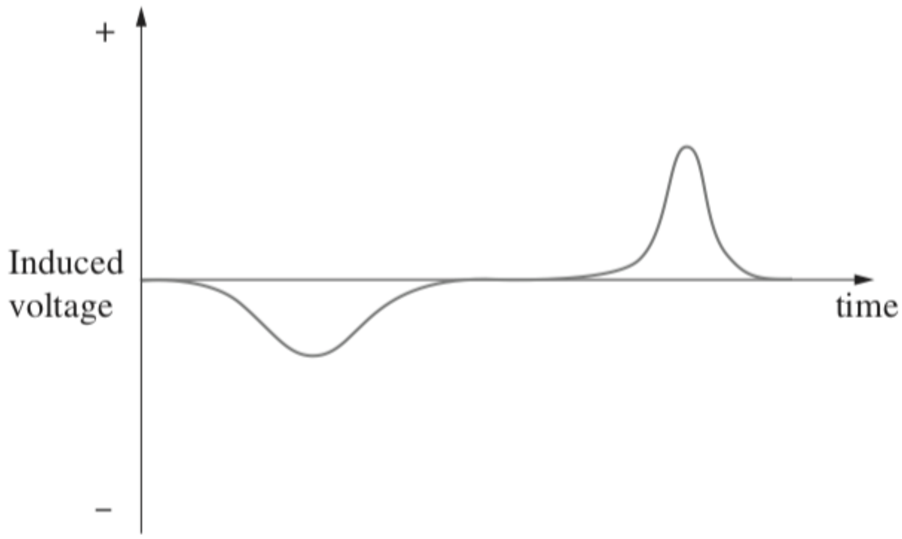
New Syllabus NESA Questions:

1) B
2) B
3) B
4) C
5)

Marking guidelines:

Criteria	Marks
• Sketches a graph showing the correct changes in voltage with time	3
• Sketches some correct features	2
• Sketches a correct feature	1

Sample answer:



Note:

- Two peaks
- Peaks separate from each other in time
- First peak wider and smaller amplitude than second peak
- First peak negative, second peak positive.

Answers:

2018:
18) B
20) C
22)

Question 22 (a)

Criteria	Marks
• Relates the movement of the disc to the effect of the rotating magnet	3
• Outlines the movement of the disc and/or the effect of the magnet	2
• Provides some relevant information	1

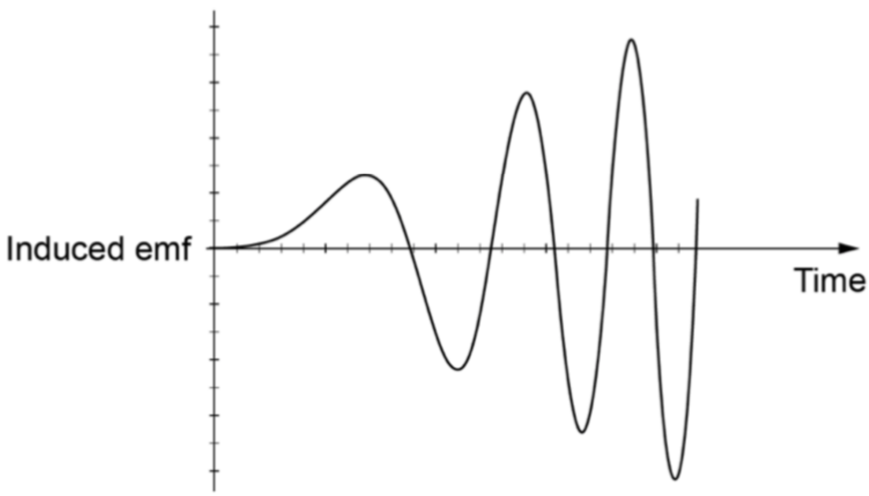
Sample answer:

As the magnet spins there is a change in magnetic flux in the metal disc, inducing eddy currents which, by Lenz's law and conservation of energy, will tend to create magnetic fields that will oppose the change. This will have the effect of the disc trying to keep up with the magnet and it will therefore spin in the same direction.

Question 22 (b)

Criteria	Marks
• Draws a graph showing all correct features	3
• Draws a graph showing some correct features	2
• Draws a graph with a correct feature	1

Sample answer:



[The graph should show a curve that is increasing in both amplitude and frequency.]

