

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

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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.

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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
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**
(any start level, 10 N or above not in horizontal section) **B1**
- (ii) difference in levels 60**
(any start level, 10 N or above not in horizontal section) **B1**
- (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**
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 $h = \text{P.E. or K.E.}/mg$ 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
- (ignore 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
- (ignore 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

(resistivity is not resistance)

B1

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
 (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 mentioneds 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)**.