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

0625/33 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.

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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, 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.

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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.

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.

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1 **(a)** **(i)** constant/steady/uniform speed/velocity OR speed/velocity = 2.5 (m/s) B1
speed/velocity = 2.5 m/s accept fraction, average speed/velocity = 2.5 m/s B1 [2]

(ii) shape curving upward but not to vertical, at least to 3.5 s unless reaches 25 m B1 [1]

(b) horizontal (straight) line OR careful sketch
accept parallel to time/*x*-axis B1 [1]

(c) tolerance on both axes ± ½ small square throughout both parts

(i) horizontal straight line at 2.5 m/s from 0 to 2 s, ecf from **(a)(i)** B1

(ii) straight line rising to the right as far as the edge of the graph area M1
Δv = 4 m/s or gradient clearly 2 m/s^2 A1 [3]

(d) horizontal (straight) line M1
at 0 m/s A1 [2]
accept for both marks: line in/along time/*x*-axis OR line with *y*/*v* = 0 OR careful sketch

[Total: 9]

2 **(a)** mass = (1.5 × 10 × 12)/(30 × 10) OR = (1.5 × 12)/30
OR any correct moment equation with force or mass but not mixture C1
= 0.6(0) kg A1 [2]

(b) 21 N ecf from **(a)** B1 [1]

(c) **(i)** stays in position B1

(ii) any two from:
- clockwise moment = anticlockwise moment B1
- centre of mass at pivot B1
- no (resultant) moment/turning force acting on sculpture
- balanced/in equilibrium
- relative distances from pivot unchanged [3]

[Total: 6]

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3 **(a)** (mass flow rate =) 1030 (kg/s) C1
use of *mgh* C1
loss of GPE = 1030 × 10 × 3 = 30 900 J or Nm ecf from 1st line A1 [3]

(b) output power = (26 × 400 =) 10 400 (W) C1
efficiency = output (power)/input (power) with/without 100
OR= output/input with/without 100 OR any numbers
that clearly show relationship the correct way up is intended C1
efficiency = (100 × 10 400/30 900 =) 33.7% at least 2 s.f. A1 [3]
allow ecf from **(a)** and 1st line of **(b)**

(c) **(i)** from basin/to sea/from right/to left B1

(ii) turbine design allows rotation in both directions
OR meaningful comment on change of pitch
OR generator works when rotating in either direction B1 [2]

[Total: 8]

4 **(a)** **(i)** 50° B1

(ii) <u>total internal</u> (reflection) B1 [2]

(b) use of <u>sin</u> *i*/<u>sin</u> *r* = *n* OR 1/*n* in any form
OR 1/<u>sin</u> *c* = *n* OR 1/*n* C1
i = 40(°) and *r* = 90(°) OR vice versa ecf if measured from interface not normal C1
n = (1/sin *i* = 1/0.643 =) 1.556 ecf from previous line A1 [3]

(c) reflected ray drawn in same position as original reflected ray B1
0° < angle of refracted ray from surface < 13° B1 [2]

(d) prism drawn in correct orientation to give t.i.r. B1
correct reflection of rays B1 [2]

[Total: 9]

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5 (a) (i) CD B1

(ii) any 3 points from
- wavefront changes direction/refracted OR wavefront bends B1
- in Q distances travelled (by waves) shorter/wavelength less B1
- wave spreads in region Q from B B1
- all points on wavefront AB move to (corresponding) points on CD
- in same time that/while end A of wavefront AB move to C and end B moves to D [4]

(b) regions P and Q same depth/regions P and Q (now) one medium B1
same wavelength/wavefronts travel same speed/distance in each region
OR no refraction/change of direction OR no bending of waves B1 [2]

[Total: 6]

6 (a) T-shirt in wind/on L dries quicker OR T-shirt out of wind/on R dries slower M1
wind removes more evaporated molecules accept quicker
NOT wind gives water molecules more KE A1 [2]

(b) T-shirt folded double/on R dries slower OR T-shirt unfolded/on L dries quicker M1
correct reference to smaller/larger surface area for molecules to evaporate
OR water trapped (in fold) OR more humid in fold A1 [2]

(c) water evaporates from her hair B1
heat required for evaporation OR heat flows (from body/hair) to warm up cold water
OR faster molecules escape leaving water cooler/lowering KE
ignore: there is a cooling effect B1 [2]

[Total: 6]

7 (a) (i) more negatives in left than right B1
roughly same no. of positives as negatives B1 [2]

(ii) clearly more negatives than positives, anywhere on sphere B1 [1]

(b) (i) straight lines, radial towards point, arrows inwards B1

(ii) direction of field OR direction of force on (point) positive (charge) B1 [2]

[Total: 5]

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8 **(a)** **(i)** (milliammeter) deflects/shows reading/current OR reading changes OR there is a current B1
change of flux/field (lines) cut OR emf/current induced/produced B1 [2]

(ii) greater deflection/current B1
rate of change of flux (linkage) is greater o.w.t.t.e
e.g. more magnetic field lines cutting coil (per second) OR field cut faster B1 [2]

(b) **(i)** upwards/opposite to magnet's direction of travel ignore towards magnet B1

(ii) current (in coil) causes a magnetic field B1
force caused by overlapping (magnetic) fields B1 [3]

[Total: 7]

9 **(a)** **(i)** total R = 320 (Ω) or V per lamp = 6 (V) C1
I = (240/320 or 6/8 =) 0.75 A ecf from previous line A1 [2]

(ii) use of $P = VI$ OR I^2R OR V^2/R C1
4.5 W ecf from **(a)(i)** A1 [2]

(b) resistance of each lamp = 8 × 1.05 = 8.4 (Ω) B1
total R = 240/0.9 = 266.7 (Ω) OR V per lamp = 8.4 x 0.9 = 7.56 (V) B1
no. of lamps (= 266.7/8.4) = 31.7 OR (= 240/7.56) = 31.7 B1
max. no. of failed lamps = 8 B1
accept reverse logic [4]

[Total: 8]

10 for **(b)** and **(d)** accept HIGH/LOW or ON/OFF

(a) NOR B1 [1]

(b) outputs 1, 0, 0, 0
lose 1 mark e.e.o.o. B2 [2]

(c) **(i)** OR and NOT gates either order B1

(ii) both symbols correct B1
OR <u>then</u> NOT, connected B1 [3]

(d) logic level at Y, 0 B1
logic level at Z, opposite to candidate's answer to Y B1 [2]

[Total: 8]

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11 (a) any mention background B1
background/radiation varies randomly o.w.t.t.e. OR rate of decay very small OR
sample nearly all decayed B1 [2]

(b) correctly deducts correct background (13 – 15 /s) B1
takes 2 detector readings, one twice the other B1
correct working, with/without background subtraction, i.e. use of graph B1
half life = 1.2 – 1.8 days OR follows from working B1 [4]

(c) α (very) short range in air OR will not reach researcher
NOT will not penetrate skin B1
γ long range/very penetrating/heavy shielding needed OR will reach researcher B1 [2]

[Total: 8]

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