

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
 $272 \leq \text{candidate's value} \leq 283 \text{ N}$ 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** $12\,000/0.14$ C1
or (in (ii)) ($F =$) pA **or** $2.5 \times 10^5 \times 0.14$ A1
 $2.5 \times 10^5 \text{ Pa}$
- (ii) 35 000 N A1
- (b) atmospheric pressure **or** friction (between cylinder and piston/oil) B1
 (accept bubbles (of air) in oil **or** viscosity of oil)
- (c) (W.D. =) $F \times d$ **or** $12\,000 \times 0.065$ **or** $35\,000 \times 0.065$ **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
 $2.3(1) \times 10^4 \text{ J}$ 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) $1.5\text{--}2.5 \times 10^4 \text{ Hz}$ **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 $\times$ a time $\times$ the unit price
 (e.g. $1.2 \times 75/60 \times 4 \times 21$ **or** $1200 \times 75/60 \times 4 \times 21$ **or** $1.2 \times 75 \times 4 \times 21$
or $1.2 \times 75/60 \times 21$ **or** 5 (hr) **or** 6 (kW h)) C1
 a power $\times$ a time $\times$ the unit price and with maximum of one physics
 error (i.e. use of 1200 **or** omits 60 **or** omits 4)
 (e.g. $1200 \times 75/60 \times 4 \times 21$ **or** $1.2 \times 75 \times 4 \times 21$ **or** $1.2 \times 75/60 \times 21$ **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 $\times$ distance **or** $F \times d$ with F and d defined **or** $F \times d_{\text{perp}}$
force $\times$ perpendicular distance **or** $F \times d_{\text{perp}}$ with F and d_{perp} defined C1
A1 [2]
- (b) (i) 1. $6 \times 750 \times 1.2$ **or** 750×1.2 **or** 900 C1
5400 N m A1
2. mgh **or** $350 \times 10 \times 160$ **or** $350 \times 10 \times 1.6$ C1
 $350 \times 10 \times 1.6$ **or** 5.6×105 C1
5600 J A1
- (ii) friction at axle/boat **or** drag due to water B1
or chain lifted also B1
heat produced (**ignore** in sailors) **or** work done against friction/drag B1
or work done raising chain
- (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]

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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 $\neq 40$ 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
 $4.4 \times 10^8 \text{ J}$ 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
 $1.1 \times 10^9 \text{ J}$ 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]

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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** $I^2 R$ **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]