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 May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.
1. (a) current, mass and temperature
   two correct 2/2, one omission or error 1/2

   (b) \( \sigma \) : no units, \( V \) : m\(^3\)
   \( E_p \) : kg m\(^2\) s\(^{-2}\)
   \( C \) : kg m\(^2\) s\(^{-2}\) \times m\(^{-3}\) = kg m\(^{-1}\) s\(^{-2}\)

2. (a) scalar has magnitude only
    vector has magnitude and direction

   (b) (i) \( v^2 = 0 + 2 \times 9.81 \times 25 \) (or using \( \frac{1}{2} m v^2 = mgh \))
    \( v = 22(.1) \) m s\(^{-1}\)

   (ii) \( 22.1 = 0 + 9.81 \times t \) (or \( 25 = \frac{1}{2} \times 9.81 \times t^2 \))
    \( t (=22.1/9.81) = 2.26 \) s or \( t [= (5.097)^{1/2}] = 2.26 \) s

   (iii) horizontal distance = \( 15 \times t \)
    = \( 15 \times 2.257 = 33.86 \) (allow \( 15 \times 2.3 = 34.5 \))
    (displacement)\(^2\) = (horizontal distance)\(^2\) + (vertical distance)\(^2\)
    = \( (25)^2 + (33.86)^2 \)
    displacement = \( 42 \) (42.08) m (allow \( 43 \) (42.6) m, allow 2 or more s.f.)

   (iv) distance is the actual (curved) path followed by ball
    displacement is the straight line/minimum distance P to Q

3. (a) work done is the product of force and the distance moved in the direction of the force
    or product of force and displacement in the direction of the force
(b) (i) work done equals the decrease in GPE – gain in KE  

(ii) 1. distance = area under line 

\[ \frac{7.4 \times 2.5}{2} = 9.3 \text{ m (9.25 m)} \]  

or  

acceleration from graph \( a = \frac{7.4}{2.5} (= 2.96) \)  

and equation of motion \( (7.4)^2 = 2 \times 2.96 \times s \) gives \( s = 9.3 \text{ (9.25) m} \)  

2. kinetic energy \( = \frac{1}{2} m v^2 \)  

\[ \frac{1}{2} \times 75 \times (7.4)^2 \]  

\[ = 2100 \text{ J} \]  

3. potential energy \( = mgh \)  

\[ h = 9.3 \sin 30^\circ \]  

\[ \text{PE} = 75 \times 9.81 \times 9.3 \sin 30^\circ = 3400 \text{ J} \]  

4. work done = energy loss  

\[ R = \frac{(3421 - 2054)}{9.3} \]  

\[ = 150 \text{ (147) N} \]  

4 (a) add small mass to cause extension then remove mass to see if spring returns to original length  
repeat for larger masses and note maximum mass for which, when load is removed, the spring does return to original length  

(b) Hooke’s law requires force proportional to extension  
graph shows a straight line, hence obeys Hooke’s law  

(c) \[ k = \text{force/extension} \]  

\[ = \frac{(0.42 \times 9.81)}{(30 - 21.2) \times 10^{-2}} \]  

\[ = 47 \text{ (46.8) N m}^{-1} \]  

5 (a) lost volts/energy used within the cell/internal resistance  
when cell supplies a current  

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(b) (i) \( E = I(R + r) \)
\[ 4.5 = 0.65 (6.0 + r) \]
\[ r = 0.92 \Omega \]  
A1  [2]

(ii) \( I = 0.65 \text{ A} \) and \( V = IR \)
\[ V = 0.65 \times 6 = 3.9 \text{ V} \]  
A1  [2]

(iii) \( P = V^2/R \) or \( P = I^2R \) and \( P = IV \)
\[ = (3.9)^2/6 = 2.5 \text{ W} \]  
A1  [2]

(iv) efficiency = power out/power in
\[ = \frac{I^2R}{(R + r)} = 6.0/(6.0 + 0.92) = 0.87 \]  
A1  [2]

(c) (circuit) resistance decreases
current increases
more heating effect  
B1  [3]

6 (a) (i) progressive wave transfers energy, stationary wave no transfer of energy/keeps energy within wave  
B1  [1]

(ii) (progressive) wave/wave from loudspeaker reflects at end of tube
reflected wave overlaps (another) progressive wave
same frequency and speed hence stationary wave formed  
B1  [3]

(iii) (side to side) along length of tube/along axis of tube  
B1  [1]

(b) all three nodes clearly marked with N/clearly labelled at cross-over points  
B1  [1]

(c) phase difference = 0  
A1  [1]

(d) (i) \( v = f\lambda \)
\[ \lambda = \frac{330}{440} = 0.75 \text{ m} \]  
A1  [2]

(ii) \( L = \frac{5}{4} \lambda \)
\[ = \frac{5}{4} \times 0.75 = 0.94 \text{ m} \]  
A1  [2]