th>
<th>change in $A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$-particle</td>
<td>$-2$</td>
<td>$-4$</td>
</tr>
<tr>
<td>$\beta$-particle</td>
<td>$+1$</td>
<td>$0$</td>
</tr>
</tbody>
</table>

A1 [1]