

**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.

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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) 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 =)  $\rho V$  **or**  $1000 \times 0.150$  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 B1  
(ignore density references, ignore oil compresses less) [7]

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- 4 (a) 56 °C (not ° or C°) B1
- (b) (Q =) ml or 110 × 210 C1  
2.3(1) × 10<sup>4</sup> 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 vibration direction parallel to energy travel/wave direction or similar C1  
A1
- (b) (i) 1.5–2.5 × 10<sup>4</sup> 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 B1  
(this is general: about the conduction property of metals)
- (ii) charge/electrons flow along the cable or (plane/charges) earthed B1  
(this is specific: about the conduction in this case) [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  $\alpha$  **or**  $\beta$  **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  $d_{\text{perp}}$  defined C1 A1 [2]
- (b) (i) 1.  $6 \times 750 \times 1.2$  **or**  $750 \times 1.2$  **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**  $5.6 \times 10^5$  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 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) B1  
(not if part of curve above horizontal section) B1  
final horizontal section ( $\geq 1$  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  $1 \text{ cm}^2$  (after counting squares) A1 [5]
- (b) (i) friction/air resistance increases (as speed increases) B1  
resultant force decreases B1  
(**not** if driving force decreases)
- (ii) (air resistance increases until) net force becomes zero **or** forces balance B1 [3]  
**or** air resistance and driving/forward force are in equilibrium/balanced/equal
- (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]

[Total: 15]

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<b>11 (a)</b>	work done per (unit) charge/coulomb/C <b>or</b> energy transformed per (unit) charge/coulomb/C	B1	
	property of a source (of electricity) <b>or</b> energy transformed to electrical energy per (unit) charge/coulomb/C	B1	[2]
<b>(b) (i)</b>	ammeter in series	B1	
	<b>(ii)</b> voltmeter in parallel with lamp <b>or</b> lamp and ammeter	B1	[2]
<b>(c) (i)</b>	(V =) 2.0 (V)	C1	
	(R =) $V/I$ <b>or</b> 2.0/0.70	C1	
	2.9/2.86 $\Omega$ (i.e. 2 <b>or</b> 3 s.f. only)	A1	
	<b>(ii)</b> (resistance) increases	B1	[4]
<b>(d)</b>	(P =) $VI$ <b>or</b> $(P =) V^2/R$ <b>or</b> $I^2 R$ <b>or</b> $12 \times 2.0$ <b>or</b> $12 \times 0.70$	C1	
	24 W	A1	[2]
<b>(e) (i)</b>	emission of electrons from heated metal/named metal/filament/wire	M1 A1	
<b>(ii) 1.</b>	prevents collision with air (molecules) <b>or</b> prevents deflection <b>or</b> lets electrons/particles reach screen/travel unimpeded	B1	
<b>2.</b>	moves vertically (e.g. up/down/above/below <b>or</b> vertical line) <b>not</b> with horizontal movement due to this voltage attracted by positive <b>or</b> repelled by negative <b>or</b> attracted by one plate and repelled by the other <b>or</b> electric field (acts on charge)	B1 B1	
		B1	[5]
			<b>[Total: 15]</b>