UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 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)**	$m_1(g)x_1$ **or** $m_2(g)x_2$ **or** 2 **or** one of these in numbers **or** 40 **and** 25 seen	C1	
		0.050 × (10) × 40 = m_2 × (10) × 25		
		or anticlockwise **moment =**clockwise **moment**	C1	
		0.080 kg **or** 80 g	A1	
	(b)	(ρ/d =) m/V **or** 0.08/1.6 × 10^{-4}	C1	
		500 kg / m^3 **or** 0.50 g / cm^3	A1	[5]
2	**(a)**	**(i)** 850 N	B1	
		(ii) KE = PE/mgh **or** mgh = 5.5 × 10^4	C1	
		65/64.7(0588) m	A1	
	(b)	WD = Fx **or** KE/x **or** 5.5 × 10^4/33 **or** v = 35(.97) **and** a = 19(.60) **and** F = ma	C1	
		1700/1670/1667/1666.7 N	A1	[5]
3	**(a)**	**(i)** $p_1V_1 = p_2V_2$	B1	
		(ii) 2.5 × 10^7 × 18 = 1.0 × 10^5 × V_2	C1	
		4500 m^3	A1	
	(b)	balloon inflates higher up/bursts (if fully inflated on ground)	B1	
		(atmospheric) pressure is less higher up/decreases with height	B1	
		OR		
		(otherwise) greater upthrust/upwards force	B1	
		(otherwise) rises (too) high/fast	B1	[5]
4	**(a)**	3(.00) × 10^8 m / s	B1	
	(b)	0.16 m **or** 16 cm	B1	
	(c)	any **three** of:		
		travel through space/vacuum		
		pass through the atmosphere/not reflected by ionosphere		
		encoded (with the signal)		
		(satellite) amplifies/boosts signal		
		sent to/received by satellite		
		transmitted/sent by satellite		
		transmitted/received by a (satellite) **dish** (on Earth)	B3	

(d) any **two** of:
same (high) speed (in air) **or** travel at speed of light
travel in vacuum/space **or** no medium needed
transfer/transmit energy
transverse (stated **or** explained)
(oscillating) magnetic **and** electric fields/waves
reflection/refraction/diffraction/interference/polarisation — B2 [7]

5 **(a)** **(i)** N at top end of bar **and** S at bottom end — B1

(ii) attracted to/moves towards iron core — B1
unlike poles attract — B1

(b) they disappear/bar is demagnetised/loses its poles/is weaker — B1 [4]

6 **(a)** **(i)** power supply, (wire/resistor/bulb) and ammeter in series — B1
voltmeter across wire/resistor/bulb **labelled/clear** — B1
variable power supply **or** rheostat in series **or** potentiometer — B1
correct symbols **or** labelled throughout

(ii) read ammeter **and** voltmeter / measure voltage **and** current — B1
vary power supply/rheostat/current — B1

(iii) (R =) V/I (**ign.** V/A) — B1

(b) horizontal line **and** above axis — B1 [7]

7 **(a)** (P =) VI **or** 23 000 × 65 — C1
1.49/1.5/1.50/1.495 × 10^6 W — A1

(b) **(i)** (V =) IR **or** 65 × 3 — C1
190/195/200 V — A1

(ii) 1.3(1.27 etc.) × 10^4 J — B1

(c) **(i)** low current/less energy/power wasted/less heat generated/less voltage **loss**/
more efficient/thinner wires — B1

(ii) **step-down** transformer between them **or** less insulation needed **or** less dangerous **or** less chance of electric shock **or** less danger of sparking /fire — B1 [7]

8 **(a)** **(i)** central ray undeviated emerging from lens — M1
two outer rays meet the central ray at a point inside the eye **and** carry on to strike the retina — A1

(ii) light (from a single point) is spread over an area (on the retina)
or rays do not meet at a point on the retina
or image formed/rays meet/principal focus off retina — B1

(b) (i) **any** diverging lens: biconcave, planoconcave, convexoconcave –
i.e. lens **clearly** thinner at the centre — B1

(ii) **all** rays diverge — B1 [5]

Section B

9 (a) 72 m / s — B1

(b) (i) area (under graph) **or** ½ base × height **or** ½vt **or** ½ × 9 × 72 — C1
320/324 m — A1

(ii) **change** in velocity/time **or** $\Delta v/t$ **or** 72/9 — C1
8(.0) m / s^2 — A1

(iii) (F =) ma **or** 650 × 8.0 — C1
5.2 × 10^3 N — A1

(c) friction **or** air/wind resistance **or** drag — M1
increases as speed increases — A1
resultant/net/unbalanced force remains constant — B1

(d) (i) **direction** (of car/motion/speed/velocity) changes — B1
(therefore) velocity changes — B1

(ii) towards centre (of circle)/centripetal — B1

(iii) friction **with ground** **OR** banking of track — B1
mention wheels/tyres — reaction force (acts towards centre) — B1 [15]

10 (a) **temperature** where: liquid and solid may exist together **or** solid turns to liquid — B1

(b) (i) (E =) ml — C1
0.0019 × 2.2 × 10^4 **or** 1.9 × 2.2 × 10^4 **or** 41 800 **or** 42 000 — C1
42 (41.8) J — A1

(ii) ½mv^2 **or** ½ × 0.0019 × v^2 **or** ½ × 1.9 × v^2 — C1
(v^2 =) 44 000 **or** 44 — C1
210 (209.761 etc.) m / s — A1

(iii) any **two** of:
heat lost to wall
heat to raise bullet to m.p.
air resistance/**air friction** reduces energy/speed/velocity **or** work done against **air resistance**/**air friction** (in air/as bullet travels) B2

(c) any **three** of:
molecules become further apart
molecules become randomly positioned/less ordered
molecules moving throughout liquid/in clusters/were fixed/free to move/ slide over each other
bonds broken/overcome/weaker **or** forces reduced B3

(d) twice the energy needed **OR** $ml = \frac{1}{2}mv^2$ M1
(bullets have) twice the KE *m* cancels **or** mass irrelevant **or** w.t.t.e. **or** calculation M1
they melt A1 [15]

11 (a) (nuclear) fission B1

(b) (i) 1...143 B1
2...36 B1
3...141 B1

(ii) (E =) mc^2 C1
$3.1 \times 10^{-28} \times (3.0 \times 10^8)^2$ **or** $3.1 \times 10^{-28} \times 3.0 \times 10^8$ **and** (E =) mc^2 C1
$2.8(2.79) \times 10^{-11}$ J A1

(c) any **five** of:

core/rods/ reactor/ ^{235}U	→	**coolant**	→	boiler/ water

(**one** mark for three correct boxes)

(splitting produces) kinetic energy of neutrons
further splitting/chain reaction
energy/heat produced/from reactor/reaction **or** from neutrons
coolant gets hot
energy to boiler/water **or** water heated **or** heat in water implied
water boiled **or** steam produced B5

(d) (i) **time** for something to halve C1
time for (radio)activity/count rate/number of atoms/nuclei to halve A1

(ii) **one** appropriate precaution:
short exposure time
safety/protective suit/gloves/clothes **or** lead boxes
large distance/(long handled) tool/forceps/tongs
robotic/mechanical handling
film badge B1 [15]