

**MARK SCHEME for the October/November 2010 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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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### Section A

- 1 (a) velocity has a direction/is a vector **or** speed does not have a direction/is not a vector **or** displacement/time **and** distance/time  
(**ign** speed is a scalar) B1
- (b) (i) (–) 47 m/s B1
- (ii) ( $a =$ )  $v/t$  **or**  $47/0.0013$  C1  
(–)  $3.6(1538 \text{ etc.}) \times 10^4 \text{ m/s}^2$  A1
- (iii) ( $F =$ )  $ma$  **or**  $0.16 \times 3.6 \times 10^4$  C1  
(–)  $5.8(\text{or } 5.78461 \text{ etc.}) \times 10^3 \text{ N}$  A1 [6]
- 2 (a) any **two** points:  
depth/height;  
density (of liquid);  
atmospheric pressure;  
 $g$ /gravitational field strength/acceleration of free-fall (**not** gravity) B2
- (b) (i) ( $m =$ )  $\rho V$  **or**  $5.0 \times 10^{-4} \times 0.066 \times 1000$  **or**  $3.3 \times 10^{-5} \times 1000$  C1  
 $0.033 \text{ kg}$  (**not** factor of 10 caused by omitted density) A1
- (ii) **mass of oil** =  $0.033 \text{ (kg)}/\text{mass of water above X}$   
**or**  $1000 \times 0.066/0.075$  **or**  $0.033/(5.0 \times 10^{-4} \times 0.075)$   
**or**  $0.033/(3.75 \times 10^{-5})$  **or** inversely proportional to height C1  
 $880 \text{ kg/m}^3$  A1 [6]
- 3 (a) (i) ( $M =$ ) force  $\times$  **perpendicular** distance **or**  $840 \times 5$   
(formula mark can be scored if not given in **3(a)(ii)**) C1  
 $4200 \text{ Nm}$  A1
- (ii)  $350 \text{ N}$  **or** (a)(i)/12 **and** calculated B1
- (iii) weight of ladder/hose **or** friction at P/pivot/axle  
(**not** air resistance; **ign.** friction) B1
- (b) any **four** lines:  
(mesh) traps air  
**air** poor conductor/good insulator **or** convection prevented  
(shiny surface) reflects/(good) reflector of IR/radiation/heat  
(shiny surface) does not absorb/poor absorber of IR/radiation/heat  
(**not** with radiator/emitter/conductor)  
less heat transmitted/to **firefighter** B4 [8]

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- 4 (a) ( $R =$ )  $V/I$  or 230/12  
19/19.2/19.1  $\Omega$  etc. C1  
A1
- (b) (resistance) increases B1  
as the temperature increases/gets hotter/gets heated B1
- (c) (if switched on suddenly) low  $R \rightarrow$  high/excess current B1  
or it prevents high/excess current  
bulb/filament/fuse blown/damaged B1  
or wires damaged (**ign** lamp/filament lamp damaged) [6]
- 5 (a) 0.80 or 0.0008 or  $4 \times 0.20$  or  $4 \times 0.0002$  or 4 divisions C1  
( $f =$ )  $1/T$  or 1.2/1.25/1.3 (Hz) C1  
1200/1250/1300 Hz A1
- (b) any **three** of: B3 [6]  
equal/same pitch/frequency (ign wavelength)  
original note louder/ S quieter/softer (ign amplitude)  
{ different qualities/timbres/  
{ more frequencies/overtones/harmonics in S
- 6 (a) remain stationary/no effect/unaffected B1
- (b) lifted up/attracted/stick to rod (stated not implied) B1  
fall down/return to dish B1
- (c) lifted up/attracted/stick to rod (stated not implied) B1  
stay up/remain attracted B1 [5]
- 7 (a) any **two** of: B2  
ionising or nuclear or  $\alpha$ ,  $\beta$  and  $\gamma$  (radiation)  
always present/inescapable/in the environment/air/atmosphere/surroundings/  
cosmic (radiation) or radiation from Sun/space/Earth/rocks
- (b) **named** activity: M1 how activity produces increase:  
nuclear tests fallout/radioisotopes spread  
nuclear power disposal of nuclear waste  
water leaks traced disposal of radioisotopes/absorption of radiation  
radioactive ore mining isotopes exposed  
smoke detector disposal of radioisotopes  
**specific** industrial use disposal of radioisotopes  
(nuclear) medicine M1 disposal of radioisotopes/absorption of radiation A1 [4]

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- 8 **gravitational** collapse (of hydrogen cloud) **or** gravity pulls cloud together  
**or** loss of GPE B1  
temperature increase **or** gain of KE B1  
fusion (of hydrogen) **or** hydrogen to helium B1  
energy released **or** exothermic **or** equilibrium **or** pressure cancels collapse  
**or** pressure increase (**not** density increase) B1 [4]