24)

Question 24 (a)

Criteria	Marks
• Outlines TWO safety features	2
• Provides a safety feature	1

Sample answer:

Earth line above the high-voltage transmission lines to protect them from lightning strikes and insulating discs used to attach transmission lines to power poles to prevent short-circuiting.

Question 24 (b)

Criteria	Marks
• Provides correct calculation of magnitude and direction of current	3
• Provides some steps to calculate the magnitude of the current OR • Substitutes into a relevant equation and shows direction of current	2
• Substitutes into a relevant equation OR • Shows direction of current	1

Sample answer:

$I_1 = 20$ A, $\quad I_2 = 20$ A, $\quad I_3 = ?$

$d_1 = 0.3, \quad d_2 = 0.75$

$\frac{F_1}{l} = \frac{F_2}{l}$, therefore $\frac{kI_1I_2}{d_1} = \frac{kI_2I_3}{d_2}$

So $\frac{20 \times 20}{0.3} = \frac{20I_3}{0.75}$, thus $I_3 = 50$ A travelling in the same direction as Y.

30)

Question 30

Criteria	Marks
• Explains the effects of the increased demand on the components of the system • Refers to voltage, current and energy	6
• Explains the effects of the increased demand on components of the system • Refers to voltage, current and/or energy	5
• Describes an effect of the increased demand on a component of the system • Makes reference to voltage, current OR energy	4
• Outlines an effect of the increased demand on the system OR • Outlines how components of the system work together to transmit power	3
• Identifies effects of the increased demand on the system OR • Outlines the operation of a component of the system	2
• Provides some relevant information	1

Sample answer:

The increased demand for energy can be analysed in terms of the effect on voltages, current and energy losses.

Voltages: The output voltage from the power station, the transmission line voltage and the supply voltage to the houses remains approximately constant.

Current: An increase in the total current being drawn from T2 by the houses produces an increase in the transmission line current and the output current from the power station. If the former doubles, then the transmission line current and the current output of the power station approximately double.

Energy losses: Heat is produced in the transmission line wires and other wires due to their resistance. As the current increases the heat produced in the wires increases. Heat is also produced by eddy currents in the transformer cores, and this increases as the current increases.

Because of the resistance of the wires, relatively small voltage drops occur along these conductors and these increase as more appliances are turned on in the houses. This results in slight decreases in the voltage inputs and outputs at each of the transformers.

Answers could include:

Reference to parallel circuits in the houses

2017:
11) C
17) B
27)

Question 27 (a)

Criteria	Marks
• Applies correct process to calculate the maximum magnetic field strength	2
• Provides some relevant information	1

Sample answer:

B (flux density) is given by $\dfrac{flux}{area}\left(B = \dfrac{\Phi}{\pi r^2}\right)$

$$\text{Max } B = \frac{0.6}{\pi \times (0.3)^2}$$
$$= 2.1\,T$$

Question 27 (b)

Criteria	Marks
• Applies correct process to calculate the maximum voltage and identifies correct polarity of the terminals (P and Q)	3
• Applies correct process to calculate the maximum voltage OR • Shows some relevant calculations and identifies the polarity of the terminal(s)	2
• Provides some relevant information	1

Sample answer:

Voltage (*emf*) = time rate of change of flux. From the graph, this is maximum when the steepest gradient occurs, ie $t = 10 - 12$s.

$$emf = \frac{-d\Phi}{dt} = -\left(\frac{-0.6}{2}\right) = 0.3V$$

Terminal P is positive and terminal Q is negative (consistent with Lenz's Law).

2016:
1) D
7) B

8) D
22)

Question 22 (a)

Criteria	Marks
• Identifies any motion of the magnet which would induce an oscillating voltage in coil B	2
• Identifies any motion of the magnet which would induce a voltage in coil B	1

Sample answer:

One end of the bar magnet is moved quickly and repeatedly towards and away from the end of coil B.

Question 22 (b)

Criteria	Marks
• Fully accounts for the features of the graph with reference to the motion of the magnet and the forces acting on it	4
• Relates features of the graph to the motion of the magnet	3
• Links a feature of the graph to a motion of the magnet	2
• Provides relevant information	1

Sample answer:

The magnet falls from rest and accelerates at 9.8 ms^{-2} due to gravity (downward line on graph). As the magnet approaches the disc, eddy currents are induced in the disc due to changes in magnetic flux. A magnetic field due to these currents opposes the change in flux, slowing the descent of the magnet (upward line on graph). It eventually comes to rest on the disc ($v = 0$).

