UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

5054 PHYSICS

5054/21 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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Do not accept fractions. No penalty for 2 sig. fig. or for 1 sig. fig. where exactly correct.
Only one unit **and only one** fraction **penalty per question**.

Section A

1	(a)	(i)	11.5 m / s	B1	
		(ii)	decrease in speed // negative gradient	C1	
			equal changes/decreases in speed in the same time // const. neg. grad. on v-t graph	A1	
	(b)	(i)	flat line at 18 m / s from t = 0 to 15	B1	
			constant slope downwards parallel to initial line (by eye)	B1	
		(ii)	greater area **under** graph // higher **initial/average** speed	B1	[6]
2	(a)	(i)	X weight // (force of) gravity // gravitational (force) **and** Y **air** resistance // (air) drag // wind resistance // **air** friction	B1	
		(ii)	(Y) opposes motion // diver moves down // air molecules hit faster from below	B1	
	(b)	(i)	accelerates // falls faster // speed/velocity greater	B1	
			X is larger than Y // resultant/net force downwards	B1	
		(ii)	**two** of: X stays the same // Y increases // forces become equal (and opposite)	B2	[6]
3	(a)	(i)	7000 (J) seen **or** 50% **used** somewhere	C1	
			(P =) E/t // 14000/t // 7000/t seen // 7000 J/minute // 420 000 J/hour	C1	
			120 W	A1	
		(ii)	water after hitting turbine still moves // has KE/energy/velocity // energy lost due to friction // friction **and** location // heat/internal energy **and** location // water misses turbine	B1	
	(b)	(i)	can be replaced/made // will not run out	B1	
		(ii)	coal, oil, gas, peat, nuclear, uranium (**not** solar)	B1	[6]

4 **(a)** (E/Q =) $mc\Delta T$ in any algebraic or numerical form e.g. 4200 × 16, 2100 × 5 — C1
67 200 **or** 10 500 **or** 77 700 seen **or** (E/Q =) ml or mL algebraic seen — C1
4.2×10^5 J — A1

(b) **(i)** break bonds // separate molecules // give molecules more P.E. — B1

(ii) (different) change in distance // molecules not so far apart // incomplete bond breaking // doesn't push atmosphere back // less work against atmosphere — B1 [5]

5 **(a)** gives out (visible) light // glows — B1
when hit by uv/electrons **or** spark/discharge/current in **tube** — B1

(b) X-rays or gamma — B1

(c) (f =) v/λ numerical or any algebraic form, e.g. $v = f\lambda$ — C1
8.3×10^{14} Hz — A1 [5]

6 **(a)** reflection (of sound/ultrasound) — B1

(b) waves of same period (by eye) — B1
smaller amplitude (by eye) — B1

(c) **(i)** 20–20 000 Hz — B1

(ii) higher than **(i)** — B1 [5]

7 **(a)** upward arrow (**not** curved) on iron bar — B1

(b) attraction/force not enough//weight of bar too high//friction at pivot/with copper bar — B1

(c) **three** of:
electromagnet works // magnetic field created
iron bar moves/lifted up
spring pulls copper bar across/contracts
contacts break circuit // contacts open — B3

(d) more turns in coil // more iron in electromagnet // electromagnet nearer iron bar // iron bar less weight // weaker spring — M1
correct explanation which involves force on iron bar — A1 [7]

8 **(a)** all three correct: force, field, current — B1

(b) **(i)** *Fd* // 20 × 4; 20 × 2; 20 × 0.04; 20 × 0.02; 20 × 4 × 2; 160 — C1
80 N cm, 0.8 N m — A1

(ii) more turns (on coil)
use soft iron
more current
increase AB or CD
increase BC or AD ANY 2 — B1 [5]

Section B

9 **(a)** **(i)** d.c. current flows in one direction **or**
a.c. current flows in one direction then the other — B1

(ii) mention of magnetic field/flux — B1
(magnetic) field lines // flux cuts coil // flux changes in coil — B1
induction of voltage/current — B1
something **relevant** reverses (e.g. field/flux cuts in one direction then the other // N pole approaches then leaves // N pole approaches and S pole approaches)
and link to a.c. — B1

(iii) **two** of: thicker wires; more turns of coil; stronger magnet; faster rotation; lower resistance (of lamp) — B2

(b) **(i)** to reduce heat/energy/power loss (on the power lines) — B1
(higher voltage means) lower current — B1

(ii) 25:400 // 1:16 // 0.0625 — B1

(iii) reduces resistance // less power loss // costs less to run // more current // more power — B1
increases weight // more support needed // more wind resistance // more ice forms // costs more to install — B1

(iv) 13 A — B1
(*I* =) *P*/*V* // 4.2 A // 4.17 etc A — B1
must choose higher value to avoid fuse blowing // other fuses melt — B1 [15]

10	**(a)**	**(i)**	brown and green	B1	
			red	B1	
		(ii)	99×10^9 or 9.9×10^{10} Ω	B1	
		(iii)	*less*: (likely to) burn out/blow // become too hot	B1	
			greater: (likely to) be large (in size)	B1	
	(b)	**(i)**	both involve energy and charge // measured in J/C/volts/by voltmeter	B1	
			energy change is from other forms (accept chemical) to electrical in e.m.f.	B1	
			energy change is from electrical to other forms (accept heat/light) in p.d. (**or** e.m.f. is property of source and p.d. is property of (part of) circuit B2)	B1	
		(ii)	correct symbol	B1	
			correct direction	B1	
		(iii)	p.d. reduces/(approximately) constant **and** current reduces	B1	
		(iv)	$R = V/I$ in any form, e.g. 1.7/0.025, 1.7/25	C1	
			correct conversion to mA, e.g. 0.025/7.3 seen	C1	
			68 or 360 seen	C1	
			290 Ω, 292 Ω	A1	[15]
11	**(a)**	**(i)**	24	B1	
		(ii)	charges (of electrons and protons) cancel // protons and electrons have the same (size of) charge but opposite in sign	B1	
	(b)	**(i)**	nuclear at start // nucleus loses energy	B1	
			to kinetic/e.m. energy (condone light/photon/γ)	B1	
		(ii)	beta 0 at top	B1	
			beta –1 at bottom	B1	
			Mg 24 at top	B1	
			Mg 12 at bottom	B1	
	(c)	**(i)**	600 at 15 hours	B1	
			300 at 30 hours	B1	
			line of decreasing gradient (**not** if it cuts time axis before $t = 30$)	B1	
		(ii)	emission is random // not predictable // not regular // exptl. error	B1	
		(iii)	4800 (counts per minute) // 80 counts /sec	B1	
		(iv)	GM tube/solid state detector/cloud chamber	M1	
			ratemeter/data logger // counter/scalar **and** stopwatch/timer	A1	[15]