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 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.
NOTES ABOUT MARK SCHEME SYMBOLS & OTHER MATTERS

**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.

**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".

**c.a.o.** correct answer only

**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.

**Sig. figs.**  
Answers are normally acceptable to any number of significant figures $\geq 2$. Any exceptions to this general rule will be specified in the mark scheme. In general, accept numerical answers, which, if reduced to two significant figures, would be right.

**Units**  
Deduct one mark for each incorrect or missing unit from an 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. $\frac{1}{2}$, $\frac{1}{4}$, $1/10$ etc are only acceptable where specified.

**Crossed out work**  
Work which has been crossed out and not replaced but can easily be read, should be marked as if it had not been crossed out.

**Use of NR**  
(# key on the keyboard) Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols.
1 (a) (i) a time from 12.5 – 14.9 s or 15.1 – 16.0 s *Unit penalty applies B1
(ii) a time from 0 – 2.5 s or 14.9 – 15.1 s *Unit penalty applies B1
(iii) a time from 2.5 – 12.5 s *Unit penalty applies B1

(b) (initially) weight/force of gravity and air friction/resistance act B1
it speeds up/accelerates and (air) friction/resistance increases B1
reaches terminal/constant velocity B1
(air) friction/resistance = weight or no resultant (force) or forces in equilibrium B1

(c) upwards B1 [8]
*Apply unit penalty once only

2 (a) 54 N *Unit penalty applies B1

(b) (i) (the point where) proportionality between force/weight and extension/Hooke’s Law stops B1
(ii) 35 – 20 or 15 (cm) or 25 – 20 or 5 (cm) C1
(F =) kx or 54/15 × 5 or 54/15 or 5/15 ecf from 2(a) C1
18 N *Unit penalty applies ecf from 2(a) A1
54 – 18 or 36 or 5.4 – 1.8 ecf from 2(b)(ii)1. C1
3.6 kg *Unit penalty applies ecf from 2(b)(ii)1. A1

(iii) (ρ =)m/V or 3.6/0.0045 ecf from 2(b)(ii)2. C1
800 kg/m³ *Unit penalty applies ecf from 2(b)(ii)2. A1

(c) air molecules further apart or oil molecules closer together B1 [10]
*Apply unit penalty once only

3 (a) (i) (a =) v/t or 65/26 C1
2.5 m/s² *Unit penalty applies A1

(ii) (F =)ma or 3.4 × 10⁵ × 2.5 ecf from 3(a)(i) C1
8.5 × 10⁵ N *Unit penalty applies ecf from 3(a)(i) A1

(b) (i) any two of: KE or GPE or heat/internal energy/thermal energy B2
(ii) chemical energy not heat B1
(iii) thermal energy/sound is lost (to the atmosphere) or KE of air B1
(c) perpendicular to path or towards centre of circle or centripetal  
B1 [9]

*Apply unit penalty once only

4 (a) (i) atoms/molecules/particles move or collide (ignore with each other)  
B1
atoms/molecules/particles collide with (inside) surface/wall  
M1
force (exerted) on wall etc. or force/unit area or force spread-out  
A1

(ii) fewer atoms/molecules/particles and fewer collisions (with wall)  
B1

(b) \( P = h \rho g \) or \( 25 \times 1.0 \times 10^3 \times 10 \)  
C1
\( h \rho g + p \) atm  
C1
\( 25 \times 1.0 \times 10^3 \times 10 + 10^5 \) or \( 2.5 \times 10^5 \)  
C1
\( 3.5 \times 10^5 \) Pa  
A1 [7]

*Apply unit penalty once only

5 (a) (i) water molecules hit copper/tank/atoms or copper atoms hit air molecules or radiation from water/tank/copper or describe/mention evaporation  
B1
vibrating (copper) atoms/molecules/particles hit neighbours pass on energy/vibration or vibrating (copper) atoms/molecules/particles hit electrons (through copper)  
B1
electrons strike copper atoms  
B1

(ii) smaller temperature difference/thermal gradient (between tank and air) or reduced vibrations of copper atoms or water molecules slower/less kinetic energy or reduced radiation (emitted) or less evaporation  
B1

(b) diagram of suitable vessel(s) (one shiny; one dark)  
B1
action – e.g. fill with hot water and same mass/volume  
B1
starting temperatures are the same  
B1
measure final temperature and compare drop or equivalent  
B1
allow detailed description of Lesley’s cube method and measure emission rate (for a maximum of 4 marks)  
[8]

6 (a) (i) \( 2.0 - 4.0 \times 10^8 \) m/s  
B1

(ii) \( f = \frac{v}{\lambda} \) or \( 3.0 \times 10^9/4.0 \times 10^{-7} \)  
C1
\( 7.5 \times 10^{14} \) Hz  
A1 ecf from 6(a)(i)

(b) (i) 55°  
B1

(ii) \( \frac{\sin i}{\sin r} = n \) or \( \sin 55°/1.5 \) or \( 0.54610 \)  
C1
\( 33° \)  
A1 ecf from 6(b)(i) [6]

*Apply unit penalty once only
7 (a) (i) any two of these rays from top of object:
paraxial to lens and on through focal point
undeviated to centre of lens
as if from focal point to lens and then paraxial
traced back to locate image
B2

(ii) any two of: virtual/upright/magnified/further from lens/dimmer
B2

(b) (i) 3.4 – 3.6 cm *Unit penalty applies
B1

(ii) magnifying glass/magnifier (c.a.o.)
B1 [7]

*Apply unit penalty once only

8 (a) (i) (I =) \( V/R \) or 230/46
5.0 A *Unit penalty applies
C1

(ii) (P =) \( IV \) or \( \sqrt{I^2R} \) or \( I^2R \) or 230 × 5 or 230²/46 or \( 5^2 \times 46 \)
ecf from 8(a)(i)
1100/1150/1200 W *Unit penalty applies ecf from 8(a)(i)
C1

(b) same as 8(a)(i) (c.a.o.) *Unit penalty applies
B1 [5]

*Apply unit penalty once only

9 (a) (i) changing magnetic field (in coil) or field lines cut coil (or vice versa)
e.m.f./current induced
B1

(ii) smaller deflection/current/reading/voltage or deflection lasts longer (ignore slower)
rate of cutting field lines/change of magnetic field reduced
B1

(iii) deflection/current in opposite direction
B1

(b) alternating/changing current (in primary coil)
alternating/changing magnetic field clearly in core
field channelled from primary to secondary by core (somehow expressed) or core increases effect
induced e.m.f. in secondary
B1 [9]

10 (a) (i) light-dependent resistor/LDR
B1

(ii) (in bright light) resistance of Z/LDR/circuit falls/is low
current rises/is large/(starts to) flow/more p.d. across R
relay (coil) magnetises/attracts/is magnet
switch closes/completes second circuit
B1
11 (a) \[ \frac{234}{91} \text{(Pa) (c.a.o.)} \]  
\[ \frac{0}{\beta} \text{(c.a.o.)} \]  
B1

(b) (i) correctly curved path upwards (ignore lines not between plates)  
(\text{not in/out not if some section is downwards})  
B1

(ii) attracted by/move towards the positive/opposite plate/charge \text{ or } repelled by the negative/same plate/charge \text{ no ecf from (b)(i)}  
B1 [5]