

## MARK SCHEME for the October/November 2013 series

### 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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Section A

- 1 (a)  $(m = ) \rho V$  or  $1000 \times 450$  C1  
 $4.5 \times 10^5$  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 B1 [6]  
(e.g. air/pool walls/tiles etc.) or heat lost by evaporation
- 2 (a)  $F_1x_1 = F_2x_2$  or  $550 \times (0.86 \text{ or } 86)/(1.1 \text{ or } 110)$  C1  
430 N A1
- (b) both moments increase C1  
girl's moment increases more or girl's moment > brother's  
or anticlockwise moment greater  
see-saw tips down on girl's side A1  
B1 [5]
- 3 (a) molecules move/collide (ignore vibrate) C1  
molecules collide with the walls (to produce force) A1
- (b) (i)  $(p_2 = ) p_1 V_1 / V_2$  or  $p_1 V_1 = p_2 V_2$  or  $1.0 \times 10^5 \times 120/16$  or  $100 \times 120/16$  C1  
 $7.5 \times 10^5$  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 B1  
through a vacuum  
infra-red or visible  $< \lambda <$  microwaves or  $\lambda$  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]

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- 5 (a) (thin-walled) bulb **and** capillary tube  
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) B1  
(e.c.f. from 0.040 A: 1,2,3 A)
- (b)  $9.6 \times 25 \times 21$  **or**  $9.6 \times 25/60$  **or**  $9.6 \times 25/60 \times 21$  **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: diagram: diagram: diagram:  
sample, sample, detector, sample, cloud sample, spark  
detector, small magnet chamber counter, small  
gap gap labelled **or** clear B1
- (insert/remove) (insert/remove) sample in sample near  
(a sheet of) magnet cloud chamber to counter  
paper/card/Al foil (in gap) 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**  $54 \times 12$   
 648/650 m

C1  
 A1

- (iii) (GPE =)  $mgh$  **or**  $70 \times 10 \times 648$   
 $4.5/4.54/4.536 \times 10^5$  J

C1  
 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  
 larger area of parachute

B1  
 B1

- (ii) (skydiver) decelerates/slows down (**not** rises up)  
 net upward force

B1  
 B1 [4]

- (f) air resistance decreases  
 speed decreases

B1  
 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)  
 divide distance by time/delay

B1  
 B1 [3]

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- (b) (i)  $3.0 \times 10^8$  m/s
- (ii)  $(\lambda = ) c/f$  or  $3.0 \times 10^8 / 7.5 \times 10^{14}$   
 $4.0 \times 10^{-7}$  m
- (iii) (in any order) blue, green, orange, red, yellow, (indigo), (violet) or VIBGYOR  
violet, indigo, blue, green, yellow, orange, red
- (c) (i) correct angle clear/labelled  $r$
- (ii) mark/determine entrance and exit points (e.g. trace rays back to glass)  
join/draw line between entrance and exit points
- (iii) 1.  $n = \sin i / \sin r$
2. 1.5/1.51/1.506176 with no unit  
(not just 1.5 without working out)
- (iv) correct direction of refraction at **both** faces  
completely correct (above blue)

[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  $0.50 \times 4.0$   
0.50 A
- (ii) 2.0 V (scores C1 in (a)(i) if not already scored)
- (b) (i) increased or becomes 1.25 A
- (ii) decreases or becomes  $0.8 \Omega$
- (c) moves up or down or 5.0/2.0  
moves up or down by 2.5 cm

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

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- (iii) to prevent/otherwise collisions with air molecules/to allow to reach the screen/to avoid deflection
- (iv) 1. electrons are charged
2. backwards **or** towards the back **or** opposite to electron motion **or** to the left **or** from the right
- B1
- B1 [8]
- [Total: 15]**