

**MARK SCHEME for the May/June 2012 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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Section A

- 1 (a) (i) straight line continues to 6 ± 0.2 s B1
- (ii) 3(0)s OR the time on Fig. 1.1 when $v = 0$ B1
- (b) $(a =) (v - u)/t$ in any form numerical or algebraic C1
 $(-)1.6 \text{ m/s}^2$ A1
- (c) any TWO lines:
(at first) graph steeper/higher acceleration/deceleration
caught sooner/shorter time to maximum
graph curves (due to air resistance) B2 [6]
- 2 (a) $(\text{K.E.}) = \frac{1}{2} mv^2$; $\frac{1}{2} \times 90 \times 5^2$ C1
1125 J or 1100 J A1
- (b) (i) no resultant force; forwards force = backwards force/drag/friction (ignore air resistance) B1
water resistance/**water** drag mentioned/**water** friction OR sail exerts force on board B1
- (ii) heat produced OR equal to work done against backwards force/drag/friction B1 [5]
- 3 (a) 14 N B1
- (b) $(P =) F/A$ algebraically in symbols or words in any form; $14/3.0 \times 10^{-5}$ C1
 $4.67 \times 10^5 \text{ Pa}$; $4.7 \times 10^5 \text{ Pa}$ ecf (a) A1
- (c) stiffer/stronger spring; piston has less area/diameter; smaller piston (and tube) B1
- (d) molecules/particles/atoms collide with tyre/walls/piston B1
air/molecules enter gauge; fewer molecules in the tyre; fewer hits/sec;
less frequent hits; volume increases B1 [6]

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- 4 (a) **temperature** when solid melts;
temperature when solid changes to liquid B1
- (b) (i) temperature increases; molecules move faster/have more kinetic energy/
vibrate faster/move further apart B1
- (ii) change of state; solid changes to liquid B1
latent heat provided; break bonds; molecules move apart/break free;
reduce bond strength; idea of more disorder B1
- (c) liquids expand more than solids B1 [5]
- 5 (a) (i) X-ray(s) B1
- (ii) infra-red B1
- (b) any TWO lines:
same speed (in vacuo)
travel in a vacuum; need no medium
carry energy
transverse
can reflect/refract/diffract/interfere/polarise B2
- (c) microwaves B1 [5]
- 6 (a) (i) amplitude decreases B1
- (ii) constant frequency/time for one wave/wavelength/period B1
- (b) (i) number of (complete) cycles in one second B1
- (ii) ($f =$) $1/T$ in any form numerical or algebraic; $1/0.02$ C1
50 Hz A1
- (iii) 0.06 s B1 [6]

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- 7 (a) LED; light-emitting diode B1
- (b) energy/work done per unit charge/coulomb B1
- (c) voltage/p.d. across P B1
one cell connected the wrong way/acting against the others B1
- (d) (i) correct arrangement B1
- (ii) cells last longer; cells run down slower; one cells fails the others still work;
reduces (internal) resistance; if cell removed circuit not broken B1 [6]
- 8 (a) (i) iron; soft iron; mu-metal B1
- (ii) rod becomes (an induced) magnet B1
opposite poles attract; N attracts S OR magnetic pole(s) on rod/at P reverses
(due to induced magnetism) B1
- (b) (i) at least two circles centred on wire (no crossings) B1
clockwise arrow on at least one circle and no arrows wrong B1
- (ii) lines closer together B1 [6]

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Section B

- 9 (a) (i) fuse symbol correct B1
in live wire before junction of two elements B1
- (ii) the (metal) case/outside B1
- (iii) 1. live wire touches case; live touches person B1
2. current goes to earth; current does not go through the person B1
fuse blows B1
- (b) (i) most of the energy output is useful/heat; little energy is wasted; B1
- (ii) hot air rises (**not** heat rises) B1
density of hot air is lower B1
convection current mentioned OR hot air rises and cold air falls B1
- (c) (i) 1500 W B1
- (ii) 1. conversion to kW seen on any power; 2.1 (kW) seen C1
5.25; 5.2; 5.3 (kWh) A1
2. $E = P \times t$ in any form, algebraic or using any power or time e.g. 600×2.5 ,
 600×150 C1
 1.89×10^7 (J) OR $3.6 \times 10^6 \times$ (c)(ii)1. A1 [15]

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10 (a) (i)	refraction	B1	
(ii)	$(n =) \sin i / \sin r$ $\sin 45^\circ / \sin 29^\circ$ 1.4585 to more than 1 sig. fig.	C1 C1 A1	
(iii)	the angle of incidence/incident angle is greater than the critical angle total internal reflection occurs	B1 B1	
(iv)	correct refraction at C with ray parallel to AB correct reflection (and correct refraction on other face i.e. downwards)	B1 B1	
(b) (i)	Any TWO of: undeviated ray through centre of lens ray parallel to axis through point 3 cm from lens on right after lens ray through point 3 cm to left of lens parallel to axis after lens rays converge and vertical image drawn and labelled I	M2 A1	
(ii)	1.2 ± 0.2 cm	B1	
(iii) 1.	real image (can be) formed on screen; virtual image not found on screen; rays converge on real image; rays do not converge on virtual image; rays only appear/seem to come from a point on virtual image	B1	
2.	place object within focal length; between lens and focal point/principal focus view from other side of lens; look through lens; image same side as/behind object	B1 B1 [15]	

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- 11 (a) (gamma) produces little or no ionisation; passes out of detector; requires shielding; reaches people B1
- (b) (i) at least 3 lines between plates and in middle at least one **straight, vertical** line B1
correct curvature at edges B1
at least one arrow down and no arrows wrong B1
- (ii) alpha charged (positively); alpha repelled by positive/attracted by negative B1
deflected down/towards positive (plate) B1
- (c) (gamma) undeviated; straight line B1
(gamma) uncharged B1
- (d) (i) any attempt at halving or 3 **half-lives** seen C1
1/8; 0.125; 12.5% A1
- (ii) decays too fast; have to replace source often; current falls too quickly; detector only works for a short time B1
- (iii) 1. any TWO of:
number of protons
number of electrons
charge on nucleus B2
2. number of neutrons B1
nucleon or mass number or mass B1 [15]
(americium-242 has **one** extra neutron gets 2 marks)