MARK SCHEME for the October/November 2013 series

5054 PHYSICS

5054/21   Paper 2 (Theory), maximum raw mark 75

Section A

1 (a) $(m =) \rho V$ **or** 1000×450 C1
4.5×10^5 kg   A1

(b) (i) $(Q =) mc\Delta T$ **or** $4.5 \times 10^5 \times 4.2 \times 15$ **or** 4200 **and** $15/(27–12)$ C1
$4.5 \times 10^5 \times 4200 \times 15$ **or** $2.8(35) \times 10^7$ C1
$2.8(35) \times 10^{10}$ J   A1

    (ii) thermal/internal energy/heat lost **or** gained by something specific
(e.g. air/pool walls/tiles etc.) **or** heat lost by evaporation   B1   [6]

2 (a) $F_1x_1 = F_2x_2$ **or** $550 \times (0.86$ or $86)/(1.1$ or $110)$ C1
430 N   A1

(b) **both** moments increase   C1
girl's moment increases more **or** girl's moment > brother's
or anticlockwise moment greater
     A1
see-saw tips down on girl's side   B1   [5]

3 (a) molecules move/collide (**ignore** vibrate)   C1
molecules collide with the walls (to produce force)   A1

(b) (i) $(p_2 =)p_1V_1/V_2$ **or** $p_1V_1 = p_2V_2$ **or** $1.0 \times 10^5 \times 120/16$ **or** $100 \times 120/16$ C1
7.5×10^5 Pa **or** 750 kPa   A1

    (ii) $(F =)pA$ **or** $7.50 \times 10^5 \times 1.2 \times 10^{-5}$ **or** $750 \times 1.2 \times 10^{-5}$ C1
$9(.0)$ N   A1

    (iii) (pressure) greater (than calculated)   B1
molecules move faster/have more KE/collide more often (accept vibrate faster)   B1
molecules collide more often/frequently **or** harder/with greater force   B1   [9]

4 (a) (energy transmitted) by electromagnetic/infra-red (wave)/can travel
through a vacuum   B1
infra-red **or** visible $< \lambda <$ microwaves **or** λ just longer than visible
(i.e. infra-red scores 2/2)   B1

(b) (i) air is a poor conductor   B1

    (ii) convection occurs (primarily) upwards/hot air rises (**not** heat rises)   B1   [4]

5 (a) (thin-walled) bulb **and** capillary tube   B1
mercury/liquid in bulb **and** constriction/U-bend   B1

(b) mercury/liquid contracts   B1
mercury/liquid/thread breaks (at the constriction)/constriction stops the mercury
falling back

     B1   [4]

6 (a) steel/alnico/SmCo/NdFeB/magnetite   B1

(b) one needle fully correct **or** both angles correct – i.e. A bottom left to top right diagonal
(0 < angle < 90°) **and** B horizontal   C1
both needles fully correct (fully = angle and orientation)   A1

(c) (place) magnet in solenoid   B1
a.c. supply to solenoid/coil (ignore cell/battery symbol)   B1
withdraw magnet (slowly) **or** reduce current (slowly)   B1   [6]

7 (a) (i) ($I = $)$P/V$ **or** 9.6/240 **or** 9600   C1
9600/240 **or** 0.040   C1
40 A   A1

(ii) any whole number from 41 to 99 (incl.) **with unit** (A)
(e.c.f. from 0.040 A: 1,2,3 A)   B1

(b) 9.6 × 25 × 21 **or** 9.6 × 25/60 **or** 9.6 × 25/60 × 21 **or** 5040 c **or** $50.40 etc.   C1
84 c **or** $0.84 **or** €0.84 **or** £0.84 **or** Rs0.84 etc. (85.7/86c from 0.42h)   A1   [6]

8 (a)

