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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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 May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) (i) all positions (accept 20, 40, 60, 80) marked to within $\pm 5^\circ$
positions are $40^\circ$, $70^\circ$, $90^\circ$ and $102^\circ$
(-1 for each error or omission)
(ii) allow $107^\circ \rightarrow 113^\circ$

(b) e.g. more sensitive at low volumes
(do not allow reference to ‘accuracy’)

2 (a) force per unit positive charge (on a small test charge)

(b) field strength $= (210/(1.5 \times 10^{-2}) =) 1.4 \times 10^4 \text{ N C}^{-1}$

(c) (i) acceleration $= Eq / m$

\[ = (1.4 \times 10^4 \times 1.6 \times 10^{-19}) / (9.1 \times 10^{-31}) \]

\[ = 2.5 \times 10^{15} \text{ m s}^{-2} \quad (2.46 \times 10^{15}) \]
towards positive plate / upwards (and normal to plate)

(ii) time $= 2.4 \times 10^{-9} \text{ s}$

(d) either vertical displacement after acceleration for $2.4 \times 10^{-9}$ s

\[= \frac{1}{2} \times 2.46 \times 10^{15} \times (2.4 \times 10^{-9})^2 \]

\[= 7.1 \times 10^{-3} \text{ m} \]

(0.71 cm < 0.75 cm and) so will pass between plates

i.e. valid conclusion based on a numerical value

or

\[0.75 \times 10^{-2} = \frac{1}{2} \times 2.46 \times 10^{15} \times t^2 \]

\[t \text{ is time to travel 'half-way across' plates} = 2.47 \times 10^{-9} \text{ s} \]

(2.4 ns < 2.47 ns) so will pass between plates

i.e. valid conclusion based on a numerical value

3 (a) mass / volume (ratio idea essential)

(b) (i) mass $= Ah \rho$

(ii) pressure = force/area

weight (of liquid)/force (on base) $= Ah \rho g$

pressure $= h \rho g$

(c) (i) ratio $= 1600$ or $1600:1$

(ii) ratio $= \sqrt[3]{1600}$

\[= 11.7 \quad (allow 12) \]
(d) (i) density of solids and liquids are (about) equal B1 [1]

(ii) strong forces: fixed volume
rigid forces: retains shape / does not flow / little deformation
(allow 1 mark for fixed volume, fixed shape) B1 [2]

4 (a) (i) (change in) potential energy = \( mgh \)
\[
\begin{align*}
&= 0.056 \times 9.8 \times 16 \\
&= 8.78 \text{ J} \quad (allow \ 8.8) \quad A1 \ [2]
\end{align*}
\]

(ii) (initial) kinetic energy = \( \frac{1}{2}mv^2 \)
\[
\begin{align*}
&= \frac{1}{2} \times 0.056 \times 18^2 \\
&= 9.07 \text{ J} \quad (allow \ 9.1) \quad C1 \\
&\text{total kinetic energy} = 8.78 + 9.07 = 17.9 \text{ J} \quad A1 \ [3]
\end{align*}
\]

(b) kinetic energy = \( \frac{1}{2}mv^2 \)
\[
17.9 = \frac{1}{2} \times 0.056 \times v^2 \quad \text{and} \quad v = 25(\cdot) \text{ m s}^{-1} \quad B1 \ [1]
\]

(c) horizontal velocity = 18 m s\(^{-1}\) B1 [1]

(d) (i) correct shape of diagram
(two sides of right-angled triangle with correct orientation) B1

(ii) angle = 41° \( \rightarrow \) 48° (allow trig. solution based on diagram)
(for angle 38° \( \rightarrow \) 41° or 48° \( \rightarrow \) 51°, allow 1 mark) A2 [3]

5 (a) (i) vibrations (in plane) normal to direction of energy propagation B1 [1]

(ii) vibrations in one direction (normal to direction of propagation) B1 [1]

(b) (i) at (displacement) antinodes / where there are no heaps, wave has maximum amplitude (of vibration) B1
at (displacement) nodes/where there are heaps, amplitude of vibration is zero/minimum B1

dust is pushed to / settles at (displacement) nodes B1 [3]

(ii) \( 2.5\lambda = 39 \text{ cm} \)
\[
\begin{align*}
\lambda &= 15.6 \times 10^{-2} \\
\lambda &= 2.14 \times 10^3 \times 15.6 \times 10^{-2} \\
&= 334 \text{ m s}^{-1} \quad (allow \ 330, \ not \ 340) \quad A1 \ [3]
\end{align*}
\]

(c) Stationary wave formed by interference / superposition / overlap of
either wave travelling down tube and its reflection
or two waves of same (type and) frequency travelling in opposite directions B1

speed is the speed of the incident / reflected waves B1 [3]
6 (a) (i) 1 total resistance = 0.16 Ω
        2 e.m.f. = either \((14 - E)\) or \((E - 14)\)
(ii) either \(14 - E = 42 \times 0.16\) or \((E - 14) = -42 \times 0.16\)
       \(E = 7.3\) V
A1
A1 [2]

(b) (i) charge = \(lt\)
        = \(12.5 \times 4 \times 60 \times 60\)
        = \(1.8 \times 10^5\) C
A1 [2]

(ii) either energy = \(EQ\) or energy = \(Eit\)
       either energy = \(14 \times 1.8 \times 10^5\) or energy = \(14 \times 12.5 \times 4 \times 3600\)
       \(= 2.52 \times 10^6\) J
A1 [2]

(iii) energy = \(I^2Rt\) or \(Vit\) and \(V = IR\)
       \(= 12.5^2 \times 0.16 \times 4 \times 3600\)
       \(= 3.6 \times 10^5\) J
A1 [2]

(c) efficiency = \((2.52 \times 10^6 - 3.6 \times 10^5)/(2.52 \times 10^6)\)
       \(= 86\%\)
A1 [2]

7 (a) \(\beta\)-(decay)
B1 [1]

(b) \(\gamma\)-(decay)
B1

\(\text{either any two of } Z, N \text{ and } A \text{ do not change}\)
\(\text{or it is loss of energy only}\)
\(\text{or it is an electromagnetic wave}\)

Allow ‘\(\alpha\)-(decay)’ as change of 4 in the nucleon number cannot be shown on the diagram’

Do not give credit for a ‘bald’ \(\alpha\)-(decay)