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.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
NOTES ABOUT MARK SCHEME

M marks are method marks upon which further marks depend. For an M mark to be scored, the point to which it refers must be seen in a candidate's answer. If a candidate fails to score a particular M mark, then none of the dependent marks can be scored.

B marks are independent marks, which do not depend on other marks. For a B mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

A marks In general A marks are awarded for final answers to numerical questions. If a final numerical answer, eligible for A marks, is correct, with the correct unit and an acceptable number of significant figures, all the marks for that question are normally awarded. It is very occasionally possible to arrive at a correct answer by an entirely wrong approach. In these rare circumstances, do not award the A marks, but award C marks on their merits. However, correct numerical answers with no working shown gain all the marks available.

C marks are compensatory marks in general applicable to numerical questions. These can be scored even if the point to which they refer are not written down by the candidate, provided subsequent working gives evidence that they must have known it. For example, if an equation carries a C mark and the candidate does not write down the actual equation but does correct substitution or working which shows he knew the equation, then the C mark is scored. A C mark is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored.

brackets ( ) around words or units in the mark scheme are intended to indicate wording used to clarify the mark scheme, but the marks do not depend on seeing the words or units in brackets, e.g. 10 (J) means that the mark is scored for 10, regardless of the unit given.

underlining indicates that this must be seen in the answer offered, or something very similar.

OR / or indicates alternative answers, any one of which is satisfactory for scoring the marks.

e.e.o.o. means "each error or omission".

o.w.t.t.e. means "or words to that effect".

Spelling Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, beware of and do not allow ambiguities, accidental or deliberate: e.g. spelling which suggests confusion between reflection / refraction / diffraction / thermistor / transistor / transformer.

Not/NOT Indicates that an incorrect answer is not to be disregarded, but cancels another otherwise correct alternative offered by the candidate i.e. right plus wrong penalty applies.

Ignore Indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong penalty.
ecf meaning "error carried forward" is mainly applicable to numerical questions, but may in particular circumstances be applied in non-numerical questions. This indicates that if a candidate has made an earlier mistake and has carried an incorrect value forward to subsequent stages of working, marks indicated by ecf may be awarded, provided the subsequent working is correct, bearing in mind the earlier mistake. This prevents a candidate being penalised more than once for a particular mistake, but only applies to marks annotated ecf.

Significant Figures
Answers are normally acceptable to any number of significant figures ≥ 2. Accept answers that round to give the correct answer to 2 s.f. Any exceptions to this general rule will be specified in the mark scheme.

Units
Deduct one mark for each incorrect or missing unit from a final answer that would otherwise gain all the marks available for that answer; maximum 1 per question. No deduction is incurred if the unit is missing from the final answer but is shown correctly in the working.

Arithmetic errors
Deduct one mark if the only error in arriving at a final answer is clearly an arithmetic one.

Transcription errors
Deduct one mark if the only error in arriving at a final answer is because given or previously calculated data has clearly been misread but used correctly.

Fractions
E.g. ½, ¼ etc are only acceptable where specified.
1 (a) Period: 1.81 s OR 1.8 s as mean value
   OR 1.8 s as most common reading / the mode  B1

(b) Time a minimum of 2 (successive) oscillations  B1
   Divide result by the number of oscillations  B1
   OR
   Count no. of oscillations in at least 20 s (B1)
   Divide the time by the number of oscillations
   OR Divide no. of oscillations by time and find reciprocal
   2 of:
   Repeat (several times) and find mean
   Time with reference to fixed / fiducial point or top or bottom of oscillation
   Check / set zero of stop-watch
   Show knowledge of what is meant by one oscillation

[Total: 5]

2 (a) (i) Increasing speed / acceleration  B1

   (ii) Constant / steady / uniform speed or motion  B1

   (iii) Decreasing speed / deceleration / braking / slowing / stopping / negative acceleration  B1

(b) (i) (Total) distance / (total) time OR \( d / t \) OR 400 / 60  C1
   6.67 m/s at least 2 s.f.  A1

   (ii) Mention of maximum gradient OR clear that whole or part of B to C is used  C1
   Use of correct data from graph to +/- ½ square  C1
   Answer rounds to 9.2 to 9.4 m/s, at least 2 s.f.  A1

[Total: 8]
3 (a) Example: e.g. battery: (chemical to) electrical
engine: (chemical to) kinetic / mechanical
fire: (chemical to) thermal / heat
(human) body: (chemical to) heat / kinetic

(b) (i) \( P = IV \) OR in words OR \( 0.27 \times 17 \)
\( = 4.59 \text{ W} \) at least 2 s.f.

