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

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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CAMBRIDGE
International Examinations

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]

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]

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]

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]

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 between t = 0 and horizontal section **or** when speed is changing **or** calculate equivalent distance to 1 cm^2 (after counting squares)	M1 A1	[5]
	(b)	**(i)**	friction/air resistance increases (as speed increases) resultant force decreases (**not** if driving force decreases)	B1 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 =) $\frac{1}{2}mv^2$ $\frac{1}{2} \times 5.5 \times 10^5 \times 40^2$ 4.4×10^8 J	C1 C1 A1	
		(ii)	(total energy input =) useful energy output efficiency **or** efficiency = useful power output/total power input **or** $4.4 \times 10^8/0.40$ 1.1×10^9 J	C1 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]

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]