

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education O Level

MARK SCHEME for the NOVEMBER 2004 question paper

5054 PHYSICS

5054/02

Paper 2 (Theory), maximum mark 75

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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NOVEMBER 2004

GCE O Level

MARK SCHEME

MAXIMUM MARK: 75

SYLLABUS/COMPONENT: 5054/02

**PHYSICS
Paper 2 (Theory)**

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Section A

- 1 (a) speed** uniform or 20 m/s **B1**
stationary/not moving till 20 minutes or after 65 minutes **or** moves for 45 minutes **B1**
(not if inconsistent; all times ± 2 min; **ignore** acceleration/deceleration periods)
- (b) d = st** any algebraic **or** area calculated **C1**
or 20 x 45, 20 x 90, 20 x 45 x 60, 20 x 90 x 60 **C1**
54 000 m **or** 54 km **A1**
- (c) any constant speed from 0 to 90 minutes** (may stop at 90 or go down to axis) **M1**
10 m/s (no e.c.f. b) **A1 6**
- 2 (a) larger** **B1**
- (b) (i) difference in levels 30** **B1**
(any start level, 10 N or above not in horizontal section)
- (ii) difference in levels 60** **B1**
(any start level, 10 N or above not in horizontal section)
- (c) trapped air exerts a pressure** **B1**
pushes the water down (on right) **or** pressure (in trapped air) > atmospheric **B1 5**
- 3 (a) (at 8.4 m/s) resistive force = 320 N/forward force** **or** no resultant **or** forces cancel/balance **B1**
or if forward force > resistive force then runner accelerates
or if forward force < resistive force then runner decelerates **B1**
(not resistive force a maximum, **accept** backwards force = resistive force)
- (b) (i) $\frac{1}{2} mv^2$** **B1**
 $\frac{1}{2} \times 60 \times 8.4^2$ **C1**
2100 J (accept 2120, 2117, 2116.8) **A1**

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- (ii) mgh C1
 $2117/60 \times 10$ or $h = P.E. \text{ or } K.E./mg$ e.c.f. (i) C1
3.5 m
(accept 3.50, 3.52, 3.53 i.e. **2 or 3 significant figures** only) A1 7
- 4 (a) (i) correct normal (by eye to centre of circle) M1
angle between normal and ray 1 marked A1
- (b) ray 1 sensibly reflected **and no** refracted ray B1
ray 2 bends upwards (ignore reflection) B1
ray 3 undeviated (ignore all rays leaving bubble) B1
- (c) (i) $\sin i/\sin r$ **or** ratio of speed in air/vacuum to speed in medium B1
(ignores real/apparent depth)
- (ii) 1.33 or 0.75
(accept 1.326, 1.3, 0.754, 0.8 **not** 1.325, 1, 0.76) B1 7
- 5 (a) (i) up and down arrow shown
(allow if one arrow and up/down stated in (ii)) B1
- (ii) 4 times in one second **or** once in 0.25 sec B1
- (b) $v = f\lambda$ in any algebraic form B1
0.8/4 C1
0.2 m A1
- (c) halve the frequency **or** move hand once every 0.5 springs B1 6
(ignores move hand slower or at half speed or speed of wave double unless spring stretched more)
- 6 (a) (i) **electrons/they** move (on sphere) away from rod/to right B1
negative or electrons repelled by (negative on) rod **or** like charges repel B1
(actual movement of positive charge max 1 positive electrons max 1)
- (ii) positive nearest rod **and** negative on side furthest from rod B1
(allow charges just outside sphere no need for same no. of +ve and -ve charges)
- (b) only positive on side near rod
no e.c.f. a (ii) B1

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- (c) >1 positive charge distributed over sphere
e.c.f. B1
- (d) plastic/perspex/polythene/rubber/ebonite/glass/wood etc. B1 6
- 7 (a) to step down/reduce the **voltage**
(**ignore** just step down transformer) B1
- (b) two coils (no label needed)
(**not** if primary connects secondary) B1
output/secondary has fewer turns than input/primary clear; coils labelled
or right-hand coil has fewer turns B1
complete (soft) iron (core) **labelled**
(**ignore** circuit symbol) B1
- (c) (i) less energy/power/heat loss/heating
(**ignore** just more efficient) B1
current is reduced/low
(**not** if resistance changes) B1
- (ii) resistance is decrease B1
(resistivity is not resistance)
electrical power/energy related to resistance
e.g. $P = I^2R$, P prop to R (**not** V^2/R alone)
or resistance $\propto 1/\text{area}$
(**accept** power related to R etc. given in (i)) B1 8
- Section B**
- 8 (a) (i) molecules (of copper) vibrate (**allow** start to vibrate) B1
pass on energy/heat/vibration from molecule **to** molecule
(accept to alcohol molecule) B1
(accept particles/atoms for molecules allow 1/2 for electron conduction description)
- (ii) boiling takes in energy **and** condensation gives out energy B1

