

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Ordinary Level

**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) ($m =$) ρV **or** $5.0 \times 10^{-4} \times 0.066 \times 1000$ **or** $3.3 \times 10^{-5} \times 1000$ C1
 0.033 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 kg/m^3 A1 [6]
- 3 (a) (i) ($M =$) force \times **perpendicular** distance **or** 840×5
(formula mark can be scored if not given in **3(a)(ii)**) C1
 4200 Nm A1
- (ii) 350 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 Ω etc.		C1 A1
	(b) (resistance) increases as the temperature increases/gets hotter/gets heated		B1 B1
	(c) (if switched on suddenly) low $R \rightarrow$ high/excess current or it prevents high/excess current bulb/filament/fuse blown/damaged or wires damaged (ign lamp/filament lamp damaged)		B1 B1 [6]
5	(a) 0.80 or 0.0008 or 4×0.20 or 4×0.0002 or 4 divisions ($f =$) $1/T$ or 1.2/1.25/1.3 (Hz) 1200/1250/1300 Hz		C1 C1 A1
	(b) any three of: equal/same pitch/frequency original note louder/ S quieter/softer { different qualities/timbres/ { more frequencies/overtones/harmonics in S	(ign wavelength) (ign amplitude)	B3 [6]
6	(a) remain stationary/no effect/unaffected		B1
	(b) lifted up/attracted/stick to rod fall down/return to dish	(stated not implied)	B1 B1
	(c) lifted up/attracted/stick to rod stay up/remain attracted	(stated not implied)	B1 B1 [5]
7	(a) any two of: ionising or nuclear or α , β and γ (radiation) always present/inescapable/in the environment/air/atmosphere/surroundings/ cosmic (radiation) or radiation from Sun/space/Earth/rocks		B2
	(b) named activity: nuclear tests nuclear power water leaks traced radioactive ore mining smoke detector specific industrial use (nuclear) medicine	how activity produces increase: fallout/radioisotopes spread disposal of nuclear waste disposal of radioisotopes/absorption of radiation isotopes exposed disposal of radioisotopes disposal of radioisotopes disposal of radioisotopes/absorption of radiation	M1 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/λ **or** $(3.0 \times 10^8/\text{their stated value}/330)/4.0 \times 10^{-7}$ C1
 7.5×10^{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); γ (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
γ -rays emitted by absorbed isotope	position/shape of organ etc. revealed	on film/CCD
tumour/cancer absorbs X/ γ -ray	tumour destroyed	photons/energy/stops cells multiplying
bacteria absorb UV/X/ γ -ray	Bacteria killed	sterilisation/stops bacteria multiplying

2.

UV:	X-rays:	γ -ray:	
damages eyes/skin cancer	cancer/hair loss/ radiation sickness	cancer/hair loss/ 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** 60×90 **or** 1.5 **or** $90/60$ **or** ($E =$) Pt **or** 450×90 B1
 $450 \times 60 \times 90$ **or** 450×5400 **or** $4.0/4.05/4.1 \times 10^4$ **or** 0.45×1.5
or $0.45 \times 90/60$ **or** 450×1.5 **or** $450 \times 90/60$ C1
 $2.4(3) \times 10^6$ J **or** 0.675 kWh A1
- (ii) ($Q =$) E/emf (**ign.** $\text{emf} = E/Q$) **OR** ($I =$) 25 (A) **or** 25×5400 C1
or $2.4(3) \times 10^6/18$ **or** $25 \times 60 \times 90$ A1 [5]
 $1.3/1.35/1.4 \times 10^5$ C
- (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 B1
 high voltage/low current transmission (possible)
 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.