**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Ordinary Level**

# MARK SCHEME for the October/November 2012 series

## 5054 PHYSICS

**5054/22**     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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**CAMBRIDGE**
International Examinations

## Section A

**1** **(a)** appropriate apparatus e.g. ruler, weights, fulcrum     B1
     action e.g. balance weights on each side     B1
     one of: force/mass × distance **or** calculate moment     B1
     vary **or** repeat     B1

     **(b)** $F × d$ **or** 8.0 × 0.15     C1
        1.2 N m (**not** J)     A1    [6]

**2** **(a)** **(i)** 4.5 kg     B1

        **(ii)** axes labelled with quantity **and** unit     B1
            linear scale     B1
            straight line from clear (0,0) to correct point     B1

     **(b)** answer from candidate's line     B1    [5]

**3** **(a)** **(i)** (PE = )$mgh$ **or** 75 × 10 × 20     C1
           $1.5 × 10^4$ J     A1

        **(ii)** $½mv^2$ **or** $½75v^2$     C1
            $v^2 = 400$    (if this is seen it scores the first 2 marks)     C1
            $v = 20$ m / s     A1

     **(b)** (G)PE **at start**     B1
        KE **at start**     B1
        to elastic/strain/clear equivalent /EPE **at end**
        (**not** stretch energy; any intermediate energy –1)     B1    [8]

**4** **(a)** **(i)** (F = )$PA$ **or** $4.6 × 10^5 × 0.005$     C1
           2300 N     A1

        **(ii)** (WD = )$F × d$ **or** 2300 × 0.074     C1
            170(.2) J     A1

     **(b)** **(i)** ($\Delta T = $)$Q/C$ **or** 170/0.27     C1
           629.6(2)/630(.370) °C       (° is **not** correct)     A1

        **(ii)** thermal energy/heat lost to cylinder/environment/atmosphere (**not**
            just 'lost') **or** work done against/heat lost due to friction     B1    [7]

**5** **(a)** space is a vacuum/empty     B1
     these methods need matter/medium/molecules
     **or** do not occur in vacuum     B1

**(b)** any **three** of:

    **day:** white is a poor absorber/good reflector

    **day:** less heat absorbed/less heating      (of house)

    **night:** white is a poor emitter/radiator

    **night:** less heat emitted/heat loss      (from house)

    **anywhere:** of IR/radiation/radiant heat      B3    [5]

**6**  **(a)**  **(i)**  electrons **cao**      (**not** positive electrons)    B1

      **(ii)**  (from) heated (filament) **or** heat **or** boiled off (from filament) **or**
           knocked out by energetic/fast-moving atoms    B1

      **(iii)**  to allow electrons to reach the screen **or**
            no collisions with (air) atoms/molecules/particles    B1

  **(b)**  $(1/t = )I/Q$ **or** $1.6 \times 10^{-19}/5.6 \times 10^{-3}$ **or** $5.6 \times 10^{-3}/1.6 \times 10^{-19}$ **or**
      $2.86/2.9 \times 10^{-17}$    C1
      $3.5 \times 10^{16}$    A1    [5]

**7**  **(a)**  solid-state detector/GM tube/ionisation chamber/scintillation
      counter/spark counter/spinthariscope    B1
      count **or** count-rate **or** reading referred to    B1
      (some) detection with appropriate blocking in the way **or** same
      reading/track in electric/magnetic field    B1
      **OR**
      film    B1
      develop    B1
      (some) detection with appropriate blocking in the way **or** same
      reading/track in electric/magnetic field    B1
      **OR**
      (diffusion) cloud chamber    B1
      track **seen/looked for/formed**    B1
      pattern of track described    B1

  **(b)**  any **two** lines:

      one **distance** method: tongs/robotic arm/carry in large box

      one **protection** method: lead suit/lead gloves/lead boxes/shield

      one **time** method: reduced time/wear badge    B2    [5]

