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.

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) (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) (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**
4.67×10^5 Pa; 4.7×10^5 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]**

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]

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]

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 (kW h)   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 3.6×10^{6} × **(c)(ii)1.**   A1   [15]

10 (a) (i) refraction   B1

(ii) (n =) sin i/sin r C1
sin 45°/sin 29°   C1
1.4585 to more than 1 sig. fig.   A1

(iii) the angle of incidence/incident angle is greater than the critical angle   B1
total internal reflection occurs   B1

(iv) correct refraction at C with ray parallel to AB   B1
correct reflection (and correct refraction on other face i.e. downwards)   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   M2
rays converge and vertical image drawn and labelled I   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   B1
view from other side of lens; look through lens; image same side as/behind
object   B1   [15]

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)