**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Ordinary Level**

# 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.

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## Section A

**1** **(a)** ($m$ = ) $\rho V$ **or** 1000 × 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 (e.g. air/pool walls/tiles etc.) **or** heat lost by evaporation B1 [6]

**2** **(a)** $F_1x_1 = F_2x_2$ **or** 550 × (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 × 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 through a vacuum B1
infra-red **or** visible < λ < 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]

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**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<br>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]

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**(b) (i)** $3.0 \times 10^8$ m / s B1

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

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**(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]**

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