**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.

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
          (e.g. air/pool walls/tiles etc.) **or** heat lost by evaporation     B1    [6]

2  **(a)**  $F_1 x_1 = F_2 x_2$ **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)**  $(p_2 =)p_1 V_1/V_2$ **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
      through a vacuum     B1
      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]

**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)** $3.0 \times 10^8$ 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** $0.50 \times 4.0$      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 $\Omega$      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]