Penetration	Magnetic/electric field	Cloud chamber	Spark counter	
diagram: sample, detector, small gap	diagram: sample, detector, magnet	diagram: sample, cloud chamber	diagram: sample, spark counter, small gap labelled **or** clear	B1
(insert/remove) (a sheet of) paper/card/Al foil (in gap)	(insert/remove) magnet	sample in cloud chamber	sample near to counter	B1
no change in count	increased count in correct direction	no short, straight, dense tracks	no sparks	B1

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(b) any **two** of:
minimise time of exposure
lead clothing (e.g. lead gloves **not** radioactive suit)
forceps, tweezers, tongs, manipulator
behind protective glass/shield
wear film badge B2 [5]

[Total: 45]

Section B

9 **(a)** speed does not have direction **and** velocity does
or speed = distance/time **and** velocity = displacement/time
or speed is a scalar **and** velocity is a vector B1 [1]

(b) **(i)** 700 N B1

(ii) 700 N B1 [2]

(c) **(i)** 54 m / s B1

(ii) (height/distance =) area (under graph) **or** ($x =$)vt **or** 54 × 12 C1
648/650 m A1

(iii) (GPE =) mgh **or** 70 × 10 × 648 C1
4.5/4.54/4.536 × 10^5 J A1 [5]

(d) (becomes) heat/thermal energy/internal energy
(**not** kinetic energy (of skydiver) unless qualified as KE of air) B1 [1]

(e) **(i)** (air resistance) increases B1
larger area of parachute B1

(ii) (skydiver) decelerates/slows down (**not** rises up) B1
net upward force B1 [4]

(f) air resistance decreases B1
speed decreases B1 [2]

[Total: 15]

10 **(a)** **(i)** speed of sound is (much) less than the speed of light (accept quoted values) B1

(ii) **measure** the time delay (between the lightning and thunder) B1
divide distance by time/delay B1 [3]

(b) (i) 3.0×10^8 m / s   B1

     (ii) $(\lambda =)$ c/f **or** $3.0 \times 10^8/7.5 \times 10^{14}$ C1
            4.0×10^{-7} m   A1

     (iii) (in any order) blue, green, orange, red, yellow, (indigo), (violet) **or** VIBGYOR   C1
            violet, indigo, blue, green, yellow, orange, red   A1   [5]

(c) (i) correct angle clear/labelled r B1

     (ii) mark/determine entrance and exit points (e.g. trace rays back to glass)   B1
            join/draw line between entrance and exit points   B1

     (iii) 1. $n = \sin i/\sin r$ B1

            2. 1.5/1.51/1.506176 with no unit
            (**not** just 1.5 without working out)   B1

     (iv) correct direction of refraction at **both** faces   M1
            completely correct (above blue)   A1   [7]

                                                            [Total: 15]

11 (a) (i) $(I =)V/R$ **or** 6.0/12.0 **or** 6.0/(4.0+8.0) **or** (in **(ii)**) $(V =)IR$ **or** 0.50 × 4.0   C1
            0.50 A   A1

     (ii) 2.0 V (scores C1 in **(a)(i)** if not already scored)   A1   [3]

(b) (i) increased **or** becomes 1.25 A   B1

     (ii) decreases **or** becomes 0.8 Ω B1   [2]

(c) moves up or down **or** 5.0/2.0   C1
     moves up or down by 2.5 cm   A1   [2]

(d) (i)

	Y-plates	X-plates
(glass) tube	anode	ZnS/screen

     (5 correct 3 marks, 4 correct 2 marks, 3 correct 1 mark
     X and Y plates reversed –1; **allow** focussing anode)   B3

     (ii) filament heated/thermionic emission   B1
            (thermionic) electrons attracted by anode **or** repelled by cathode   B1

   (iii) to prevent/otherwise collisions with air molecules/to allow to reach
the screen/to avoid deflection   B1

   (iv) **1.** electrons are charged   B1

           2. backwards **or** towards the back **or** opposite to electron motion
or to the left **or** from the right   B1   [8]

                                                      [Total: 15]