MARK SCHEME for the October/November 2012 series

0625 PHYSICS

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

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 ⩾ 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) <u>and</u> 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   B1
(owtte)

(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 $(m =) V \times d$ C1
OR $(m =) 0.25 \times 0.012 \times 920$
$= 2.76\,kg$ at least 2 significant figures. *Unit penalty applies A1

(ii) 60% of 250 = 150 (W/m^2) OR $250 \times 0.25 = 62.5$ (J) C1
Heat absorbed in 1 s = $150 \times 0.25 = 37.5$ (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 $m = 37.5 / 3.3 \times 10^5$ 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 (kΩ) 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)] × 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
<u>Magnetic field</u> 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