Assess Quizzes from the o-book – Explanations for the answers.

Chapter 8 Review – Support

Q	Reason
1	By definition. See NCPQ U3&4 page 215. The trap here is that you could be asked what EMF (or emf) stands for. The answer is 'electromotive force' which is measured in SI unit 'volts' and has the SI symbol 'V'. It is not a force even though it has *force* in the name. We'll try to trap you in questions by suggesting it is 'electromagnetic force'. There is no SI quantity called 'electromagnetic force'. It is just the quantity 'force', unit symbol 'F', unit 'newton', unit symbol 'N'. I know it seems stupid and it would be better to do away with *emf* and just call it *voltage*. Ho hum!
2	$emf = -N\frac{\Delta\phi}{\Delta t}$ $= -\text{number of turns} \times \frac{\text{change in flux}}{\text{time elapsed}}$ $emf \propto \frac{\text{change in flux}}{\text{time elapsed}}$ [called 'rate of change of flux']
3	See answer above: $emf \propto \frac{\Delta\phi}{\Delta t}$. 'Rate of change of magnetic flux linkage' is just another way of saying 'Rate of change of magnetic flux'. The other options are wrong. The 'change of magnetic flux linkage' is $\Delta\phi$. The 'change of magnetic flux density' is ΔB
4	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$ $V_s = \frac{n_s}{n_p}V_p$ Note that the question uses *N* for the number of turns rather than *n*. This is an alternative symbol. The QCAA Formula and Data Book uses *n*.
5	The loop shrinks in area so not as many flux lines thread the loop in the final diagram as in the initial. We say that there has been a reduction in magnetic flux density. By Lenz's law, the loop tries to generate more flux in the same direction to restore the amount of flux in the loop back to like it was. That is, restore the flux density. So, we need to generate flux going into the page (shown by the X). Using Ampere's RH Rule for a loop or solenoid (see NCPQ page 193), the direction of the current needs to be *clockwise*. The cause is the *change in magnetic flux*. Note that the option that says 'change in magnetic flux density' is wrong as there is no change in magnetic flux density (it remains constant as shown by the constant spacing of the crosses '×' in the diagram.
6	The changing magnetic flux in the primary coil of a transformer has to be conveyed to the secondary coil. The simplest way is to have a steel core that goes through both coils. This is said to increase the magnetic flux linkage from one coil to the other. The option that says 'to absorb the heat generated' is irrelevant. It is true that transformers heat up as they are not 100% efficient and some energy is lost to

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	the surroundings (eg the air, or immersed in oil) – but this has nothing to do with the iron core. The option that says 'to prevent the collapse of the magnetic field' is partly true in the sense that the iron core reacts against the change in flux, but that is certainly not its purpose.
7	As the S-pole of the magnet approaches the solenoid, the solenoid induces a S-pole on the right-hand end of the solenoid to oppose the flux from the magnet. To generate a S-pole on that end means there will also be a N-pole on the left end of the solenoid. To get this, a current has to flow in the solenoid wire. Using Ampere's RH rule for solenoids, the thumb points left (towards the N), and the fingers curl around the solenoid in the direction of the current (up the page at the front of the solenoid). If you look from the left end you would see this as an anticlockwise current, and the field would be towards your eye (out of the N-end).
8	The quantity you are manipulating is the independent variable (IV) and this is the strength of the magnet. The quantity you are measuring as a result of this is the dependent variable (DV) – the current. You would need to control the speed of the magnet because the speed is known to affect the size of the current.
9	Rate of change of flux is $\frac{\Delta\phi}{\Delta t}$. It is change in flux (in weber, symbol Wb) per unit of time (seconds, symbol, s). Hence, it is Wb/s or Wb s^{-1}. It produces an emf so is also equivalent to the unit 'volts (V)'.
10	***n*** is the number of turns. Note that sometimes it is written as ***N***. Note also that in the formula for the flux inside a solenoid $B = \mu_o n I$, the ***n*** stands for number of turns per metre of length of the solenoid. In that case n = N/L where N is the number of turns. It is confusing but just remember which formula you are using. The other symbols are: $\text{rate of change of flux} = \frac{\text{change in flux}}{\text{time elapsed}} = \frac{\Delta\phi}{\Delta t}$

Chapter 8 Review – Consolidate

Q	Reason
1	Flux density is measure in the number of lines of flux per unit area. P has 4 lines of flux $(\phi_P = 4Wb)$ inside a loop 1 unit in diameter (or a half a unit in radius), whereas Q has 9 lines $(\phi_Q = 9Wb)$ inside a bigger loop which appears to have a diameter of 3 units (r_Q = 1.5 units).

