CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2013 series

5054 PHYSICS

5054/22 Paper 2 (Theory), maximum raw mark 75

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Section A

1 (a) (i) arrow(head) on chain pointing to the right — B1

(ii) vertical arrow downwards and part of arrow touching **or** within rectangle of lights **or** direction of arrow in **(i) and (ii)** correct (by eye) — B1

(b) scale given (must have unit of cm:N **or** cm/N **or** N:cm **or** N/cm) — B1
correct triangle **or** rectangle (might be implied) and correct resultant (compulsory e.c.f. from **(i) or (ii)**: i.e. correct diagonal according to candidate's **(i)** and **(ii)**) — B1
272 ≤ candidate's value ≤ 283 N — B1 [5]

2 (a) (m =) ρV **or** 1000 × 0.150 — C1
150 kg — A1

(b) (when full) greater mass **or** greater momentum — B1

more inertia **or** mass resists change in state of motion
or small(er) deceleration (for same force)
or large(r) force for same deceleration (rate of decrease of momentum for deceleration) — B1
or
greater kinetic energy — (B1)
more work done in same distance (to stop) — (B1) [4]

3 (a) (i) (p =) F/A **or** 12 000/0.048 **or** 12 000/0.14
or (in **(ii)**) (F =) pA **or** 2.5 × 105 × 0.14 — C1
2.5×10^5 Pa — A1

(ii) 35 000 N — A1

(b) atmospheric pressure **or** friction (between cylinder and piston/oil)
(accept bubbles (of air) in oil **or** viscosity of oil) — B1

(c) (W.D. =) $F \times d$ **or** 12 000 × 0.065 **or** 35 000 × 0.065 **or** 2275 — C1
780 J — A1

(d) (liquids) incompressible **or** air spongy **or** (oil) lubricates the system **or** (oil) reduces friction
(**ignore** density references, **ignore** oil compresses less) — B1 [7]

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4 **(a)** 56 °C (**not** ° **or** C°) B1

(b) (Q =) ml **or** 110 × 210 C1
2.3(1) × 10^4 J A1

(c) **(i)** (wax) is solidifying **or** freezing B1

(ii) (molecules) form structure/come closer/lose PE
or bonds made/stronger (no e.c.f. from **(c)(i)**) M1
KE. of molecules const. **or** replace/release/produce energy/heat
(transferred to environment/latent heat emitted)
(no e.c.f. from **(c)(i)**) A1 [6]

5 **(a)** transmission of energy through a medium **or** vibration **or** oscillation **or**
two opposite motions (e.g. up and down) **or** compressions and rarefactions C1
vibration direction parallel to energy travel/wave direction **or** similar A1

(b) **(i)** 1.5–2.5 × 10^4 Hz **or** 15–25 kHz cao B1
15–25 Hz cao B1

(ii) (λ =) c/f **or** 330/either of candidate's frequencies C1
330/candidate's higher frequency and correctly calculated with unit
(candidate's higher frequency is either the one stated as the highest
or the one that is in fact the higher) A1 [6]

6 **(a)** electrons (move) M1
to the fuel **or** from the pipe **or** pipe becomes positively charged
(**not** moving protons/+ve charges) A1

(b) spark (jumps from the plane) B1
ignite the fuel/explosion/blast B1
or
current from ground (B1)
shock (to worker/passenger) (B1)

(c) **(i)** (metal an electrical) conductor **or** has low resistance **or allows/lets** charges/
electrons to flow through it
(this is general: about the conduction property of metals) B1

(ii) charge/electrons flow along the cable **or** (plane/charges) earthed
(this is specific: about the conduction in this case) B1 [6]

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7 **(a)** a power × a time × the unit price
(e.g. 1.2 × 75/60 × 4 × 21 **or** 1200 × 75/60 × 4 × 21 **or** 1.2 × 75 × 4 × 21 **or** 1.2 × 75/60 × 21 **or** 5 (hr) **or** 6 (kW h)) C1
a power × a time × the unit price and with maximum of one physics error (i.e. use of 1200 **or** omits 60 **or** omits 4)
(e.g. 1200 × 75/60 × 4 × 21 **or** 1.2 × 75 × 4 × 21 **or** 1.2 × 75/60 × 21 **or** 126 000 **or** 7560 **or** 31.5 (accept 0.21 for 21 and 75.60 and 0.315)
(if this C mark is scored so is the previous one) C1
126/130 c **or** $1.26/1.30 **or** €/£/Rs 1.26/1.30 etc. A1

(b) (if) case becomes live **or** live wire touches the case B1
fuse blows **or** (large) current to earth **or** no current in workman
(**ignore** excess; **not** "some current") B1 [5]