(ii) \( (\text{K.E.} =) \text{efficiency} \times \text{input} \) OR \( 0.35 \times 4.59 \)
\( = 1.61 \text{ J} \) or \( \text{Nm} \) at least 2 s.f.

(iii) 1. \( d = \frac{m}{V} \) OR \((m =) \ V \times d \) OR in words OR \( 0.00014 \times 1000 \)
\( = 0.14 \text{ kg} \) A1

2. P.E. gained = K.E. lost OR \( mgh = \frac{1}{2} mv^2 \)
\( \text{OR} \ 0.14 \times 10 \times h = 1.61 \) OR \( 1.6 \)
\( h = 1.15 \text{ m} \) OR \( 1.14 \text{ m} \) at least 2 s.f.

OR
\( \frac{1}{2} mv^2 = 1.61 \) OR
\( v^2 = 2 \times 1.61 / 0.14 = 23 \) OR \( v^2 = 2 \times 1.6 / 0.14 = 22.86 \)
\( (h =) \ v^2/2g = 23/20 = 1.15 \text{ m} \) OR \( (h =) 22.86/20 = 1.14 \text{ m} \)

[Total: 9]

4 (a) \( \frac{p = F}{A} \) OR in words OR \( 90/4.8 \) OR \( 90 / 0.00048 \)
\( = 18.75 \text{ N/cm}^2 \) OR \( 1.875 \times 10^5 \text{ Pa} \) OR \( 187500 \text{ Pa} \)
\( \text{OR} 187.5 \text{ kPa} \) OR \( 0.1875 \text{ MPa} \) at least 2 s.f.

(b) Area of Y bigger (than area of X so force greater)

(c) Volume of oil moved at Y = volume of oil moved at X
Area of Y \times distance moved by Y = Area of X \times distance moved by X (so distance move by Y smaller)
OR
Work done by piston X = work done on piston Y
Work = force \times distance and \( F_2 \) is greater than \( F_1 \) so distance moved by Y smaller (than distance moved by X)

(d) Air bubbles compress when pressure applied
More movement of piston X required for same movement of piston Y OR Y moves less (for same movement of X)
OR Driver must push the brake pedal further / do more work
OR Pressure reduced / force on Y reduced
OR System is less efficient

[Total: 7]

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5 (a) (i) e.g. freezing, solidification, condensation
OR example e.g. water to ice, steam to water, gas to solid  B1

(ii) No change  B1

(b) Heat/energy required to change temperature of the body  B1
by 1 °C / 1 K / 1 unit / 1 deg  B1
OR
mass (of body) × specific heat capacity (B2)

(c) (i) $Q = mc\theta$ OR in words OR $250 \times 4.2 \times 20$  C1
= 21000 J  A1

(ii) 21000 J OR same as (c)(i)  B1

(iii) $Q = mL$ OR $m = Q/L$ OR either in words
OR $21000 = m \times 330$ OR $m = 21000/330$
= 63.6 g at least 2 s.f.  A1

[Total: 9]

6 (a) (i) Glass / flask receives heat / rises in temperature  B1
Glass / flask expands  B1

(ii) Heat flows through glass to water OR Water receives heat / thermal energy
from / conducted by glass  OR Water temperature rises OR Water molecules
move faster / gain K.E.  B1
Water expands / Water molecules move further apart  B1

(iii) Glass / solid expands less OR water / liquid expands more  B1

(b) Use a bigger flask OR a narrower tube  B1
OR Use a solid and a liquid that expand more  B1

[Total: 6]
7  (a) (Molecule) moves up and down / rises and falls
   OR oscillates perpendicular to direction of wave
   OR describes a circle

   (b) (i) At least 3 circular arcs, angular spread greater than 90° (symmetrically above
           and below slit
           Centre of arcs at centre of slit and with same spacing (by eye) as incident
           waves

           (ii) Diffraction

   (c) \( v = f \times \lambda \) OR \( 12 = f \times 1.4 \) OR \( f = v / \lambda \) OR \( f = 12 / 1.4 \)
       \( f = 8.57 \text{ Hz} / \text{per s / waves or vibrations per s} \)
       at least 2 s.f.

