UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

5054 PHYSICS

5054/22 Paper 2 (Theory), maximum raw mark 75

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.

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Section A

1 **(a)** components shown on correct diagram with correct resultant (i.e. towards NE) and a scale given B1
540 (±10) m B1
22º ± 3° E of N with correct diagonal B1 [3]

(b) idea that ends at start, returns in opposite direction B1 [1]

[Total: 4]

2 **(a)** energy/time C1
1 joule in one second A1 [2]

(b) **(i)** 5800 N or 5684 N or 5700 N B1 [1]

(ii) *mgh* algebraic, words or numerical (i.e. 580 ×10 × 12) C1
69 600 J or 70 000 J or 68 208 J or 68 000 J A1 [2]

(iii) (efficiency =) output power or energy/input power or energy algebraic or numerical or 93 000 seen or 4 640 seen C1
0.75 or 75% (accept 0.748) e.c.f. from (ii) A1 [2]

[Total: 7]

3 **(a)** radiation or infra-red or electromagnetic waves B1
travels through space/vacuum or does not require medium/molecules/particles or medium required for conduction and/or convection or for other methods B1 [2]

(b) conduction occurs
or atoms/particles/molecules vibrate
or electrons given energy B1
heat/energy/vibration passed on from one particle to another
or electrons move to other parts/diffuse/hit atoms B1 [2]

(c) (Q =) mcT algebraic or numerical in any form (e.g. $1.2 \times 10^6 = m \times 400 \times 20$) C1
150 kg A1 [2]

[Total: 6]

4 **(a)** increased/high(er) temperature/hot(ter)
wind or air flow
less humidity
less pressure ANY 2 lines B2 [2]

(b) molecules/atoms/particles escape/leave (surface)
or molecules become gaseous/vapour
or molecules break bonds C1
molecules with large(est) energy/high(est) speed sufficient or enough energy escape/break bonds/become gaseous or leave behind slow/less energetic molecules A1 [2]

[Total: 4]

5 **(a)** **(i)** smallest angle of incidence for total internal reflection
or greatest angle of incidence that allows refraction
or angle of incidence for (refracted) ray along surface/angle of refraction 90° B1 [1]

(ii) correct angle marked to normal (by eye) B1 [1]

(iii) ray along surface or reflected ray correct (by eye) or both rays B1 [1]

(b) ray in air refracted away from normal B1 [1]

(c) refractive index = $\sin i / \sin r$ algebraic or numerical e.g. $1.5 = \sin 50 / \sin r$ C1

31° accept 30.71, 30.7 degree symbol required somewhere A1 [2]

[Total: 6]

6 **(a)** **(i)** electrons B1 [1]

(ii) neutralised/charge becomes zero/loses all charge/charge goes to earth B1
electrons move to plane/tyres from ground/earth/zero potential/surface/land B1 [2]

(b) (otherwise) plane/tank/fuel becomes or is charged or charge builds up in some way
or stays neutral/uncharged or (earthing) conducts charge away (to ground) B1
avoids sparks or prevents explosion/fire/fuel igniting/blast
or sparks/fires, etc. may be produced B1 [2]

[Total: 5]

7 **(a)** both arrows point inwards
both arrows extended must pass through base of bar magnet B1
N marked on both needles nearest S pole B1 [2]

(b) (current causes) coil/iron to become magnet/an electromagnet/creates magnetic field B1
iron (in coil) attracts/pulls (pivoted) iron/armature
(and L-shaped iron rotates/moves/turns) not contacts attract each other B1 [2]

(c) **(i)** resistance decreases B1 [1]

(ii) series circuit/loop with C and lamp C1
completely correct circuit with a battery A1 [2]

[Total: 7]

8 **(a)** **(i)** Geiger Muller/GM tube or any other gamma detector B1 [1]

(ii) keep distance e.g. forceps/tongs
barrier accept gloves, lead suit, metal container
time of use accept use badge ANY ONE B1 [1]

(iii) (with source) take a count for a time
or take count rate (from a ratemeter/meter/count meter/counter)
or read ratemeter (connected to GM tube) or record number of tracks (chamber)
or count clicks in a time or note time when click occurs B1
or several readings taken or readings fluctuate ignore readings random
or time when click occurs varies B1 [2]

