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.

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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) $F \times d$ **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) $\frac{1}{2}mv^2$ **or** $\frac{1}{2}75v^2$ — 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** $4.6 \times 10^5 \times 0.005$ — C1
2300 N — A1

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

(b) **(i)** (ΔT =)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

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(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

3.5×10^{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]

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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 =)ρhg **or** 1000 × 15 × 10 C1
1.5×10^5 Pa A1

(ii) 2.5×10^5 Pa B1 [3]

(b) **(i)** $p_1V_1 = p_2V_2$ **or** 250 000 × 0.048 = 100 000 × 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]

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

(b) raybox/light source/ laser **and** mirror — pin(s) **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 × 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]

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