**8 (a)** $^{15}_{8}O$ /oxygen-15/oxygen (nucleus)  B1

**(b) (i)** $^{12}_{6}C$ **and** $^{14}_{6}C$ /carbon-12 **and** carbon-14/the two carbon nuclei  B1

**(ii)** $^{14}_{6}C$ **and** $^{14}_{7}N$ /carbon-14 **and** nitrogen-14  B1

**(iii)** $^{14}_{7}N$ **and** $^{15}_{8}O$ /nitrogen-14 **and** oxygen-14/the nitrogen and oxygen nuclei  B1  [4]

[Total: 45]

## Section B

**9 (a) (i)** $(p = )\rho hg$ **or** $1000 \times 15 \times 10$  C1
$1.5 \times 10^5$ Pa  A1

**(ii)** $2.5 \times 10^5$ Pa  B1  [3]

**(b) (i)** $p_1V_1 = p_2V_2$ **or** $250\,000 \times 0.048 = 100\,000 \times V_2$  C1
$0.12$ m$^3$  A1

**(ii)** molecules/particles: further apart **or** their speed is unchanged  B1
(molecular) collisions with balloon/walls/unit area  B1
less frequent collisions (**not** if force/violence of each collision less)  B1  [5]

**(c)** water molecules: close(r)/move in clusters/move within the liquid
**or** air molecules: far/further apart/move individually/move throughout container  B1  [1]

**(d) (i)** net/resultant/unbalanced force upwards (at first)
**or** upwards force greater  B1

friction/resistance/drag/downward force increases

(until) downward force = upward force/forces balance/no resultant force  B3

**(ii)** starts from **marked** (0,0) **or** initial gradient = 0  B1
increasing gradient initially  B1
constant gradient (must be greater than zero) finally  B1  [6]

[Total: 15]

**10 (a)** $(\lambda =)v/f$ **or** $2 \times 10^8/4.7 \times 10^{14}$                   C1
        $4.3 \times 10^{-7}$ m                                                    A1      [2]

**(b)**  raybox/light source/              pin(s) **and** mirror
           laser **and** mirror                                                B1
        shine ray at mirror          place two pins                          B1
        mark rays          **or**   two more pins in line with image          B1
        measure $i$ and $r$ **and** equal    measure $i$ and $r$ **and** equal  B1
        repeat                       repeat                                    B1      [5]

**(c) (i)** 83°                                                                B1

**(ii)** total internal reflection **or** TIR **cao**                          B1
        **angle of incidence** exceeds critical angle                         B1      [3]

**(d) (i)** (at least) one ray from X to mirror                                M1
        (at least) **two** rays from X to mirror **and** correct reflections   A1
        rays traced back to marked I **or** I marked in correct place (by eye) B1

**(ii)** 0.19 m                                                                B1

**(iii)** less/no light wasted **or** hall brighter                            B1      [5]

                                                                              **[Total: 15]**

**11 (a) (i)** 4.5 + 0.3 **or** 4.8                                             C1
        $(I =)V/R$ **or** 12/4.8 **or** 12/4.5 **or** 12/0.3 **or** 12/0.28125  C1
        2.5 A                                                                  A1

**(ii)** decrease resistance (of variable resistor)                            B1
        increase current (in solenoid)                                        B1

**(iii) 1.** force on PQ/wire **or** PQ/wire moves                             M1
        force/movement out of page/outwards/towards observer
        (**not** upwards)                                                      A1
        **2.** force/speed/acceleration larger                                 B1      [8]

**(b) (i)** $(P =)VI$ **or** $75 \times 12$                                     C1
        900 W                                                                  A1

**(ii)** (thick wires) have low resistance                                     B1
        (thick wires) not as hot/do not melt                                  B1

**(c)** current to relay/coil/solenoid/electromagnet                           B1
        core/relay/coil/solenoid/electromagnet magnetised                     B1
        connections made (in motor circuit)                                   B1      [7]

                                                                              **[Total: 15]**