CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Ordinary Level

MARK SCHEME for the May/June 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) 11 cm   B1

    (b) (graph is) a straight line/linear **or** has constant gradient **or** not curved   B1

    (c) (i)   change in speed/velocity   M1
              same change in uniform/same time **or** in 1 s   A1

         (ii) 1.   0.8 N   B1

              2.   (*a*=) *F*/*m* algebraic or numerical e.g. *F* = *ma*; 0.8/0.2   C1
                   (ecf **1.** but **not** if *F* = 0)
                   4(.0) m/s^2 A1   [7]

2   (a) total/resultant **moment** zero **or** (sum of) clockwise = anticlockwise **moment**   B1

    (b) F_1d_1 **or** F_2d_2 seen in any form   C1
         8(.0) N   A1

    (c) 4 + 1.2 or 5.2 seen   C1
         2.8 N   ecf **(b)** i.e. accept 5.2 – **(b)** or **(b)** – 5.2   A1   [5]

3   (a) Q and R   B1

    (b) ρgh in any form, algebraic or numerical   C1
         1.0(336) × 10^5 N/m^2 A1

    (c) water is less dense **or** has density 1000 (kg/m^3)   B1
         water further up tube/fills tube **or** height greater **or** water enters pump **or** water
         boils   B1   [5]

4   (a) (i)   120 °C **or** –10 to 110 °C   B1

         (ii) same distance/length (on scale) for a temperature rise (along scale) **or**
               regular intervals/equal divisions (**ign.** numbers equally spaced)   B1

         (iii) diagram with any two markings further apart and none less   B1

    (b) resistance (of metal); e.m.f./voltage/current/p.d. (of thermocouple); pressure of
         gas;
         colour; quantity of radiation (**ign.** radiation) etc.   B1   [4]

5 **(a)** critical angle   B1

   (b) **(i)** light refracted out into air **and** bent away from normal (ignore reflected ray)   B1

   (ii) correct internal reflection (by eye) **and** no refracted ray (**not** at 90°)   B1

   (c) (t =) distance/speed in any form numerical or algebraic (e.g. d/s, s/v 10/2 × 10^8)   C1
   2.5 × 10^{-10} s   A1   [5]

6 **(a)** current is directly proportional to voltage (**accept** voltage/current = constant, but
   not just = R)   B1
   if temperature/physical conditions constant   B1

   (b) (R=) V/I in any form algebraic or using any value of V and I from graph   C1
   20 Ω   A1

   (c) **(i)** 40 Ω **or** 2 × **(b)**   B1

   (ii) straight line graph through origin below given line ecf **(b)** (e.g. **accept** above
   line if R < 20)   M1
   goes through 0.1 A at 4 V ecf **(b)** (e.g. allow through 0.2 A at 2 V if R = 10 Ω)   A1   [7]

7 **(a)** correct symbol for thermistor   B1
   in series circuit with any power supply (e.g. cell or two circles) and a fixed resistor   B1

   (b) **(i)** 12 (V)   B1
   0.018 (A)   B1

   (ii) (P=) VI in any form algebraic or numerical with any voltage (4, 8 or 12)   C1
   0.14(4) W   A1

   (iii) above maximum power **or** gets too hot **or** blows up **or** fails   B1   [7]

8 **(a)** (soft) iron/mu-metal   B1

   (b) magnetic field **or** flux **or** flux/magnetic lines mentioned   B1
   changing magnetic field **or** changing flux **or** flux lines cut coil   B1
   induced voltage/current/e.m.f.   B1

   (c) less power/energy/heat loss (**allow** no power loss/to prevent power loss) **or**
   more efficient **or** thinner wire can be used (**ign.** cheaper)   B1   [5]

                                                                                                                                    [Total: 45]

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Section B

9 **(a)** **(i)** mass is the amount of matter/substance **or** to resist (change in) motion **or** (measurement of)inertia   B1
weight is the pull/force of gravity **or** pull of Earth   B1
accept mg where g stated as 10 (N/kg) or grav. field strength or acc. due to gravity
ignore mg where g is gravity or grav. force or undefined

    (ii) mgh algebraic or numerical   C1
1200 J   A1

    (iii) ½ mv^2 algebraic or numerical   C1
(speed =) 9/12 **or** 0.75 seen   A1
5.6(25) J   A1

    (iv) (E=) VIt algebraic or numerical   C1
4100 J **or** 4140 J   A1

    (v) **1.** energy can neither be created or destroyed/lost   B1
        (but) may change form / be transferred   B1

        2. electrical energy changes to P.E. (and K.E. and heat/work against friction; **ign**. mechanical energy)   B1   [12]

  (b) **(i)** will not run out **or** infinite **or** being replaced (**allow** does not finish/always available)
(**ign.** cannot be reused/recycled)   B1

    (ii) wind, tidal, solar/Sun, geothermal, hydroelectric, biomass, waves, wood (**not** nuclear)   B2   [3]
(**allow** biogas/biofuel e.g. cane into petrol, dung into gas etc.) (**ign.** tidal waves)

[Total: 15]

10 **(a)** **(i)** (amount of) energy/work   M1
(by a device of power) 1 kW in 1 hr   A1

    (ii) 80/1000 **or** 0.08 seen   (e.g. 0.08 × 24 × 25)   C1
168 **or** 24 × 7 (hours) seen   (e.g. 0.08 × 24 × 7 × 25)   C1
336 c **or** 340 c (accept \$3.36 or any other e.g. £, R)   A1   [5]

  (b) **(i)** mcT algebraic or numerical   C1
conversion of mass to g seen, e.g. 1500 used **or** shc used as 4200   C1
1.6×10^5 J **or** 1.58×10^5 J **or** 157 500 J (**allow** 157(.5) J to score 2/3)   A1

    (ii) (m=) E/L in any form numerical or algebraic e.g. $157\,500/3.3 \times 10^5$ C1
0.48 **or** 0.477 kg e.c.f. **(i)**   A1

(iii) 1. no fixed position/clusters/arranged randomly/close together/closely packed   B1
move throughout/at random/slide past each other/not in an organised way   B1

2. regular/orderly arrangement/crystal lattice **or** fixed position **or** close together
(**ign.** evenly spaced)   B1
vibrate   B1

(iv) nothing/no change **and** increases   B1   [10]

[Total: 15]

11 (a) (i) 6 protons   B1
8 neutrons   B1
6 electrons outside nucleus **or** 6 electrons and protons & neutrons inside nucleus   B1

(ii) different number of neutrons   B1
same number of protons (ignore electrons)   B1   [5]

(b) (i) 2 half lives seen e.g. $8 \rightarrow 4 \rightarrow 2$ C1
number of carbon atoms 2×10^{20} A1
number of nitrogen atoms 6×10^{20} **or** $(8 \times 10^{20} - N_C)$ atoms   B1

(ii) many half lives **or** has decayed (too much) **or** very few atoms (of C) left   B1   [4]

(c) (i) background count/rate taken without source   B1
any count taken over any measured time e.g. 1 minute
or any rate determined (**allow** read ratemeter)   B1
take count/rate with aluminium **between source and detector**   B1
at 5 mm count/rate goes to background/constant/zero **when** corrected for background   B1

(ii) for protection (of the class/teacher e.g. to avoid cancer) **or** gamma-rays cannot pass through **or** to stop particles (hitting class/teacher) (**ign.** just "for safety")   B1

(iii) gamma-rays not stopped by/pass through (5–10 mm) aluminium   B1   [6]

[Total: 15]