TUTORIAL ANSWERS_ELECTROMAGNETIC INDUCTION

Question 1

E = BLv = **6×10^{-4} V**

Question 2

E = change in flux linkage / time taken
= $[(NBA_{final} - NBA_{initial})]$ / time taken ; final flux linkage is zero since plane in parallel to field
= $(20)(0.5)(0) - (20)(0.5)(\pi)(0.1)^2 / 0.05$ = **6.28 V**

Question 3

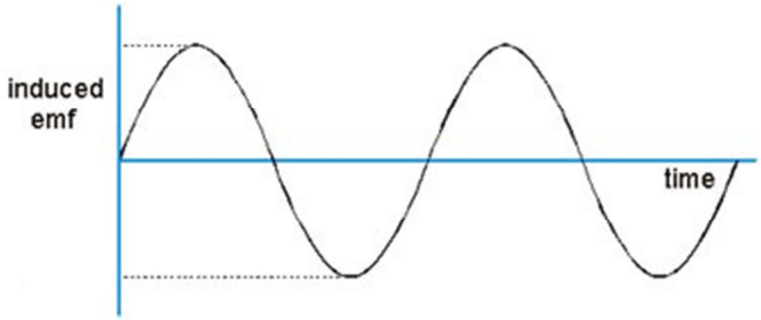
a.) E = change in flux linkage / time taken
= $[(NBA_{final} - NBA_{initial})]$ / time taken
= $(250)(0)(1.6 \times 10^{-3}) - (250)(0.35)(1.6 \times 10^{-3}) / 0.05$ = **2.8 V**
b.) I = V / R = (0.14 / 100) = **0.028 A**

Question 4

a.) E = $(0.4)(0) - (0.4)(0.0346 \times 0.02) / 5.0 \times 10^{-3}$ = **0.0554 V**
b.) I = E/R = $0.0554 / 4.0 \times 10^{-3}$ = **13.85 A**
c.) E = Pt = $I^2Rt = (13.85)^2(4.0 \times 10^{-3})(5.0 \times 10^{-3})$ = **3.84×10^{-3} J**

Question 5

a.) As shown in graph below or anti-phase as graph below.



b.) **Emf is induced as magnet approaches the coil. As flux linkage is increasing, emf induced also increases since emf is proportional to the rate of change of flux linkage. As magnet moves away, emf will be induced in the opposite direction because flux linkage is decreasing.**

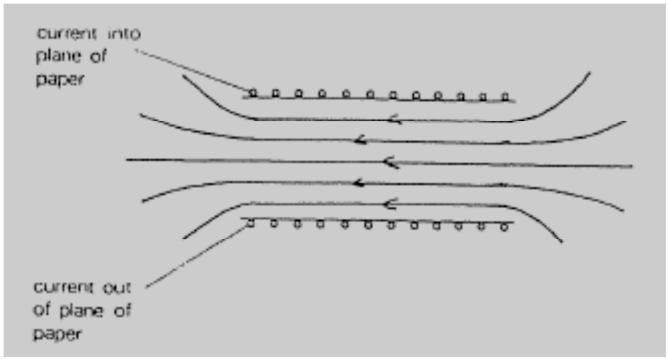
c.) 1 revolution has N pulses.
Time for 1 revolution = TN
Thus, revolution per unit time, R = 1 / TN

d.) i.) R = 1 / TN , T = 1 / RN
T = 1 / (15.0)(60) = 1.11×10^{-3} s

ii.) $0.9 \times (1.11 \times 10^{-3}) = 1 \times 10^{-3}$ s OR $1.1 \times (1.11 \times 10^{-3}) = 1.22 \times 10^{-3}$ s
R = 1 / $(1 \times 10^{-3})(60)$ = **16.7 s^{-1}** OR R = 1 / $(1.22 \times 10^{-3})(60)$ = **13.6 s^{-1}**

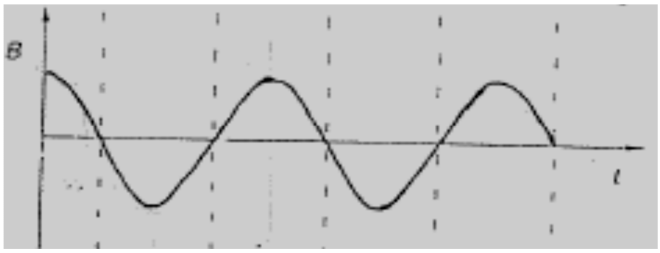
Question 6

Field lines should be parallel within the coil with the direction of the field to the left.

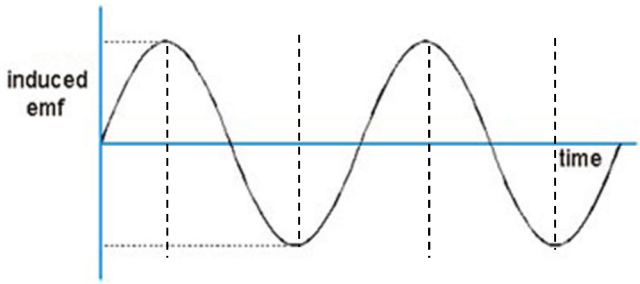


Question 7

a.) Same frequency and phase as current



b.) Same frequency but π/2 rad OR 90^{o} out of phase (lagging) with current.



c.) i.) **Frequency of E is the same.**
Amplitude of E increases as core increase the flux density B.

ii.)**Frequency of the E increases to same as current, I.**
Amplitude of E also increases because rate of change of flux linkage is larger.

Question 8

a.) **Magnitude of the induced emf is proportional to the rate of change of magnetic flux linkage.**

b.) **For a.c. input, the voltage is always changing, which lead to change in the magnitude & direction of the flux within the core. Thus, when there is a change in flux linking the secondary coil, there will be emf induced.**
For d.c., the flux is constant, so no emf induced.

c.) **The induced emf / current is in the direction so as to produce effects which opposes the change that is producing it.**

d.) **When the rate of change of current in primary coil changes direction, the rate of change of flux also changes direction.**
When the rate of change of flux changes direction, the emf induced also changes direction. Thus, input voltage and output voltage will always have the same frequency.

Question 9

a.) **Flux increases to a maximum value.**

b.) **When current is increasing, the flux also changes (increase) accordingly.**
When there is a rate of change of flux linkage, emf will be induced.

c.) **The induced emf acts in opposite direction to the emf of battery. So current grows more slowly which causes the delay to the lamp to light up.**

d.) **Flux generated is lesser. Thus emf induced also smaller. So delay also reduces.**