

**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

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) forces balance/cancel **or** no net force **or** upward force = downward force
or weight = air resistance/drag/air friction B1 [1]
- (b) (i) $9.8-10 \text{ m/s}^2$ 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 C1 [1]
or point where length or extension against load graph curves
- (b) $4 = k 6$ **or** $4/6$ **or** $6/4$ **or** $6 \times 2/4$ **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
 1.2×0.08 **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) C1
accept $2/0.2$ or 10 W A1 [2]
0.48 W (ecf (i) including power of ten error in (i))
- 4 (a) at least 3 reflected wavefronts with same wavelength as before B1
all **and** ≥ 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 (>0.6 V) 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 M1
 connected to meter/ammeter/galvanometer/voltmeter 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 80×5 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
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** $140/2.0$
 $70 \text{ (N/cm}^2\text{)}$ C1 A1 [2]
- (ii) 70×2.8
 200 N **accept** 196 N ecf (i) C1 A1 [2]
- (iii) distance foot to pivot larger than piston to pivot
force \times distance constant B1 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)
smaller volume **or** molecules closer/less space B1 B1 [2]
- (iii) $P_1V_1 = P_2V_2$ **or** $PV = \text{constant}$
 $1 \times 10^5 \times 6 (\times 2) = P \times 4 \times (2)$
 $1.5 \times 10^5 \text{ Pa}$ B1 C1 A1 [3]
- (d) air/bubbles compress/reduce in volume **or** brakes pushed further/spongy
ignore: efficiency; less pressure; less force transmitted B1 [1]

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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]