UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2011 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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International Examinations

Section A

1 **(a)** (uses spring balance) for a reading/value // finds weight/force of gravity — B1
divides reading/weight by 10/g // uses $W = mg$ — B1

(b) reading (of measuring cylinder) taken with liquid/water (alone) //
initial volume mentioned // fill to certain level — C1
measure increase/change when stone (totally) immersed/in cylinder — A1

(c) 2.1 or 2.14 g/cm^3 // 2142.86 kg/m^3 // 0.00214286 kg/cm^3 — B1

(d) mass unchanged **and** weight less — B1 [6]

2 **(a)** chemical (potential) energy at start — B1
gravitational/potential energy increases — B1
thermal energy/heat/internal energy produced — B1

(b) energy not created/lost/destroyed // energy **only** changes form // total energy constant **and** at least one attempt to explain a conversion **in the journey** // all ends up as heat — B1

(c) (h =) PE/mg numerical or algebraic seen, e.g. 5400/10 × 60 — C1
9(.0) m — A1 [6]

3 **(a)** **(i)** molecules have more **kinetic** energy/speed/velocity — B1
hit sides hard(er)/with more force // (initially) hit sides (more) often/frequently // create large(r) pressure (initially) — B1

(ii) (larger) forces between liquid molecules/(stronger) bonds — B1

(b) **(i)** $P_1V_1 = P_2V_2$ numerical or algebraic — C1
6(.0) cm^3 — A1

(ii) temperature is constant // no gas enters/leaves // mass constant — B1 [6]

4 **(a)** 2(.0) mm B1

(b) same period (by eye), with at least one wave B1
opposite phase to wave drawn B1

(c) **(i)** (f =) 1/T numerical or algebraic seen (e.g. 1/0.5) // 1 wave in 0.5 s // 2 waves in 1 s C1
2(.0) Hz A1

(ii) $v = f\lambda$ // 8 × 2 or 8 × **(i)** // 16 (cm / s) // 5 (wavelengths from centre to edge) // (t =) d/v C1
2.5 s **ecf** from **(i)** – i.e. **accept 5/(c)(i)** A1 [7]

5 **(a)** ammeter in series with supply // ammeters in series with A **and** in series with B & C B1
A across cell with no switch (condone closed switch) **not**  B1
B and C in series with switch (closed or open) and cell B1

(b) **(i)** (R =) V/I in any form numerical or algebraic, e.g. 8/50, 8/0.05 C1
160 Ω A1

(ii) 50 mA // 0.05(0) A B1 [6]

6 **(a)** no shock // no electrocution B1
(if) case becomes live // live touches case B1

(b) correct conversion to kW, 0.5 seen // conversion to hours // 0.75 // $\frac{45}{60}$ // (E =) $P \times t$ C1
0.375 // 0.38 // 0.37 (kW h) A1 [4]

7 **(a)** (same) electrons/beam produced/emitted by heating // thermionic emission occurs B1
still produces heating // same heating // heating depends on I^2 B1

(b) no beam produced // electrons do not reach screen/do not pass anode/not emitted B1
electrons/beam repelled by negative/anode // electrons no longer attracted by anode // electrons/beam attracted by positive/filament B1 [4]

8 **(a)** fission cao B1

(b) neutron hits/goes inside (U) **nucleus** B1
atom/nucleus/particle/uranium/nuclide splits/forms daughter nuclei **and** emits neutrons/energy B1

(c) **(i)** emits particles // emits **ionising**/**nuclear** radiation // spontaneous or random emission (of radiation) // **atom**/**nucleus** decays B1

(ii) long time to decay // radioactive for a long time // decays slowly
long time for any quantity to halve B1
halving of:
count, count rate, emissions, (number of) nucl**ei**, (number of) atoms, activity B1 [6]

Section B

9 **(a)** **(i)** curve with decreasing gradient from origin to 50 m / s at 10 s B1
constant speed from 10 to 20 s B1
decrease to 5 m / s at 25 s B1
constant speed from 25 s until at least 30 s B1

(ii) gradient/slope not constant/decreases // graph curves // graph not a (straight) line // increase (in speed) per second/unit time not equal B1

(b) any mention of **air** resistance/drag/upward force B1
(initially) force upwards larger than force downwards // resultant force upwards B1
air resistance decreases (with fall in speed) B1
(at constant speed) air resistance/friction/drag equals weight //
forces (up and down) balance // zero resultant force B1

(c) 500 m B1

(d) **(i)** (a =) $\frac{v-u}{t}$ in any numerical or algebraic form, e.g. 45/5 C1
9(.0) m/s^2 ecf **(a)(i)** A1

(ii) ($F = ma$) in any numerical or algebraic form, e.g. 60 × 9 ecf **(i)** C1
540 N A1

(iii) area **under** graph/line/curve B1 [15]

10 (a) suitable block (semicircular/rectangular/prism) B1
suitable source of rays (e.g. ray box; pins on incident ray; laser **not** torch) **must** be labelled on diagram or clear in text B1
diagram showing incident ray in glass/perspex (no arrow needed) **and** correct refraction out into air B1
adjustment of (angle of incidence of) ray until along surface/just no longer emerges B1
(measure) correct angle marked or described clearly or C marked on diagram B1

(b) (i) converging or convex B1

(ii) ray from top through middle of lens undeviated B1
other ray from top of object to same position on film M1
correct image labelled/drawn/marked A1

(iii) ratio of size/height/length/distance of image to size/height/length/distance of object B1

(iv) 0.4(0) (±0.05) no ecf **(iii)** B1

(v) upside down // inverted // real // other side of lens to object // nearer lens than object B1

(vi) (otherwise) not focussed // to/adjust focus // to produce a clear/sharp image // (otherwise) rays do not converge on film // to converge rays onto film // image on film // object at different distance B1
(otherwise) image formed in front of film // object now further C1
A1 [15]

11 (a) (i) 50°C **and** 24/25°C B1

(ii) heat loss or evaporation mentioned // molecules escape // liquid to vapour C1
more heat loss or **more** evaporation etc. **because** temperature is higher A1

(iii) temperature becomes 100°C // reaches boiling point // temperature becomes steady B1
water boils // water turns to steam/gas // energy loss = energy gain B1

(b) (i) (c =) $E/m\Delta T$ in any form, numerical or algebraic, e.g. 7400/72 × 23 C1
4.5 or 4.47 or 4.4686 J/(g °C) // 4468.6 J/(kg °C) A1

(ii) (E =) ½ mv^2 algebraic only C1
½ . 0.072. 450^2 C1
7300 J // 7290 J (7 290 000 (J) alone gets 2/3) A1

(iii) *water molecules* move/vibrate fast(er)/(more) vigorously B1
water molecules **random** motion // move (more) throughout liquid/all directions // slide over each other // move in convection // hit more often // move further apart B1
bullet molecules motion in one direction/away from gun/towards target/ all have same (increase in) speed B1

(c) two different metals at any junction/two outside wires if three used B1
joined wires connected to meter/voltmeter/ammeter/galvanometer B1 [15]