8 **(a)** **(i)** any two of:
minimise time of exposure
lead clothing (e.g. lead gloves **not** radioactive suit)
tongs, manipulator, forceps, tweezers
behind protective/lead glass/shield
wear film badge B2

(ii) (radioactive emission) random/unpredictable (process)
(e.g. background radiation is random; **ignore** spontaneous) B1

(b) penetration strong(er) **or** penetrates casing (accept α **or** β **or** both; **ignore** larger range) B1
(more) weakly/slowly ionising B1
either explained: harms health **or** hazardous **or** dangerous **or** air is not ionised **or** sounds all the time (accept doesn't work) B1 [6]

[Total: 45]

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Section B

9 **(a)** force × distance **or** $F \times d$ with F and d defined **or** $F \times d_{perp}$ C1
force × perpendicular distance **or** $F \times d_{perp}$ with F and d_{perp} defined A1 [2]

(b) **(i)** **1.** 6 × 750 × 1.2 **or** 750 × 1.2 **or** 900 C1
5400 N m A1

2. *mgh* **or** 350 × 10 × 160 **or** 350 × 10 × 1.6 C1
350 × 10 × 1.6 **or** 5.6 × 105 C1
5600 J A1

(ii) friction at axle/boat **or** drag due to water
or chain lifted also B1
heat produced (**ignore** in sailors) **or** work done against friction/drag
or work done raising chain B1

(iii) same amount of work done **or** $P = E/t$ **or** $P = WD/t$ B1
in less time **or** power inversely proportional to time (**ignore** faster rate) B1 [9]

(c) clear/labelled diagram with ruler, fulcrum, at least two weights B1
any three of the following points made in words:
balance ruler (on its own)
place weights on ruler so it balances
clockwise and anticlockwise moments equal **or** net moment zero
repeat (apply similar principles to other possible methods) B3 [4]

[Total: 15]

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10 (a) (i) start at origin **and** not horizontal — B1
gradient (gradually) decreasing (**ignore** sudden decrease)
(not if part of curve above horizontal section) — B1
final horizontal section (≥ 1 cm) (not if v is shown as ≠ 40 m/s) — B1

(ii) area **under** the graph **or** count squares **under** graph — M1
between t = 0 and horizontal section **or** when speed is changing **or**
calculate equivalent distance to 1 cm^2 (after counting squares) — A1 [5]

(b) (i) friction/air resistance increases (as speed increases) — B1
resultant force decreases
(**not** if driving force decreases) — B1

(ii) (air resistance increases until) net force becomes zero **or** forces balance
or air resistance and driving/forward force are in equilibrium/balanced/equal — B1 [3]

(c) (i) (KE =) $\frac{1}{2}mv^2$ — C1
$\frac{1}{2} \times 5.5 \times 10^5 \times 40^2$ — C1
4.4×10^8 J — A1

(ii) (total energy input =) useful energy output efficiency **or**
efficiency = useful power output/total power input **or** $4.4 \times 10^8/0.40$ — C1
1.1×10^9 J — A1

(iii) two valid examples
e.g. furnace/boiler/turbines/generator/coils/cooling water/cooling towers/heat exchanger/transformer/chimney/waste gases/
transmission cables/lines/wires (**ignore** power station/all parts of motor) — B2 [7]

[Total: 15]

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11 (a) work done per (unit) charge/coulomb/C **or** energy transformed per (unit) charge/coulomb/C B1
property of a source (of electricity) **or** energy transformed to electrical energy per (unit) charge/coulomb/C B1 [2]

(b) (i) ammeter in series B1

(ii) voltmeter in parallel with lamp **or** lamp and ammeter B1 [2]

(c) (i) (V =) 2.0 (V) C1
(R =) V/I **or** 2.0/0.70 C1
2.9/2.86 Ω (i.e. 2 **or** 3 s.f. only) A1

(ii) (resistance) increases B1 [4]

(d) (P =) VI **or** (P =) V^2/R **or** I^2R **or** 12 × 2.0 **or** 12 × 0.70 C1
24 W A1 [2]

(e) (i) emission of electrons M1
from heated metal/named metal/filament/wire A1

(ii) 1. prevents collision with air (molecules) **or** prevents deflection **or** lets electrons/particles reach screen/travel unimpeded B1

2. moves vertically (e.g. up/down/above/below **or** vertical line) **not** with horizontal movement due to this voltage B1
attracted by positive **or** repelled by negative **or** attracted by one plate and repelled by the other **or** electric field (acts on charge) B1 [5]

[Total: 15]

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