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) $\times$ 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 $10/2 \times 10^8$) 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]

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. 157 500/3.3×10^5 — 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]