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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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 $\pm$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**

$\frac{1}{2}$ x 60 x 8.4^2 **C1**

2100 J (accept 2120, 2117, 2116.8) **A1**

(ii) mgh   **C1**

2117/60 x 10 or h = 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 λ 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**

(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

(resitivity 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 α 1/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**

    (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 ΔT or (ΔT =) 21 000/4.2 x 500   **C1**

      10 ºC   **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**

     (ii) 3 x 0.065 or 3 x 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**

(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 β thin or wavy lines γ no tracks or tracks
compared   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 cm^3

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

(iv) attempt to halve or ¼ 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).**