

**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]

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- 5 (a) (i) correct ray B1
(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) $(f =) v/\lambda$ 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]

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Section B

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

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(d)	lower mass/weight of cycle less force needed greater acceleration/easier to acc. less energy/work (input) less kinetic energy more efficient/less energy wasted less friction less pressure (on ground)	same acceleration/get up hill/to stop cycle/lift cycle for same force or $F = ma$ quoted to go uphill/due to less friction/ $\frac{1}{2} mv^2$ less less stopping distance/less force to stop going uphill/less friction easier turn handlebars/higher (top) speed sinks less into ground	B1 M1A1 [15]
11 (a) (i)	coil and magnet (poles) in a correct orientation – no label needed 2 slip rings correct and labelled brushes touching 2 slip rings, labelled		B1 B1 B1
(ii)	induction of voltage or current (magnetic) flux change or field/flux lines cut wire/coil		B1 B1
(b) (i)	attach (generator to) voltmeter measure voltage (e.g. gives 1.0 V, ± 0.5 V) measure trace height (e.g. gives 0.5 div, ± 0.25 div) clear 2 V moves up 1 div OR observe trace/line/spot with no input apply battery/voltage (to y input) measure voltage applied (with voltmeter) or battery has known voltage check distance moved up/down for voltage supplied e.g. 2 V moves up 1 div		B1 B1 B1 B1 B1 B1 B1 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 time/div (horizontally) changed or time base/x-gain changed to expand trace horizontally y-shift used to move trace up (if no mark – y gain and time base/x gain mentioned B1 trace expanded vertically and horizontally B1)		B1 B1 B1 B1
(iii)	hot/heated filament/cathode or by thermionic emission anode electrons attracted by/accelerated towards positive voltage/anode		B1 B1 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