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

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International Examinations

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 (frequency) above 15–20 kHz — C1 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]