(b) electromagnetic B1
(wave/ray/particle) high frequency or small wavelength B1 [2]

[Total: 6]

Section B

9 (a) (i) distance travelled while thinking/in reaction time or before braking starts — B1 [1]

(ii) distance travelled while brakes applied/car decelerates — B1 [1]

(b) (i) speed (of cars) or same force/pressure on pedal or same braking force or same tyres or condition of brakes — B1 [1]

(ii) greater inertia/kinetic energy/momentum or smaller deceleration/acceleration — B1 [1]

(c) any road condition, e.g. icy, wet, poor surface, slippery/smooth/rough surface and its correct effect on distance — B1
correct explanation that refers to friction e.g. more friction when dry — B1 [2]

(d) pressure low(er) (with larger area) — B1 [1]

(e) (i) $a = v/t$ any algebraic or numerical value e.g. 20/4; 20/3.4; 20/4.6; 20/0.6 — C1
5(.0) m/s^2 — A1 [2]

(ii) $F = ma$ algebraic or numerical e.g. 900 × **(i)** — C1
4500 N e.c.f. **(i)** — A1 [2]

(iii) correct axes labelled with quantity and/or unit — B1
horizontal line at 20 m/s from 0 to 0.6 s — B1
straight line from end of horizontal section or from (0.6,20) to (4.6,0) or (4,0) — B1 [3]

(iv) area (under graph or of trapezium) — B1 [1]

[Total: 15]

10 (a) how sound is made e.g. gun, clap hands, hit metal — B1
correct measurement of time, e.g. from seeing flash to hearing sound, clap-echo — B1
correct measurement of distance, e.g. gun to observer, observer to wall — B1
correct calculation for measurements, e.g. d/t or $2d/t$ — B1
precaution e.g. time clap on echo and time 10; ensure no wind; repeat in opposite direction; repeat and average; use large distance; use more than 200 m — B1 [5]

(b) (i) (sound/wave/vibration) of high frequency or (sound that) cannot be heard — C1
(frequency) above 15–20 kHz — A1 [2]

(ii) $f = 1/T$ or 6×10^{-6} (s) seen or 2,3,4 pulses in 12,18,24 μs — C1
1.7×10^5 allow 166667 — A1 [2]

(iii) not all sound is reflected (from back surface) or some passes through the back (some energy/sound) absorbed (by metal)
(sound/energy) spreads out/scattered/reflected in other directions/dispersed/ travels a (greater) distance any 2 lines B2 [2]

(iv) at least one pulse half way between S and R in the long gap B1
total height of pulse smaller than S and 3 or more drawn and labelled C B1 [2]

(v) $v = f\lambda$ in any algebraic or numerical form e.g. $4000/8 \times 10^6$ C1
$5(.0) \times 10^{-4}$ m A1 [2]

[Total: 15]

11 (a) circuit diagram with cell and ammeter in series with resistor/wire/lamp and voltmeter across resistor/wire/lamp B1
R = V/I in any form or gradient of V, I graph B1
thermometer/thermocouple used or shown B1
statement of how different temperatures obtained,
e.g. water bath/oven/heat room/change supply voltage or current or series resistor to change temperature B1 [4]

(b) (i) resistance increases with temperature M1
(approximately) linear, proportional, straight line increase A1 [2]

(ii) curved line starting at origin C1
correct curvature from origin with decreasing gradient
allow zero gradient not negative gradient A1 [2]

(c) (i) 1 (current) increases B1
thermistor resistance decreases B1 [2]

2 (voltmeter reading) increases B1
greater fraction of voltage across resistor or potential divider equation explained
or greater current through fixed/constant/2000 Ω resistor B1 [2]

(ii) (voltage across thermistor) 2.2 (V) or attempt to use potential divider formula C1
(current) 3.8 / 2000 or 1.9×10^{-3} (A)
or $3.8 = 6 \times 2000/(R+2000)$ or other correct potential divider equation C1
1200 Ω allow 1157 – 1160 A1 [3]

[Total: 15]