UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

0625 PHYSICS

0625/31 Paper 3 (Extended Theory), maximum raw mark 80

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.

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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 (B1)
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 B2
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 B1

(b) **(i)** (P =) IV OR in words OR 0.27 × 17 C1
= 4.59 W at least 2 s.f. A1

(ii) (K.E. =) efficiency × input OR 0.35 × 4.59 C1
= 1.61 J or Nm at least 2 s.f. A1

(iii) **1.** $d = m/V$ OR (m =) $V \times d$ OR in words OR 0.00014 × 1000 C1
= 0.14 kg A1

2. P.E. gained = K.E. lost OR $mgh = ½\ mv^2$
OR 0.14 × 10 × h = 1.61 OR 1.6 C1
h = 1.15 m OR 1.14 m at least 2 s.f. A1

OR
$½\ mv^2$ = 1.61 OR
v^2 = 2 × 1.61 / 0.14 = 23 OR v^2 = 2 × 1.6 / 0.14 = 22.86 (C1)
(h =) $v^2/2g$ = 23/20 = 1.15 m OR (h =) 22.86/20 = 1.14 m (A1)

[Total: 9]

4 **(a)** (p =) F/A OR in words OR 90/4.8 OR 90 / 0.00048 C1
= 18.75 N/cm^2 OR 1.875 × 10^5 Pa OR 187500 Pa
OR 187.5 kPa OR 0.1875 MPa at least 2 s.f. A1

(b) Area of Y bigger (than area of X so force greater) B1

(c) Volume of oil moved at Y = volume of oil moved at X B1
Area of Y × distance moved by Y = Area of X × distance moved by X (so distance move by Y smaller) B1
OR
Work done by piston X = work done on piston Y (B1)
Work = force × distance and F_2 is greater than F_1 so distance moved by Y smaller (than distance moved by X) (B1)

(d) Air bubbles compress when pressure applied M1
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 A1

[Total: 7]

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 × 4.2 × 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 × 330 OR m = 21000/330 C1
= 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
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 B1

(b) **(i)** At least 3 circular arcs, angular spread greater than 90° (symmetrically above and below slit B1
Centre of arcs at centre of slit and with same spacing (by eye) as incident waves B1

(ii) Diffraction B1

(c) $v = f \times \lambda$ OR $12 = f \times 1.4$ OR $f = v / \lambda$ OR $f = 12 / 1.4$ C1
$f = 8.57$ Hz / per s / waves or vibrations per s A1
at least 2 s.f.

[Total: 6]

8 **(a)** **(i)** Electron(s) B1

(ii) At least 2 + signs on left-hand side of S
Same number of – signs on right-hand side of S B1

(iii) Connect S to earth (with rod in place) M1
Remove connection of S to earth M1
Remove R / rod A1

(b) **(i)** $Q = It$ OR $I = Q / t$ OR in words OR $I = 30/120$ C1
$= 0.25$ A or C/s A1

(ii) $E = IVt$ OR in words OR $0.25 \times 1.5 \times 10^6 \times 120$ C1
OR
$E = QV$ OR in words OR $30 \times 1.5 \times 10^6$ (C1)
$E = 45000000$ J / 4.5×10^7 J / 45 MJ / 12.5 kWh A1

[Total: 9]

9 (a) (i) $I_1 = I_2 + I_3$ B1

(ii) $I_1 = I_4$ OR same B1

(b) (i) ($V = IR$ = 0.80 × 3.0 =) 2.4 V A1

(ii) $I = V/R$ in any algebraic form OR 2.4 / 2 OR **(b)(i)** / 2
OR any voltage divided by 2 C1
($I_3 = V/R$ = 2.4 / 2 =) 1.2 A A1
OR
I_3/I_2 = 3/2 (C1)
I_3 = 3/2 × 0.8 A = 1.2 A (A1)

(iii) ($I_2 + I_3$ OR Current through R = 0.8 + 1.2) = 2.0 (A)
OR 6 V / 2 A used C1
Parallel combination formula: $1/r = 1/r_1 + 1/r_2$
OR (r =) $r_1r_2/(r_1 + r_2)$ C1
Use of formula: combined resistance = 1.2 (Ω) C1
(R + 1.2 = 6/2 = 3.0 Ω R =) 1.8 Ω A1
OR
Current through R = 0.8 + 1.2 = 2.0 (A) (C1)
P.D. across R = 6.0 – 2.4 (C1)
= 3.6 (V) (C1)
R = 3.6 / 2.0 = 1.8 Ω (A1)

[Total: 9]

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

(ii) Arrow pointing to the right B1

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

(ii) Out of the plane of the paper B1

(iii) (Path is) a curve / circular / arc B1

(iv) (Air molecules are) ionised / lose electrons B1

[Total: 6]

11 (a) Transistor B1

(b) Resistor / variable resistor / rheostat identified B1
Light-dependent resistor / LDR identified B1
Resistor or alternative in gap A; LDR in gap B B1

(c) Thermistor / thermal resistor / heat or temperature dependent resistor identified B1
Thermistor (or alternative name) in gap A and resistor in gap B B1

[Total: 6]