UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

5054 PHYSICS

5054/02 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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1 unit penalty per question.
Allow 2 or more sig. figs throughout paper. 2 or 3 sig. fig. answers must be correctly rounded.

Section A

1 **(a)** (speed) increases or (paper) accelerates B1
(speed) becomes constant/uniform or acceleration zero (after 0.5 s) B1

(b) any clear change in distance/time or 1.87 (m/s) (allow 1.9) C1
2.3–2.5 m/s A1

(c) PE at beginning of a change B1
heat/internal energy/thermal energy at end of a change/K.E. of air B1 [6]

2 **(a)** **(i)** conduction B1

(ii) molecules hit each other or molecules pass vibration on
or free electrons move (through metal) and hit molecules B1

(b) **(i)** downwards at or near X B1

(ii) hot water less dense or cold water more dense B1
hot water rises (not heat rises) or cold water falls B1
convection current mentioned or water flows to replace hot water that rises
or rising and falling described or water cools at surface B1 [6]

3 **(a)** (E =) $P.t$ in any algebraic form or 85 × 120 or 85 × 2 or 170 C1
10200 J or 2.8×10^{-3} kW h A1

(b) (H =) mL seen in any algebraic form or **(a)**/31 or **(a)**/0.031 C1
330 or 329 J/g or 3.29×10^{5} J/kg ecf **(a)** A1

(c) heat/time needed to warm ice to 0°C/melting point/freezing point B1 [5]

4 **(a)** solid more regular/ordered etc. or less space/separation between molecules or vv
or solid molecules fixed and liquid molecules move throughout B1

(b) **(i)** solids: strong(er) forces/bonds or energy not enough to break molecules free
or vv B1

(ii) fast(er)/high(er kinetic) energy molecules escape/evaporate B1
molecules left are slower/less kinetic energy (on average) B1

(iii) (hotter) molecules move faster/higher energy B1
more molecules have energy/speed to break bonds/overcome forces B1 [6]

5	**(a)**	**(i)**	correct ray		
		(ii)	correct angle marked to normal	B1	
		(iii)	(the angle) between the incident ray and the normal (at the point of contact)	B1	
	(b)		correct ray from hat to eye	B1	
			0.85–1.15 m	B1	[5]
6	**(a)**		(sound) too high a frequency to be heard or (frequency) above 20 kHz	B1	
	(b)		(f =) v/λ or $v = f\lambda$ algebraic or numerical	C1	
			1 250 000 Hz	A1	
	(c)		vibrate/oscillate	C1	
			vibration etc. in same direction as/parallel to wave/energy or horizontally	A1	
	(d)		pressure increases and decreases or compressions and rarefactions mentioned in **(d)** or particles come together and move apart	B1	[6]
7	**(a)**		NS marked on each piece correctly	B1	
	(b)		NS/unlike/opposite poles attract	B1	
			switch closes or soft-iron/contacts touch	B1	
	(c)	**(i)**	resistance decreases	B1	
		(ii)	current increases clearly in coil/through thermistor	B1	
			magnetic field (in coil) (and contacts close)	B1	[6]
8	**(a)**		number of protons and neutrons	B1	
			protons and neutrons in the nucleus	B1	
	(b)	**(i)**	2	B1	
		(ii)	4	B1	
		(iii)	90 or 92–**(i)** and **(iv)** 234 or 238–**(ii)**	B1	[5]

Section B

9	**(a)**	circuit diagram showing power supply, lamp and ammeter in series		B1	
		voltmeter across lamp		B1	
		ensure voltage is 24 V in some way e.g. power supply 24 V		B1	
		$V \times I$ or voltmeter × ammeter readings		B1	
	(b)	**(i)**	P 0.63(2) A	B1	
			Q 1.26(3) A	B1	
			R 1.89(5), 1.9 A or sum of candidate's P and Q	B1	
		(ii)	240/current at R or $1/R = 1/R_1 + 1/R_2$	C1	
			127, 130, 126.7 Ω ecf **(i)**	A1	
	(c)	**(i)**	(I =) V/R numerical or algebraic	C1	
			0.42 A	A1	
		(ii)	80 V or 79.8 V ecf **(i)**	B1	
	(d)	one lamp goes out/blows/fuses/switched off they do not all go out/others stay on		B1	
		lamps are working at correct/more brightness/voltage/current power		B1	
		reference to voltage is 240 V across each lamp or voltage shared in series/<240 V or current value(s) quoted		B1	[15]
10	**(a)**	**(i)**	air resistance increases (as speed increases)	B1	
			(at constant speed) becomes equal to driving force/applied force etc.	B1	
		(ii)	driving force (forward force) larger (than air resistance/backwards force)	B1	
	(b)	**(i)**	(E =) ½ mv^2 algebraic formula	C1	
			½ × 75 × 4^2	C1	
			600 J	A1	
		(ii)	(a =) F/m algebraic seen or 10 (N) used as force	C1	
			0.13 m/s^2	A1	
	(c)	**(i)**	friction (in chain/axles) or rubbing of surfaces	B1	
			heat or thermal energy produced	B1	
		(ii)	(efficiency = useful) energy output/energy input algebraic or numerical or 380 seen	C1	
			0.95 or 95%	A1	

(d) lower mass/weight of cycle

less force needed	same acceleration/get up hill/to stop cycle/lift cyc		
greater acceleration/easier to acc.	for same force or $F = ma$ quoted		
less energy/work (input)	to go uphill/due to less friction/$\frac{1}{2} mv^2$ less		
less kinetic energy	less stopping distance/less force to stop		
more efficient/less energy wasted	going uphill/less friction		
less friction	easier turn handlebars/higher (top) speed		
less pressure (on ground)	sinks less into ground	M1A1	[15]

11 (a) (i) coil and magnet (poles) in a correct orientation – no label needed B1
2 slip rings correct and labelled B1
brushes touching 2 slip rings, labelled B1

(ii) induction of voltage or current B1
(magnetic) flux change or field/flux lines cut wire/coil B1

(b) (i) attach (generator to) voltmeter B1
measure voltage (e.g. gives 1.0 V, ±0.5 V) B1
measure trace height (e.g. gives 0.5 div, ±0.25 div) B1
clear 2 V moves up 1 div B1
OR
observe trace/line/spot with no input B1
apply battery/voltage (to y input) B1
measure voltage applied (with voltmeter) or battery has known voltage B1
check distance moved up/down for voltage supplied e.g. 2 V moves up 1 div B1

(ii) volts/div (vertically) changed (e.g. 2 V/div decreased, changes to 0.2 V/div)
or *y*-gain changed to expand trace vertically B1
time/div (horizontally) changed
or time base/*x*-gain changed to expand trace horizontally B1
y-shift used to move trace up B1

(if no mark – *y* gain and time base/*x* gain mentioned B1
trace expanded vertically and horizontally B1)

(iii) hot/heated filament/cathode or by thermionic emission B1
anode B1
electrons attracted by/accelerated towards positive voltage/anode B1 [15]

MARK SCHEME CODE

B1	Independent mark.
C1	Compensation mark; given automatically if the answer is correct, i.e. the working need not be seen if the answer is correct; also given if the answer is wrong but the point is seen in the working.
M1	Method mark: if not given subsequent A marks fall (up to next B, M or C mark).
A1	Answer mark.
e.c.f.	error carried forward; it usually is even where not specifically indicated, i.e. subsequent working including a previous error is credited, if otherwise correct.
vv	vice versa