UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

5054 PHYSICS

5054/21 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.

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Do not accept fractions. No penalty for 2 sig. fig. or for 1 sig. fig. where exactly correct.
Only one unit **and only one** fraction **penalty per question**.

Section A

1 (a) (i) 11.5 m/s   B1

       (ii) decrease in speed // negative gradient   C1
             equal changes/decreases in speed in the same time // const. neg. grad. on
             v-t graph   A1

   (b) (i) flat line at 18 m/s from t = 0 to 15   B1
             constant slope downwards parallel to initial line (by eye)   B1

       (ii) greater area **under** graph // higher **initial/average** speed   B1   [6]

2 (a) (i) X weight // (force of) gravity // gravitational (force)
             and Y **air** resistance // (air) drag // wind resistance // **air** friction   B1

       (ii) (Y) opposes motion // diver moves down // air molecules hit faster from below   B1

   (b) (i) accelerates // falls faster // speed/velocity greater   B1
             X is larger than Y // resultant/net force downwards   B1

       (ii) **two** of:
             X stays the same // Y increases // forces become equal (and opposite)   B2   [6]

3 (a) (i) 7000 (J) seen **or** 50% **used** somewhere   C1
             (P =) E/t // 14000/t // 7000/t seen // 7000 J/minute // 420 000 J/hour   C1
             120 W   A1

       (ii) water after hitting turbine still moves // has KE/energy/velocity // energy lost
             due to friction // friction **and** location // heat/internal energy **and** location //
             water misses turbine   B1

   (b) (i) can be replaced/made // will not run out   B1

       (ii) coal, oil, gas, peat, nuclear, uranium (**not** solar)   B1   [6]

4 (a) ($E/Q =$) $mc\Delta T$ in any algebraic or numerical form e.g. 4200 × 16, 2100 × 5   C1
67 200 **or** 10 500 **or** 77 700 seen **or** ($E/Q =$) ml or mL algebraic seen   C1
4.2×10^5 J   A1

(b) (i) break bonds // separate molecules // give molecules more P.E.   B1

(ii) (different) change in distance // molecules not so far apart // incomplete bond
breaking // doesn't push atmosphere back // less work against atmosphere   B1   [5]

5 (a) gives out (visible) light // glows   B1
when hit by uv/electrons **or** spark/discharge/current in **tube**   B1

(b) X-rays or gamma   B1

(c) ($f =$) v/λ numerical or any algebraic form, e.g. $v = f\lambda$ C1
8.3×10^{14} Hz   A1   [5]

6 (a) reflection (of sound/ultrasound)   B1

(b) waves of same period (by eye)   B1
smaller amplitude (by eye)   B1

(c) (i) 20–20 000 Hz   B1

(ii) higher than **(i)**   B1   [5]

7 (a) upward arrow (**not** curved) on iron bar   B1

(b) attraction/force not enough//weight of bar too high//friction at pivot/with copper bar   B1

(c) three of:
electromagnet works // magnetic field created
iron bar moves/lifted up
spring pulls copper bar across/contracts
contacts break circuit // contacts open   B3

(d) more turns in coil // more iron in electromagnet // electromagnet nearer iron bar //
iron bar less weight // weaker spring   M1
correct explanation which involves force on iron bar   A1   [7]

8 (a) all three correct: force, field, current   B1

(b) (i) *Fd* // 20 × 4; 20 × 2; 20 × 0.04; 20 × 0.02; 20 × 4 × 2; 160   C1
80 N cm, 0.8 N m   A1

(ii) more turns (on coil)
use soft iron
more current
increase AB or CD
increase BC or AD   ANY 2   B1   [5]

Section B

9 (a) (i) d.c. current flows in one direction **or**
a.c. current flows in one direction then the other   B1

(ii) mention of magnetic field/flux   B1
(magnetic) field lines // flux cuts coil // flux changes in coil   B1
induction of voltage/current   B1
something **relevant** reverses (e.g. field/flux cuts in one direction then the other // N pole approaches then leaves // N pole approaches and S pole approaches)
and link to a.c.   B1

(iii) **two** of: thicker wires; more turns of coil; stronger magnet; faster rotation; lower resistance (of lamp)   B2

(b) (i) to reduce heat/energy/power loss (on the power lines)   B1
(higher voltage means) lower current   B1

(ii) 25:400 // 1:16 // 0.0625   B1

(iii) reduces resistance // less power loss // costs less to run // more current // more power   B1
increases weight // more support needed // more wind resistance // more ice forms // costs more to install   B1

(iv) 13 A   B1
(*I* =) *P*/*V* // 4.2 A // 4.17 etc A   B1
must choose higher value to avoid fuse blowing // other fuses melt   B1   [15]

10 (a) (i) brown and green   B1
             red   B1

      (ii) 99×10^9 or 9.9×10^{10} Ω B1

     (iii) *less*: (likely to) burn out/blow // become too hot   B1
          greater: (likely to) be large (in size)   B1

  (b) (i) both involve energy and charge // measured in J/C/volts/by voltmeter   B1
          energy change is from other forms (accept chemical) to electrical in e.m.f.   B1
          energy change is from electrical to other forms (accept heat/light) in p.d.   B1
          (**or** e.m.f. is property of source and p.d. is property of (part of) circuit B2)

      (ii) correct symbol   B1
          correct direction   B1

     (iii) p.d. reduces/(approximately) constant **and** current reduces   B1

     (iv) $R = V/I$ in any form, e.g. 1.7/0.025, 1.7/25   C1
          correct conversion to mA, e.g. 0.025/7.3 seen   C1
          68 or 360 seen   C1
          290 Ω, 292 Ω A1 [15]

11 (a) (i) 24   B1

      (ii) charges (of electrons and protons) cancel // protons and electrons have the
          same (size of) charge but opposite in sign   B1

  (b) (i) nuclear at start // nucleus loses energy   B1
          to kinetic/e.m. energy (condone light/photon/γ)   B1

      (ii) beta 0 at top   B1
          beta −1 at bottom   B1
          Mg 24 at top   B1
          Mg 12 at bottom   B1

  (c) (i) 600 at 15 hours   B1
          300 at 30 hours   B1
          line of decreasing gradient (**not** if it cuts time axis before t = 30)   B1

      (ii) emission is random // not predictable // not regular // exptl. error   B1

     (iii) 4800 (counts per minute) // 80 counts /sec   B1

     (iv) GM tube/solid state detector/cloud chamber   M1
          ratemeter/data logger // counter/scalar **and** stopwatch/timer   A1 [15]