Mark scheme
June 2001

GCE

Physics A

Unit PHA3/W

Instructions to Examiners

1 Give due credit to alternative treatments which are correct. Give marks for what is correct; do not deduct marks because the attempt falls short of some ideal answer. Where marks are to be deducted for particular errors specific instructions are given in the marking scheme.

2 Do not deduct marks for poor written communication. Refer the script to the Awardsmeeting if poor presentation forbids a proper assessment. In each paper candidates may be awarded up to two marks for the Quality of Written Communication in cases of required explanation or description. However, no candidate may be awarded more than the total mark for the paper. Use the following criteria to award marks:

   2 marks: Candidates write with almost faultless accuracy (including grammar, spelling and appropriate punctuation); specialist terms are used confidently, accurately and with precision.

   1 mark: Candidates write with reasonable and generally accurate expression (including grammar, spelling and appropriate punctuation); specialist terms are used with reasonable accuracy.

   0 marks: Candidates fail to reach the threshold for the award of one mark.

3 An arithmetical error in an answer should be marked 'AE' thus causing the candidate to lose one mark. The candidate's incorrect value should be carried through all subsequent calculations for the question and, if there are no subsequent errors, the candidate can score all remaining marks (indicated by ticks). These subsequent ticks should be marked 'CE' (consequential error).

4 With regard to incorrect use of significant figures, normally a penalty is imposed if the number of significant figures used by the candidate is one less, or two more, than the number of significant figures used in the data given in the question. The maximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by 'SF' and, in addition, write 'SF' opposite the mark for that question on the front cover of the paper to obviate imposing the penalty more than once per paper.

5 No penalties should be imposed for incorrect or omitted units at intermediate stages in a calculation or which are contained in brackets in the marking scheme. Penalties for unit errors (incorrect or omitted units) are imposed only at the stage when the final answer to a calculation is considered. The maximum penalty is **one mark per question**.

6 All other procedures, including the entering of marks, transferring marks to the front cover and referrals of scripts (other than those mentioned above) will be clarified at the standardising meeting of examiners.

1(a)   (three parallel resistors) give $\dfrac{1}{40} + \dfrac{1}{20} + \dfrac{1}{40} = \dfrac{1}{R}$ ✓

$R = 10\ (\Omega)$ ✓
10 Ω and 50 Ω in series gives 60 Ω ✓
            (allow e.c.f. from value of R)   *(3)*

(b)   ($V = IR$ gives) $12 = I \times 60$ and $I = 0.2$ A ✓
            (allow e.c.f. from (a))   *(1)*
                                                    (4)

2(i) $V_{\mathrm{o}} = 8.0$ V ✓

  (ii) $V_{\mathrm{rms}} = 8/\sqrt{2} = 5.7$ (V) ✓
            (allow e.c.f. from (i))

(iii) $T = 3.0$ ms ✓

  (iv) $f = \dfrac{1}{T} = 330$ (333) Hz ✓
            (allow e.c.f. from (iii))   *(4)*
                                                    (4)

3(a)(i) energy provided by the battery ✓
          per unit charge ✓
          [or potential difference across battery ✓ when no current flows ✓]

  (ii)   when current flows, work is done inside the battery
                    to overcome the resistance (hence $V < \epsilon$) ✓
          (or any correct alternative)   *(3)*

(b)(i)   suitable scale for I ✓
          four correct points ✓ ✓
          best straight line ✓

  (ii)   ($\epsilon = Ir + V$ gives) $V = - rI + \epsilon$ ✓
          intercept $= \epsilon = 5$ V ✓
          gradient $= (-)r$ ✓
                    $= \dfrac{5}{0.35} = 14.(2)\ \Omega$ ✓   *(8)*

                                                    (11)

4(a)(i)   resistivity defined by $\rho = \dfrac{RA}{l}$ ✓
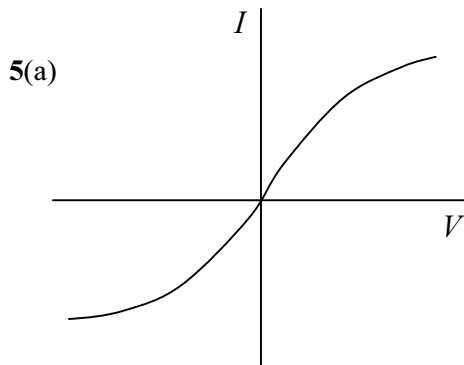
        symbols defined ✓

  (ii) $R = \dfrac{\rho l}{A} = \dfrac{1.7 \times 10^{-8} \times 2}{\pi (0.4 \times 10^{-3})^2}$ ✓

          $= 0.068 \ (\Omega)$ ✓ $(0.0676 \ \Omega)$

      $I = \dfrac{1.5}{0.068} = 22 \ \text{A}$ ✓ $(22.2 \ \text{A})$

          (allow e.c.f. from value of R)   (5)

(b)(i) $\text{pd}_{AB} = \dfrac{2}{3} \times 12 = 8 \ \text{V}$ ✓ ✓

  (ii) $\text{pd}_{BC} = (\dfrac{1}{3} \times 12) = 4 \ \text{V}$ ✓

  (iii) $\text{pd}_{AC} = $ potential at A − potential at C ✓
          $= (8 - 4) = 4 \ \text{V}$ ✓
            (allow e.c.f. from (i) and (ii))   <u>(5)</u>
                                                               <u>**(10)**</u>

5(a)

          correct curve in positive quadrant ✓
          correct curve in negative quadrant ✓
          passing through origin ✓

                                                            (3)

(b)   the current heats the filament ✓
        (temperature rises) resistance increases ✓
        pd. and current do not increase proportionally ✓
        some reference to mirror image in negative quadrant ✓   _{max}(3)

(c)   diagram to show:
         battery, variable resistance (or variable supply) and filament ✓
         current sensor in series circuit ✓
         voltage sensor across filament ✓
         the two sensor boxes connected to datalogger ✓

        method:
         variable resistor or variable supply altered
         [or choose recording interval] ✓
         thus changing both V and I ✓   _{max}<u>(5)</u>
                                                                   <u>**(11)**</u>

6(a)(i) tensile stress: the force per unit cross-sectional area ✓
tensile strain: extension per unit length ✓

(ii) the Young modulus = tensile stress/tensile strain ✓ *(3)*

(b)(i) brittle: material A ✓

(ii) A, (brittle) obeys Hooke's law (until it fractures without warning) ✓

B, (ductile) obeys Hooke's law up to the limit of proportionality ✓
beyond this point wire is permanently stretched (or behaves plastically)✓

(iii) A has greatest value of the Young modulus
because of steeper gradient ✓ $_{max}$*(5)*

(c) $(Y = \dfrac{F}{A} \times \dfrac{l}{e}$ gives) $2.10 \times 10^{11} = \dfrac{80}{1.3 \times 10^{-6}} \times \dfrac{1.5}{e}$ ✓

$e = 0.44 \times 10^{-3}$ m ✓ *(2)*

(10)

The Quality of Written Communication marks are awarded primarily for the quality of answers to Q5(b) and Q5(c),