

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
**GCE Ordinary Level**

**MARK SCHEME for the May/June 2010 question paper**  
**for the guidance of teachers**

**5054 PHYSICS**

**5054/21**

Paper 2 (Theory), maximum raw mark 75

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## Section A

- 1 (a) forces balance/cancel **or** no net force **or** upward force = downward force  
**or** weight = air resistance/drag/air friction B1 [1]
- (b) (i)  $9.8\text{--}10 \text{ m/s}^2$  B1 [1]
- (ii)  $a = v(-u)/t$  algebraic or numerical C1  
 $2(.0) \text{ m/s}$  ecf (i) A1 [2]
- (iii) straight line from (0,0) to (0.2,2) ecf (ii) B1  
after 0.2 s, decreasing but not negative gradient B1 [2]
- 2 (a) **where** extension/stretching stops being proportional to force/load/weight/mass  
**or** extension/load = constant  
**or** point where length or extension against load graph curves C1 [1]
- (b)  $4 = k \frac{6}{11}$  **or**  $\frac{4}{6}$  **or**  $\frac{6}{4}$  **or**  $6 \times \frac{2}{4}$  **or** 3 (cm) seen C1  
11 cm A1 [2]
- (c) different weights/masses/load **and** measure new length B1  
how extension is found e.g. reading on scale for loaded spring subtracted from  
reading with no load/mass/original B1 [2]
- 3 (a) chemical energy to **or** K.E to B1  
heat/thermal energy/internal energy – at end B1 [2]
- (b) friction/resistive force **increases** B1 [1]
- (c) (i) work = force  $\times$  distance in words, number or symbols C1  
 $1.2 \times 0.08$  **or** 0.096 **or** 20 **or** 0.208 seen C1  
20.8 **or** 21 A1 [3]
- (ii) power = work/time **or** energy/time, numerical or algebraic – may use values  
in (i)  
**accept**  $2/0.2$  or 10 W C1  
0.48 W (ecf (i) including power of ten error in (i)) A1 [2]
- 4 (a) at least 3 reflected wavefronts with same wavelength as before B1  
all **and**  $\geq 2$  reflected wavefronts at correct angle B1 [2]
- (b) (i) no change in direction **and** clearly smaller, approximately constant  
wavelength B1 [1]
- (ii) 1 reduces B1  
2 constant B1 [2]

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- 5 (a) (i) correct direction of refraction at **both** faces (**not** along normal)  
blue below red **and** blue and red diverge B1 [2]  
B1
- (ii) any **two** from orange, yellow, green B1 [1]
- (b) (i) **total internal reflection** or angle of incidence greater than critical angle B1 [1]
- (ii) all colours reflected at same angle **or** all have  $i = r$  B1 [1]
- 6 (a) variable resistor **or** rheostat B1 [1]
- (b) curved line starting at origin **allow** straight at first **not** two straight lines  
correct curvature **from origin** with decreasing gradient C1 [2]  
A1
- (c) (i) (resistance) increases (as p.d. increases) B1 [1]
- (ii) explanation, e.g. lower current than expected for given p.d. **or** given current  
needs larger p.d. **or** correct explanation involving  $R = V/I$  **accept** gradient  
decreases B1 [1]
- 7 (a) (i)  $I = V/R$  **or** 2400 seen C1  
0.0025 A (2.5 mA) A1 [2]
- (ii) 4 V **or**  $1600 \times (i)$  ecf B1 [1]
- (b) **EITHER**  
capacitor stores charge/charges up/stores energy B1  
takes time/delay e.g. voltmeter reading rises slowly/capacitor charges up slowly  
or to a maximum B1  
**OR**  
(small) current into transistor/base **or** large base/emitter voltage ( $>0.6V$ ) B1  
switches (transistor) on **or** large current collector/emitter or resistance of  
transistor reduced B1 [2]
- 8 (a) meter deflects (one way) B1  
changing magnetic field/flux in ring/coil or cutting of flux/field B1  
**induces** voltage/current B1 [3]
- (b) ammeter returns to/remains at zero B1 [1]
- (c) ammeter deflects in opposite direction (then returns to zero) B1  
field decreases/change in opposite direction **or** field/flux cuts in opposite direction B1 [2]