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- (iii) movement of alcohol/vapour **fast**
 (ignore convection)
 or pressure difference **large**
 or molecules move **fast** (with partial evacuation) **B1**
- (b) (i) amount of energy/heat to change state/evaporate/boil
 (**condone** boil and condense) **M1**
 unit mass/1 kg/1 g (without change in temperature) **A1**
 (any change in temperature mentioned 0/2)
- (ii) mL or 25 x 840 **C1**
 21 000 J **A1**
- (iii) $mc \Delta T$ or $(\Delta T =) 21\,000/4.2 \times 500$ **C1**
 10 °C **A1**
- (c) (i) **black** and **white**/shiny objects whose temperature can be sensed in some way
 e.g. (metal) plates + cork, thermometers, foil on back of hand, people under
 umbrellas) **B1**
 method of producing radiation (e.g. Sun, heater, candle, bulb accept drawn on
 diagram) **B1**
 correct observation from a physical measurement
 (**ignore** feels hotter) **B1**
- (ii) method of obtaining **hot** black and white surfaces of approximately **same**
temperature **B1**
 (same temperature may not be stated) **B1**
 method of detecting radiation e.g. thermopile, thermotransistor, back of hand,
 blackened thermometer, **thermometer** shows black cools faster **B1 15**
- 9 (a) (i) low resistance **or** short circuit **or** large current (in battery) **or** no current
 in coil **B1**
 (ii) brushes touch gaps or no contact with ring **or** coil vertical **B1**
 no current **or** open circuit **or** no forces **or** no moment **B1**
- (b) (i) force x distance **M1**
 perpendicular distance **A1**

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- (ii) 3×0.065 or $3 \times 0.065/2$ C1
0.195 Nm
(accept 0.19 or 0.20; 0.39 or 0.0975 Nm...C1) A1
- (iii) large (perpendicular) distance (between forces/axis when coil horizontal) B1
- (iv) axes labelled **and** graph any repeating shape with same sign B1
(not a sine wave either side of axis)
1 revolution correct on time axis B1
(should be between three maxima/minima if graph always same sign, if graph goes either side of axis e.g. sine wave, award mark for period of wave drawn)
- (c) (i) voltage (p.d.) (across motor) B1
current (through motor) B1
power = VI B1
- (ii) correct series circuit with ammeter, cell etc., any symbol for motor
(accept lamp labelled motor **condone** V in series) B1
voltmeter in parallel with motor
(or cell if no extra resistor) B1 15
- 10 (a) (i) 53 protons B1
78 neutrons B1
53 electrons in orbit/around centre/outside nucleus (can be on diagram) B1
- (ii) 131 on top B1
54 underneath B1

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(b) comparison	example
nature	β electron γ electromagnetic or wave
mass	β small, 1/2000, γ zero
charge	β negative or charged, γ zero/neutral
ionising effect	β larger than γ
penetrating effect	β penetrates less, β but not γ stopped by A1
speed	β fast, γ at speed of light
deflection in E or B fields	β deflected γ not
tracks in cloud chamber compared	β thin or wavy lines γ no tracks or tracks appear

ANY 3 correct which may be given as lists or implied comparisons **B3**

If more than 3 comparisons give a mark for each one correct to max 3

then -1 for each **clearly wrong** statement e.g. β is a helium nucleus, β do not travel in a vacuum

ignore correct ideas but with a wrong fact e.g. β heavy, γ no mass; β stopped by skin, γ is not

ignore unclear comparisons e.g. γ stronger, β travel shorter distances – give mark if medium specified, γ are rays but β particles; β straight γ wavy, wavelengths mentioned

(c) (i) (radioactive) count/emission random

(**accept** not constant) **B1**

sample not mixed (in blood)

(**accept** not diffused)

or takes time to circulate/mix/reach other arm **B1**

(ii) 38.5 no unit needed

(**accept** 38, 39) **B1**

(iii) 7480 cm³

(7481, 7500 i.e. no significant figure penalty) e.c.f. (ii) i.e. 144 000 x 2/(ii)**B1**

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(iv) attempt to halve or $\frac{1}{4}$ seen **C1**

10 no unit needed **A1**

(d) keep distance/use tongs/wear a radiation badge or detector/store in lead container/suitable absorber between source and doctor e.g. lead apron/lead gloves/lead suit

not wear a radioactive suit/wear gloves or do not touch source/look at source **B1 15**

MAX 1 unit error per question in the paper.

There are to be no significant figure penalties except in **Q3 (b) (ii)**.