### Section B

- 9 (a) (i) **one** correctly reflected ray (by eye) B1
- (ii) **two** reflected rays traced back to an image  
(labelled) image in correct position (by eye) B1
- (iii) any **two** of:  
virtual  
full size/mag = 1 **or** same distance from mirror as C  
**laterally** inverted (**ign** upright)  
dimmer B2
- (iv) more comfortable/no neck strain/no need to look up/reflects to eyes B1 [6]
- (b) (i) ( $c =$ )  $3(.00) \times 10^8$  (m/s) **or**  $3(.00) \times 10^5$  (km/s) **or** used in equation B1  
( $f =$ )  $c/\lambda$  **or**  $(3.0 \times 10^8/\text{their stated value}/330)/4.0 \times 10^{-7}$  C1  
 $7.5 \times 10^{14}$  Hz **or** correct answer from **stated** value (incl. unit)  
**or**  $8.2/8.25/8.3 \times 10^8$  Hz A1
- (ii) any **two**:  
UV(radiation); X(radiation);  $\gamma$ (radiation) B2
- (iii) 1.
- |  |                                       |  |
|--|---------------------------------------|--|
| UV absorbed by skin                            | psoriasis destroyed                   | cells multiply less rapidly              |
| X-rays absorbed by bones/not absorbed by flesh | shadow/image of bones                 | on film/CCD                              |
| $\gamma$ -rays emitted by absorbed isotope     | position/shape of organ etc. revealed | on film/CCD                              |
| tumour/cancer absorbs X/ $\gamma$ -ray         | tumour destroyed                      | photons/energy/stops cells multiplying   |
| bacteria absorb UV/X/ $\gamma$ -ray            | Bacteria killed                       | sterilisation/stops bacteria multiplying |
- 2.
- |                             |   |   |
|-----------------------------|---|---|
| UV:                         | X-rays:                                 | $\gamma$ -ray:                          |
| damages eyes/skin<br>cancer | cancer/hair loss/<br>radiation sickness | cancer/hair loss/<br>radiation sickness |
- B1 [9]

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- 10 (a) (i) 32 000 N B1
- (ii) two arrows/lines in correct direction by eye B1
- (iii) scale given B1  
two arrows/lines **and** correct resultant drawn B1  
32.0 → 35.0 kN (2/3 sig. fig. only) B1  
58.5 → 61.5° to horizontal  
(2/3 sig. fig. only; don't penalise twice) B1
- (iv) zero/no force/0 B1 [7]
- (b) weight/gravitational force/gravitational attraction (**not** gravity) B1  
higher in gravitational field **or** (to gravitational) potential energy B1  
friction/air resistance B1  
heat/thermal/internal energy B1 [4]
- (c) (i) labelled axes **and** correct way round ( $x \rightarrow t$ ) B1  
**straight** line of positive slope B1  
followed only by horizontal line (ign curve at junction) B1
- (ii) distance travelled/time taken (from points) **or** calculate the gradient B1 [4]
- 11 (a) energy released/unit charge **or** power released/unit current C1  
18 J/C **or** 18 W/A A1 [2]
- (b) (i) ( $t =$ ) 5400 **or**  $60 \times 90$  **or** 1.5 **or**  $90/60$  **or** ( $E =$ )  $Pt$  **or**  $450 \times 90$  B1  
 $450 \times 60 \times 90$  **or**  $450 \times 5400$  **or**  $4.0/4.05/4.1 \times 10^4$  **or**  $0.45 \times 1.5$   
**or**  $0.45 \times 90/60$  **or**  $450 \times 1.5$  **or**  $450 \times 90/60$  C1  
 $2.4(3) \times 10^6$  J **or** 0.675 kWh A1
- (ii) ( $Q =$ )  $E/\text{emf}$  (**ign.**  $\text{emf} = E/Q$ ) **OR** ( $I =$ ) 25 (A) **or**  $25 \times 5400$   
**or**  $2.4(3) \times 10^6/18$  **or**  $25 \times 60 \times 90$  C1  
 $1.3/1.35/1.4 \times 10^5$  C A1 [5]
- (c) (i) laminated/iron core B1  
two coils on core B1
- (ii) turns ratio = 10:1 (may be shown on diagram) B1
- (iii) diode symbol B1  
symbol for battery/cell (**allow** either polarity w.r.t. diode) **and** complete circuit B1 [5]

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- (d) can be transformed/operate transformer/voltage can be changed  
high voltage/low current transmission (possible) B1  
**or** changing magnetic field B1  
less energy/power loss **or** less heating (in wires) **or** thinner wires B1 [3]

### MARKING SCHEME CODE:

- B1 Independent Mark  
C1 Compensation Mark:  
awarded automatically if the answer is correct. i.e. the working need not be seen if the answer is correct; also given if the answer is wrong but the point is seen in the working.  
M1 (Compulsory) Method Mark:  
if not awarded subsequent A marks are lost (up to next B, M or C mark).  
A1 Answer Mark.  
c.a.o. correct answer only (including unit)  
e.e.o.o. each error or omission  
e.c.f. error carried forward:  
it is usually awarded even where not specifically indicated.  
i.e. subsequent working including a previous error is credited, if otherwise correct.

Incorrect units, errors in powers of 10 (except where the power of 10 comes from  $g = 10 \text{ N/kg}$ ) and unit multipliers are to be treated as arithmetical errors.

Correct numerical answers with incorrect units will normally gain preceding C marks even when the working is not shown.

Do not penalise a sig. fig. /fraction or a unit error more than once in the same question.

- Sig. fig. Answers must given to 2 or more sig. fig. except where the answer is exactly 0.6, 2 etc. Answers given to 2 or 3 sig. fig. must be correctly rounded – but a 5 can produce a rounding up or down.