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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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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		
	(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

(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)
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 // — B1

(otherwise) rays do not converge on film // to converge rays onto film //
image on film // object at different distance — C1
(otherwise) image formed in front of film // object now further — 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]