   [Total: 6]

8  (a) (i) Electron(s)

   (ii) At least 2 + signs on left-hand side of S
       Same number of – signs on right-hand side of S

   (iii) Connect S to earth (with rod in place)
       Remove connection of S to earth
       Remove R / rod

   (b) (i) \( Q = It \) OR \( I = Q / t \) OR in words \( I = 30/120 \)
       = 0.25 A or C/s

   (ii) \( E = IVt \) OR in words \( 0.25 \times 1.5 \times 10^6 \times 120 \)
       \( E = QV \) OR in words \( 30 \times 1.5 \times 10^6 \)
       \( E = 45000000 \text{ J} / 4.5 \times 10^7 \text{ J} / 45 \text{ MJ} / 12.5 \text{ kWh} \)

   [Total: 9]
9 (a) (i) \( I_1 = I_2 + I_3 \)  
\( I_1 = I_2 \) OR same  \( \text{B1} \)

(b) (i) \( V = IR = 0.80 \times 3.0 = 2.4 \text{ V} \) \( \text{A1} \)

\( I = \frac{V}{R} \) in any algebraic form \( \text{OR} \) \( \frac{2.4}{2} \) \( \text{OR} \) \( (b)(i) / 2 \) \( \text{C1} \)

\( I_3 = \frac{V}{R} = 2.4 / 2 = 1.2 \text{ A} \)

\( I_3 = \frac{V}{R} = 2.4 / 2 = 1.2 \text{ A} \)

\( I_3 = \frac{3}{2} \times 0.8 \text{ A} = 1.2 \text{ A} \)  \( \text{C1} \)

\( \text{OR} \)

\( \text{Parallel combination formula: } \frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2} \)

\( \text{OR} \)

\( \frac{r_1r_2}{r_1 + r_2} \)  \( \text{C1} \)

\( \text{Use of formula: combined resistance } = 1.2 \text{ (Ω)} \)

\( R + 1.2 = 6 / 2 = 3 \text{.0 } \Omega \)

\( R = 1.8 \text{ Ω} \)  \( \text{A1} \)

\( \text{OR} \)

\( \text{Current through } R = 0.8 + 1.2 = 2.0 \text{ (A)} \)

\( \text{OR} \)

\( 6 \text{ V} / 2 \text{ A used} \)  \( \text{C1} \)

\( \text{P.D. across } R = 6.0 - 2.4 \)

\( = 3.6 \text{ (V)} \)  \( \text{C1} \)

\( R = 3.6 / 2.0 = 1.8 \text{ Ω} \)  \( \text{A1} \)

[Total: 9]

10 (a) (i) Parallel lines perpendicular to pole faces with arrows N to S  \( \text{B1} \)

(ii) Arrow pointing to the right  \( \text{B1} \)

(b) (i) Geiger (counter) / Geiger (tube) (+ scaler / ratemeter) / photographic plate / scintillation counter / cloud chamber / luminescent or phosphorescent plate  \( \text{B1} \)

(ii) Out of the plane of the paper  \( \text{B1} \)

(iii) (Path is) a curve / circular / arc  \( \text{B1} \)

(iv) (Air molecules are) ionised / lose electrons  \( \text{B1} \)

[Total: 6]
11  (a) Transistor  

(b) Resistor / variable resistor / rheostat identified  
    Light-dependent resistor / LDR identified  
    Resistor or alternative in gap A; LDR in gap B  

(c) Thermistor / thermal resistor / heat or temperature dependent resistor identified  
    Thermistor (or alternative name) in gap A and resistor in gap B  

[Total: 6]