MODEL ANSWER
A2 PHYSICS
MAGNETIC FIELD & EM INDUCTION

JAN 2006

4.(a) (i) Before the switch is turned on, the weight of the U-shaped magnet is registered to be 965.62 g. The current moves along the rod in perpendicular direction with the magnetic field. Magnetic field around the wire interacts with that of the permanent U-shaped magnet and produces a distorted field. The distorted field then "catapults" the wire. An upward force is acting on the wire. However, since the rigid wire is clamped securely, the corresponding downward force on the magnets, due to Newton's Third Law, has contributed to the change of the mass reading of the top pan balance, to 966.07. The difference in readings is a measure of force on the magnets, which is equal in magnitude with the force on the rigid wire.

(ii) At equilibrium, $mg = F = B I l$
Magnetic flux density, $B = F / I l$
$= mg / I l$
$= [\{966.07 - 965.62\} \times 10^{-3} \times 9.81] / [1.5 \times 0.06]$
$= \underline{4.9 \times 10^{-2}\ T}$

(b) (i) Depending on the power supply, after closing the switch, the student can vary the current gradually up to about 5 or 6 A. Every particular amount of current is used, the corresponding top pan balance reading is recorded. Adjust the rheostat to obtain more values from ammeter and top pan balance. All current and mass readings are tabulated.

(ii) A graph of force against the current in the wire is plotted. It's observed from the graph that the electromagnetic forced produced is directly proportional with the magnitude of current in the wire. It's a straight line with positive gradient and through the origin.

5.(i) Given **$B = 4.4 \times 10^{-5}$ T**, the magnitude of vertical component can be expressed with B sin 65°
$B_{vertical} = B \sin 65^o$
$= 4.4 \times 10^{-5} \times \sin 65^o$
$= \underline{4.0 \times 10^{-5}\ T}$

(ii) Length swept after 0.8 s, $l = vt$
$= 250 \times 0.8$
$= \underline{200\ m}$

Horizontal area swept out by wingspan, A = *length* X *wingspan length*
$= 200 \times 18$
$= \underline{3600\ m^2}$

(iii) Change in flux, $\Delta\Phi = BA$
$= 4.0 \times 10^{-5} \times 3600$
$= \underline{0.144\ Wb}$

(iv) e.m.f. induced across the wings, $\varepsilon = d\Phi / dt$
$= 0.144 / 0.80$
$= \underline{0.18\ V}$

(v) The charge does not flow across the wings due to this induced e.m.f. because there's no closed circuit to enable the flow of charge.

OR
The charge does not flow across the wings due to this induced e.m.f. because the wing is not part of a closed circuit.

If the both the tips of the wings are connected to a wire respectively to form a closed circuit, then an induced current is able to flow in the wire as well as through the airplane, from one tip to another .

If the most right tip is labeled as pointing towards the North and the most left tip is labeled as pointing to the South, then the North-pointing tip of the wing become positively charged and the \ south-pointing tip become negatively charged.

PREPARED BY MR.DERYK NG
UCSI UNIVERSITY
A LEVEL ACADEMY
deryk123@gmail.com
Facebook: deryk123