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**Section B**

- 9 (a) (i)** 120°C **or** –10°C to 110°C B1 [1]
- (ii)** longer thermometer **or** wider bore **or** less mercury **or** smaller bulb **not** change liquid B1 [1]
- (b) (i)** measures small(er) change in temperature **or** small(er) range for same distance **or** large(r) expansion for (same) temperature rise B1 [1]
- (ii)** larger bulb **or** more liquid **or** narrower bore/tube **or** use liquid that expands more B1 [1]
- (c)** constriction/narrowing (**accept** 1st and 3rd marks on diagram)  
 mercury/thread breaks at constriction (on cooling) **or** thermometer is a “maximum” thermometer  
 range different  
 more sensitive/divisions further apart  
 triangular cross-section/acts as lens  
 thin(ner) bulb (quick response to temperature change) ANY 3 lines B3 [3]
- (d) (i)** two different metals joined  
 connected to meter/ammeter/galvanometer/voltmeter M1  
 A1 [2]
- (ii)** low/high temperatures **or** greater range  
 responds quickly/measures rapidly changing temperatures  
 measures temperature at a point  
 electronic output  
 more robust  
 measures temperatures at a distance (**not** more sensitive) ANY 2 lines B2 [2]
- (e) (i)**  $(Q =) Pt$  **or**  $80 \times 5 \times 60$  **or**  $80 \times 5$  **or** 400 **or** 300 (s) seen C1  
 24000 J cao A1 [2]
- (ii)**  $(Q =) mc\Delta T$  **or**  $1.8 \times 390 \times T = 24000$  in any form ecf (i) C1  
 34°C (**accept** 34.188, 34.18, 34.19, 34.2) A1 [2]

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- 10 (a) (master cylinder creates) **pressure** in brake **fluid or** pressure from master piston transmitted to slave piston B1  
 fluid/pressure produces **force/push** (not press) (on slave piston) **or** force from master piston transmitted (to slave piston) B1 [2]
- (b) (i)  $P = F/A$  **or**  $140/2.0$  C1  
 $70 \text{ (N/cm}^2\text{)}$  A1 [2]
- (ii)  $70 \times 2.8$  C1  
 $200 \text{ N}$  **accept**  $196 \text{ N}$  ecf (i) A1 [2]
- (iii) distance foot to pivot larger than piston to pivot B1  
 force  $\times$  distance constant B1 [2]
- (c) (i) molecules hit against walls/piston (**ignore** hit each other) B1 [1]
- (ii) hit more often/more frequently (**accept** hit each other more often) B1  
 smaller volume **or** molecules closer/less space B1 [2]
- (iii)  $P_1V_1 = P_2V_2$  **or**  $PV = \text{constant}$  B1  
 $1 \times 10^5 \times 6 (\times 2) = P \times 4 \times (2)$  C1  
 $1.5 \times 10^5 \text{ Pa}$  A1 [3]
- (d) air/bubbles compress/reduce in volume **or** brakes pushed further/spongy B1 [1]  
**ignore:** efficiency; less pressure; less force transmitted

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- 11 (a) electron B1  
 negative B1  
 electromagnetic (high frequency wave/particle/photon) B1  
 neutral/none B1 [4]
- (b) (i) time taken to halve M1  
 activity **or** number of atoms/nuclei **or** count (rate)  
 (**ignore** radioactivity/mass/volume/amount/number of particles/molecules/  
 a nucleus to halve) A1 [2]
- (ii) alpha stopped by body/flesh/skin **or** cannot penetrate body/skin **or** causes  
 damage to body (1 max for damage) B1  
 gamma penetrates body/not absorbed **or** can be detected outside body **or**  
 causes less/no damage to body (1 max for damage) B1 [2]
- (iii) takes time for isotope to spread/investigation/experiment (so 6 min too short) B1 [1]
- (iv) radioactive for longer/more dangerous/more damage/causes damage B1 [1]
- (c) (i) (radioactive emission is) random B1 [1]
- (ii) 3200 seen (as average) C1  
 attempt to halve e.g. 3202 → 1601 **or** 4 half-lives C1  
 52 hours A1 [3]
- (iii) rocks/cosmic rays/radon gas/nuclear fall out B1 [1]