

**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) B1  
**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]

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- 4 (a) ( $E/Q =$ )  $mc\Delta T$  in any algebraic or numerical form e.g.  $4200 \times 16$ ,  $2100 \times 5$  C1  
67 200 or 10 500 or 77 700 seen or ( $E/Q =$ )  $ml$  or  $mL$  algebraic seen C1  
 $4.2 \times 10^5$  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) ( $f =$ )  $v/\lambda$  numerical or any algebraic form, e.g.  $v = f\lambda$  C1  
 $8.3 \times 10^{14}$  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]

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- 8 (a) all three correct: force, field, current B1
- (b) (i)  $Fd$  //  $20 \times 4$ ;  $20 \times 2$ ;  $20 \times 0.04$ ;  $20 \times 0.02$ ;  $20 \times 4 \times 2$ ; 160  
80 N cm, 0.8 N m C1  
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]

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10	(a)	(i)	brown and green red	B1 B1	
		(ii)	$99 \times 10^9$ or $9.9 \times 10^{10} \Omega$	B1	
		(iii)	<i>less</i> : (likely to) burn out/blow // become too hot <i>greater</i> : (likely to) be large (in size)	B1 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 correct direction	B1 B1	
	(iii)	p.d. reduces/(approximately) constant <b>and</b> current reduces	B1		
	(iv)	$R = V/I$ in any form, e.g. 1.7/0.025, 1.7/25 correct conversion to mA, e.g. 0.025/7.3 seen 68 or 360 seen 290 $\Omega$ , 292 $\Omega$	C1 C1 C1 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 to kinetic/e.m. energy (condone light/photon/ $\gamma$ )	B1 B1
(ii)				beta 0 at top beta -1 at bottom Mg 24 at top Mg 12 at bottom	B1 B1 B1 B1
(c)			(i)	600 at 15 hours 300 at 30 hours line of decreasing gradient ( <b>not</b> if it cuts time axis before $t = 30$ )	B1 B1 B1
				(ii)	emission is random // not predictable // not regular // exptl. error
		(iii)	4800 (counts per minute) // 80 counts /sec	B1	
(iv)		GM tube/solid state detector/cloud chamber ratemeter/data logger // counter/scalar <b>and</b> stopwatch/timer	M1 A1 [15]		