CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2012 series

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 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.

CAMBRIDGE
International Examinations

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 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".

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 $\geqslant 2$. 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. ½, ¼, 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)** s = area under graph, stated or clearly used C1
= (½ × 18 × 10) + (120 × 18) + (½ × 18 × 20) Award if at least one term correct C1
= 90 + 2160 +180 C1
= 2430 m / 2.43 km at least 2 significant figures. *Unit penalty applies A1

(ii) v = u + at in any form OR (a=) gradient OR 18/10 C1
= 1.8 m/s^2 *Unit penalty applies A1

(b) (F=) ma OR 1.1 × 10^5 × 1.8 ecf from **(a)(ii)** C1
= 1.98 × 10^5 N at least 2 significant figures. *Unit penalty applies A1

(c) driving force = friction/air resistance/drag B1 **[9]**

*Apply unit penalty once only

2 **(a)** Size / magnitude (NOT distance) and direction B1

(b) Vectors towards East and North with arrows correct by eye B1
Complete triangle or rectangle for candidate's vectors B1
Resultant with correct arrow B1
Resultant 94 to 96 m/s by scale OR 95 m/s by calculation *Unit penalty applies B1
Angle measured 13.5° – 15.5° OR 15° by calculation *Unit penalty applies B1 **[6]**

*Apply unit penalty once only

3 **(a)** No resultant/net force OR no resultant force in any direction
OR no resultant force in any two perpendicular directions B1

No resultant/net moment/turning effect/couple/torque
OR (total) clockwise moment = (total) anticlockwise moment B1

Either order

(b) **(i)** F × 120 / F × 0.12 C1
= 20 × 500 OR 20 × 0.5 C1
F = 83.3 N at least 2 significant figures. Allow 83$^1/_3$ *Unit penalty applies A1

(ii) F/A or in words OR 83.3/0.0036 ecf from **(b)(i)** C1
= 23100 Pa / N/m^2 OR 2.31 N/cm^2 OR 23.1 kPa *Unit penalty applies A1 **[7]**

*Apply unit penalty once only

4 **(a)** (The point in the body) where (all) the mass / weight / gravity acts / appears to act (owtte) B1

(b) h is the height through which the centre of mass/rises
OR centre of mass/rises (much) less than 2.0 m

OR centre of mass/of athlete is above the ground level
OR centre of mass/gravity passes under bar B1

Allow centre of gravity in place of centre of mass

(c) Standing: has chemical energy B1
Run-up: kinetic energy gained B1
Pole bent: has strain / elastic energy B1
Rise: potential energy gained B1
Fall: kinetic energy gained B1
On mat: has thermal / heat / sound / strain / elastic energy B1 **[8]**

5 **(a)** **(i)** (Force exerted when) molecules hit wall / surface / solid (and rebound) B1
Allow (force) due to momentum change in collision

(ii) Molecules/atoms/particles collide with / push against walls B1
more (often) B1
(so) bigger force / push B1

NOT collide faster

(b) $P_1V_1 = P_2V_2$ OR PV = constant C1
$8.0 \times 10^5 \times 5000 = 1 \times 10^5 \times V_2$ C1
$V_2 = 40\,000\ cm^3$ C1
Volume escaped = $40\,000 - 5000 = 35\,000\ cm^3$ A1 **[8]**

6 **(a)** Heat required to change state of / melt 1 kg / 1 g / unit mass of solid (with no change of temperature) B1

Allow specific example e.g. ice to water
NOT liquid to gas

(b) (i) d = m/V in any form OR (m =) V × d C1
OR (m =) 0.25 × 0.012 × 920
= 2.76 kg at least 2 significant figures. *Unit penalty applies A1

(ii) 60% of 250 = 150 (W/m^2) OR 250 × 0.25 = 62.5 (J) C1
Heat absorbed in 1 s = 150 × 0.25 = 37.5 (J)
OR 60 % of 62.5 = 37.5 J OR J/s OR W *Unit penalty applies A1

Allow J/s or W because in one second.

