

**MARK SCHEME for the October/November 2011 question paper
for the guidance of teachers**

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) $m_1(g)x_1$ or $m_2(g)x_2$ or 2 or one of these in numbers or 40 and 25 seen C1
 $0.050 \times (10) \times 40 = m_2 \times (10) \times 25$
or anticlockwise **moment** = clockwise **moment** C1
0.080 kg or 80 g A1
- (b) $(\rho/d =) m/V$ or $0.08/1.6 \times 10^{-4}$ C1
 500 kg/m^3 or 0.50 g/cm^3 A1 [5]
- 2 (a) (i) 850 N B1
- (ii) $KE = PE/mgh$ or $mgh = 5.5 \times 10^4$ C1
 $65/64.7(0588) \text{ m}$ A1
- (b) $WD = Fx$ or KE/x or $5.5 \times 10^4/33$ or $v = 35(.97)$ and $a = 19(.60)$ and $F = ma$ C1
 $1700/1670/1667/1666.7 \text{ N}$ A1 [5]
- 3 (a) (i) $\rho_1 V_1 = \rho_2 V_2$ B1
- (ii) $2.5 \times 10^7 \times 18 = 1.0 \times 10^5 \times V_2$ C1
 4500 m^3 A1
- (b) balloon inflates higher up/bursts (if fully inflated on ground) B1
(atmospheric) pressure is less higher up/decreases with height B1
OR
(otherwise) greater upthrust/upwards force B1
(otherwise) rises (too) high/fast B1 [5]
- 4 (a) $3(.00) \times 10^8 \text{ m/s}$ B1
- (b) 0.16 m or 16 cm B1
- (c) any **three** of:
travel through space/vacuum
pass through the atmosphere/not reflected by ionosphere
encoded (with the signal)
(satellite) amplifies/boosts signal
sent to/received by satellite
transmitted/sent by satellite
transmitted/received by a (satellite) **dish** (on Earth) B3

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- (d) any **two** of:
 same (high) speed (in air) **or** travel at speed of light
 travel in vacuum/space **or** no medium needed
 transfer/transmit energy
 transverse (stated **or** explained)
 (oscillating) magnetic **and** electric fields/waves
 reflection/refraction/diffraction/interference/polarisation B2 [7]
- 5 (a) (i) N at top end of bar **and** S at bottom end B1
- (ii) attracted to/moves towards iron core B1
 unlike poles attract B1
- (b) they disappear/bar is demagnetised/loses its poles/is weaker B1 [4]
- 6 (a) (i) power supply, (wire/resistor/bulb) and ammeter in series B1
 voltmeter across wire/resistor/bulb **labelled/clear** B1
 variable power supply **or** rheostat in series **or** potentiometer B1
 correct symbols **or** labelled throughout
- (ii) read ammeter **and** voltmeter / measure voltage **and** current B1
 vary power supply/rheostat/current B1
- (iii) $(R =) V/I$ (ign. V/A) B1
- (b) horizontal line **and** above axis B1 [7]
- 7 (a) $(P =) VI$ **or** $23\,000 \times 65$ C1
 $1.49/1.5/1.50/1.495 \times 10^6 W$ A1
- (b) (i) $(V =) IR$ **or** 65×3 C1
 $190/195/200 V$ A1
- (ii) $1.3(1.27 \text{ etc.}) \times 10^4 J$ B1
- (c) (i) low current/less energy/power wasted/less heat generated/less voltage **loss**/
 more efficient/thinner wires B1
- (ii) **step-down** transformer between them **or** less insulation needed **or** less
 dangerous **or** less chance of electric shock **or** less danger of sparking /fire B1 [7]
- 8 (a) (i) central ray undeviated emerging from lens M1
 two outer rays meet the central ray at a point inside the eye **and** carry
 on to strike the retina A1

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(ii) light (from a single point) is spread over an area (on the retina)
 or rays do not meet at a point on the retina
 or image formed/rays meet/principal focus off retina B1

(b) (i) **any** diverging lens: biconcave, planoconcave, convexoconcave –
 i.e. lens **clearly** thinner at the centre B1

(ii) **all** rays diverge B1 [5]

Section B

9 (a) 72 m/s B1

(b) (i) area (under graph) or $\frac{1}{2}$ base \times height or $\frac{1}{2}vt$ or $\frac{1}{2} \times 9 \times 72$ C1
 320/324 m A1

(ii) **change** in velocity/time or $\Delta v/t$ or $72/9$ C1
 8(0) m/s² A1

(iii) ($F =$) ma or 650×8.0 C1
 5.2×10^3 N A1

(c) friction or air/wind resistance or drag M1
 increases as speed increases A1
 resultant/net/unbalanced force remains constant B1

(d) (i) **direction** (of car/motion/speed/velocity) changes B1
 (therefore) velocity changes B1

(ii) towards centre (of circle)/centripetal B1

(iii) friction **with ground** OR banking of track B1
 mention wheels/tyres reaction force (acts towards centre) B1 [15]

10 (a) **temperature** where: liquid and solid may exist together or solid turns to liquid B1

(b) (i) ($E =$) ml C1
 $0.0019 \times 2.2 \times 10^4$ or $1.9 \times 2.2 \times 10^4$ or 41 800 or 42 000 C1
 42 (41.8) J A1

(ii) $\frac{1}{2}mv^2$ or $\frac{1}{2} \times 0.0019 \times v^2$ or $\frac{1}{2} \times 1.9 \times v^2$ C1
 ($v^2 =$) 44 000 or 44 C1
 210 (209.761 etc.) m/s A1

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(iii) any **two** of:
 heat lost to wall
 heat to raise bullet to m.p.
air resistance/air friction reduces energy/speed/velocity **or** work done
 against **air resistance/air friction** (in air/as bullet travels) B2

(c) any **three** of:
 molecules become further apart
 molecules become randomly positioned/less ordered
 molecules moving throughout liquid/in clusters/were fixed/free to move/
 slide over each other
 bonds broken/overcome/weaker **or** forces reduced B3

(d) twice the energy needed **OR** $ml = \frac{1}{2}mv^2$ M1
 (bullets have) twice the KE m cancels **or** mass irrelevant **or** w.t.t.e. M1
 they melt **or** calculation A1 [15]

11 (a) (nuclear) fission B1

(b) (i) 1...143 B1
 2...36 B1
 3...141 B1

(ii) $(E =) mc^2$ C1
 $3.1 \times 10^{-28} \times (3.0 \times 10^8)^2$ **or** $3.1 \times 10^{-28} \times 3.0 \times 10^8$ **and** $(E =) mc^2$ C1
 $2.8(2.79) \times 10^{-11} \text{ J}$ A1

(c) any **five** of:



(**one** mark for three correct boxes)

(splitting produces) kinetic energy of neutrons
 further splitting/chain reaction
 energy/heat produced/from reactor/reaction **or** from neutrons
 coolant gets hot
 energy to boiler/water **or** water heated **or** heat in water implied
 water boiled **or** steam produced B5

(d) (i) **time** for something to halve C1
time for (radio)activity/count rate/number of atoms/nuclei to halve A1

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- (ii) **one** appropriate precaution:
short exposure time
safety/protective suit/gloves/clothes **or** lead boxes
large distance/(long handled) tool/forceps/tongs
robotic/mechanical handling
film badge

B1 [15]