Mark Scheme Physics Challenge 2007

Please award marks as indicated below. Equivalent valid reasoning should gain equal credit to the solution presented here. Schools may give 'error carried forward' marks where an incorrect answer is used as part of the data needed for a subsequent question, providing that the resulting final answer is not plainly ridiculous.

If **incorrect units** are used more than once in the paper, one mark should be deducted from the pupil's total. If an inappropriate number of **significant figures** are given more than once in final answers on the paper, then one mark should be deducted from the pupil's total.

(There are NO star marks this year.)

Section A: Multiple Choice

1. C	2. D	3. C	4. A	5. B
6. C	7. D	8. A	9. C	10. D

Question Total   *10 marks*

Section B: Written Answer

1. (a) AC supply means that there is a changing flux linking coil [1]

    Therefore there is an induced EMF measured by voltmeter [1]

    (b) EMF $\propto$ rate of change of flux [1]

    $2 \times$ current $\Rightarrow 2 \times$ flux $\Rightarrow 2 \times$ EMF [1]

    (c) No [1]

    No change in flux [2]

    (d) Yes [1]

    Under normal operating conditions the current in N is same as current in L

    [1]

    Question Total   *9 marks*

2. (a) 900 kg $\times$ 10 N/kg / 4 = 2250 N [2]

    Assumption: equal force produced by each column [1]

    (b) 20 cm^2 = 20 $\times$ 10^{-4} m^2 [1]

    $p = F/A$ = 2250 N/20 $\times$ 10^{-4} m^2 = 1.13 $\times$ 10^6 Pa [2]

    (c) Pressures in cylinders are the same [1]

    Pressure in part (b) multiplied by 1 cm^2 in m^2 = 112.5 N [2]

    (d) Mechanic might be 60 kg so could put all the weight on it [2]

    (e) Volume of oil = 2 m $\times$ 4 $\times$ 20 cm^2 [1]

    2 $\times$ 80 $\times$ 10^{-4} m^3 = 0.016 m^3 [2]

    Question Total   *14 marks*

3. a) Graph axes labelled correctly with units   [2]

    Points plotted correctly (-1 for each incorrect, 0 minimum)   [2]

    Line of best fit   [1]

    b) Intercept on vertical is h_1 with no load   [1]

    Intercept on horizontal is the load that makes h_1 = 140 mm, but also
    accept the load that makes h_1 zero   [2]

    c) Gradient = $-$ 50 mm/9.0N = $-$ 5.6 mm/N   [1]

    Change in Load per mm   = $-$ 0.18 N/mm   [1]

    d) Same y intercept, but half the gradient   [2]

    $h_2 \sim$ 162 mm for 10 N   [1]

    Question Total   *13 marks*

Section C: Written Answer

    a) Units correctly represented (cm & m)   [1]

    Tan of angle or otherwise   [1]

    7.0 degrees   [1]

    b) C = (360/7) 800 km   [2]

    = 4.1×10^4 km   [1]

    c) 2.5 h from Y to Z and 1 h is equiv. to a diameter   [1]

    Shadow width = 2.5 moon diameters   [1]

    d) $\pi D = 4.1 \times 10^4$ km so $D = 4.1 \times 10^4$ km/π [1]

    $D_{moon} = D/2.5 = 5.2 \times 10^3$ km   [1]

    e) $0.88 m/(0.8 \times 10^{-2)} m = 110$ [1]

    f) Let x be the distance from the earth to the Moon

    $0.88 m/(0.8 \times 10^{-2} m) = x/ 5.2 \times 10^3$ km   [2]

    $x = 110 \times 5.2 \times 10^3$ km $= 5.5 \times 10^5$ km   [1]

    Question Total   *14 marks*

    Total marks on paper   **60**

PHYSICS CHALLENGE CERTIFICATES

All Participating students will receive a certificate.
They will be awarded Gold, Silver, Bronze and
Participation Medal Certificates, based on their marks,
according to the scheme below:

Medal Certificate	Gold	Silver	Bronze	Participation
Mark Range	60 - 42	41 - 30	29 - 18	17 − 0
No of Certs.				

Total Number of Entries

NAME OF TEACHER

NAME OF SCHOOL

ADDRESS OF SCHOOL

Please return to:
Dr Cyril Isenberg
Physics Challenge Competition
British Physics Olympiad Office
Department of Physics and Astronomy
University of Leicester
University Road, Leicester LE1 7RT