Assess Quizzes from the o-book – Explanations for the answers.

	$\phi_P = 4Wb$ $r_P = 0.5\ unit$ $A_P = \pi r_P^{\ 2} = \pi \times 0.5^2 = 0.25\pi$ $B_P = \frac{\phi_P}{A_P} = \frac{4}{0.25\pi} = \frac{16}{\pi}\ [flux\ density]$ $\phi_Q = 9Wb$ $r_Q = 1.5\ units$ $A_Q = \pi r_Q^{\ 2} = \pi \times 1.5^2 = 2.25\pi$ $B_Q = \frac{\phi_P}{A_P} = \frac{9}{2.25\pi} = \frac{4}{\pi}$ $B_P > B_Q\ [P\ has\ bigger\ flux\ density]$ $\phi_Q > \phi_P\ [Q\ has\ bigger\ amount\ of\ flux]$
2	$emf = -N\frac{\Delta\phi}{\Delta t} = 100 \times \frac{3-1}{5-0} = 40V$
3	$emf = -N\frac{\Delta\phi}{\Delta t} = -N\frac{\Delta(BA)}{\Delta t} = -N\frac{\Delta B \times A}{\Delta t}$ $= -10\frac{(0-5)\times 10^{-3} \times 0.1}{0.20}$ $= 0.025V$
4	The current will produce a N-pole at the left end, and a S-pole at the right end (Ampere's RH rule for solenoids). For a S-pole to be induced on the right, the N-pole of the magnet must be moving away to the right, or in relative terms, the solenoid could be moving to the left.
5	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$ $V_s = \frac{n_s}{n_p}V_p$ Increase V_S by increasing n_s, or decreasing n_P. You could also increase V_S by increasing V_P but this is not an option. The option that says "rewind the secondary coil in the opposite direction' is wrong as it would just reverse the direction of the deflection on the voltmeter, not change its size. Likewise, replacing the iron core with a copper core would reduce the efficiency and lead to a smaller deflection in the secondary voltmeter.

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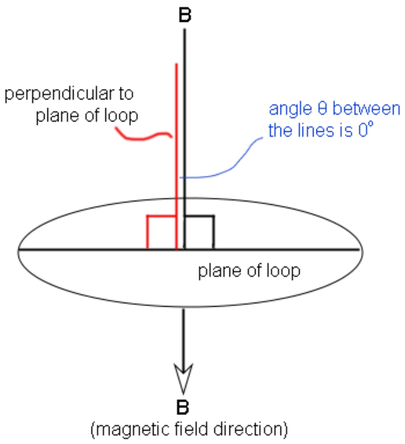
Chapter 8 Review – Extend

Q	Reason
1	As the N-pole approaches, the ring generates a like pole (N-pole) to repel the magnet. As the magnet falls through the ring and starts to move away, the ring generates a pole (N-pole) to attract the S-pole.
2	In the diagram, θ is the angle between the plane of the loop and the field. The angle between the field line and the perpendicular to the loop would then be (90°- θ). The formula: $\phi = BA\cos\theta$ is used to calculate the amount of flux inside the loop but that's when θ is the angle between the field line and the perpendicular to the loop. We know that cos (90°– θ) = sin θ, hence the formula becomes: $\phi = BA\sin\theta$ when θ is the angle in the diagram. That's a bit sneaky. Further $\phi = BA\sin\theta$ can be expanded into $\phi = B\pi r^2 \sin\theta$.
3	$\phi = BA\cos\theta$ $\phi = BA\cos 0^\circ$ The angle θ is zero degrees because the question says the angle between the plane of the loop and the field is 90°, so the angle between the perpendicular to the plane of the loop and the field is 0°.  $\phi = BA \times 1 = BA$ For N turns: $\phi = NBA$
4	$emf = -N\frac{\Delta\phi}{\Delta t} = \frac{\Delta\phi}{\Delta t}$ (for a single loop) $= gradient$
5	As the rod moves, ϕ (flux) increases so by Lenz's law, the system tries to decrease ϕ (flux) and it does this by producing a magnetic field out of the page. This will decrease the amount of flux coming out of the page. Think of it as 'wiping out' some of the flux.