(iii) Q = mL OR m = Q/L OR m = 37.5 / 3.3×10^5 ecf from **(b)(ii)** C1
m = 0.0001136 (kg) (in 1 s) C1
Time taken = 2.76/0.000114 = 24300 s at least 2 significant figures. *Unit penalty applies A1
OR
P = Q/t OR t = Q/P OR t = mL/P (C1)
t = $2.76 \times 3.3 \times 10^5$ / 37.5 (C1)
= 24300 s *Unit penalty applies (A1) **[8]**

*Apply unit penalty once only

7 (a) Faster / more energetic molecules escape / evaporate (from surface) B1
Molecules left (in liquid) have lower average speed / energy so temperature is lower B1
OR
(Latent) heat needed to evaporate / leave the surface (B1)
comes from remaining liquid (B1)

(b) (i) Dull surface is <u>better</u> radiator / radiates <u>faster</u>
OR Shiny surface is <u>poorer</u> radiator / radiates <u>slower</u> B1

(ii) C <u>hotter</u> (than A) OR A <u>cooler</u> (than C) (so evaporates at a <u>faster</u> rate in C) B1

(iii) Less liquid in D OR more liquid in A B1

(iv) E has <u>greater</u> (surface) area / more open to air / is <u>shallower</u> B1
<u>greater</u> rate of loss of heat by evaporation / convection / conduction / radiation B1 **[7]**

8 (a) (i) Diagram to show – boundary, normal <u>and</u> ray bending towards normal B1
Angle of incidence labelled i or 51° B1
Angle of refraction labelled r or 29° B1

(ii) n = sin i / sin r OR n = sin 51 / sin 29 C1
n = 1.603 at least 2 s.f. *Unit penalty applies A1

(b) Ray is totally internally reflected / undergoes TIR B1
Angle of incidence is more than / equal to the critical angle (of the glass) B1
OR
Ray travels along the boundary (B1)
Angle of incidence = critical angle (of the glass) (B1)
OR
Critical angle calculated as 38.6° ecf from **(a)(ii)** (B1)
Angle of incidence greater than critical angle (of the glass) (B1) **[7]**

9 **(a)** **(i)** In the opposite direction OR downwards B1
Faster / fast B1

(ii) No voltage/current induced B1
Currents/voltages (induced) in each half of XY are equal and in opposite directions/oppose each other B1

(b) **(i)** Y-plates B1

(ii) Up and down (repeatedly) owtte B1

(iii) Off / zero B1 **[7]**

10 **(a)** **(i)** current

(ii) p.d. OR potential difference OR voltage B1

Both required

(b) $R = R_1 + R_2$ OR 1.2 + 3.6 OR 4.8 (k Ω) C1
$I = 9.0 / 4.8 = 1.875$ (mA) OR $9.0/4800 = 1.875 \times 10^{-3}$ (A) C1
Voltmeter reading = 6.75 V *Unit penalty applies A1
OR
Voltmeter reading = $[R_1 / (R_1 + R_2)]$ V (C1)
$= [3.6 / (1.2 + 3.6)] \times 9.0$ (C1)
= 6.75 V *Unit penalty applies (A1)

(c) (In fire) temperature of thermistor rises and its resistance falls B1
Current (through thermistor and relay coil) rises / flows B1
OR voltage / p.d. across / of relay coil rises
Magnetic field of relay closes switch (and bell rings) B1 **[7]**

*Apply unit penalty once only

11 (a) (i) alpha or α

(ii) beta or β

(iii) gamma or γ B2

Symbols must be clear
3 correct B2
2 correct B1

(b) (i) repulsion B1
α particle and (gold) nucleus / protons of (gold) nucleus have positive charges B1

(ii) Any two of:
Nucleus is very small (compared to size of atom) OR Most of atom is empty space

Nucleus is positive / contains protons OR Nucleus has (all) the positive charge of the atom

Nucleus is heavy OR Nucleus has most / all of the mass of the atom B2 **[6]**

Ignore neutrons