2015:
15) A

Question 25 (a)

Criteria	Marks
• Identifies TWO devices and outlines the two energy transformations involved	3
• Outlines the conversion of electrical energy by a device in the home to another form of energy	2
• Shows a basic understanding of energy transformation	1

Sample answer:

Motors (as found in fans, drills and blenders) convert electrical energy to kinetic energy.

Toasters, jugs, etc use heating elements to convert electrical energy to heat.

Question 25 (b)

Criteria	Marks
• Calculates input and output power • Refers to law of conservation of energy	3
• Compares input and output power	2
• Performs a relevant calculation OR • Provides some relevant information about the transformer	1

Sample answer:

From data given

Power in $= V_{in} \times I_{in}$

$= 240\text{ V} \times 5\text{A}$

$= 1200\text{ W}$

These values of 240 V and 5 A are consistent with household electricity supply.

Power out $= 2000\text{ V} \times 1\text{ A}$

$= 2000\text{ W}$

This is not consistent with law of conservation of energy – more energy out than in.

2014:
7) B
8) D
10) C
13) C

Question 23

Criteria	Marks
• Clearly explains how the current in the wire loop affects the straight conductor, showing a good understanding of the forces associated with the loop and the straight conductor	3
• Shows some understanding of the forces associated with the sides of the loop and/or the straight conductor	2
• Shows a basic understanding of a force associated with the loop or the straight conductor	1

Sample answer:

Sides *AB* and *CD* are perpendicular to the straight wire and do not contribute any force.

Side *BC* has current in the same direction as the wire and has an attractive force. Side *DA* has current in the opposite direction as the wire and has a repulsive force. As *DA* is further from the straight wire than *BC*, its magnitude is smaller and partly balances the latter.

The overall force is the unbalanced attractive force of side *BC* causing the wire and loop to attract.

Question 24 (a)

Criteria	Marks
• Shows correct process to calculate the number of turns	2
• Shows partial substitution into a relevant formula	1

Sample answer:

$$\frac{V_{out}}{V_{in}} = \frac{N_{out}}{N_{in}} \text{ so } N_{out} = \frac{V_{out}}{V_{in}} N_{in} = \frac{660000}{23000} \times 2000 = 57391$$

Question 24 (b)

Criteria	Marks
• Shows correct process to calculate the power loss	3
• Correctly substitutes to calculate secondary current OR • Shows partial substitution into relevant formulae	2
• Shows partial substitution into a relevant formula	1

Sample answer:

$$\frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{n_P}{n_S} \quad , \quad P = I^2R$$

$$\text{Using} \quad \frac{V_P}{V_S} = \frac{I_S}{I_P} \quad \frac{23000V}{660000V} = \frac{I_S}{100A}$$

$$I_S = \frac{23000 \times 100}{660000} = 3.48A$$

$$\begin{aligned} \text{Power loss } &= I_S^2\ R_S \\ &= (3.48)^2 \times 2000W \\ &= 24\ \text{k}W \end{aligned}$$

Answers could include:

$$\begin{aligned} 2.3 \times 10^6 &= I^2R + IV \\ &= 2000I^2 + 660000I \\ 1150 &= I^2 + 330I \\ I &= 3.5A \end{aligned}$$

<u>2013:</u>

1) B
3) A
7) A
10) C
13) D

2012:

10) D
14) D

Question 22 (a)

Sample answer:

The magnetic field around the bar magnet passes through the turns of the coil, resulting in a certain enclosed magnetic flux. An emf is induced when the coil is moved because the enclosed magnetic flux decreases as the coil is moved away from the magnet. Since the coil terminals are short-circuited, this emf will cause a current to flow.

Question 22 (b)

Sample answer:

As the coil is moved away, initially the reading on the balance becomes less and then it goes back to 42.42 g. The induced current in the coil that results from the change in flux produces a magnetic field that tends to maintain the flux through the solenoid. The field due to the induced current in the coil has a south pole at the bottom of the coil, resulting in a force of attraction on the magnet causing the force and, therefore the reading on the balance due to the bar magnet to decrease. As the coil is moved further away, the interaction between the magnet and the coil effectively disappears and the reading on the balance returns to 42.42 g.

2011:
5) B
11) D
14) A

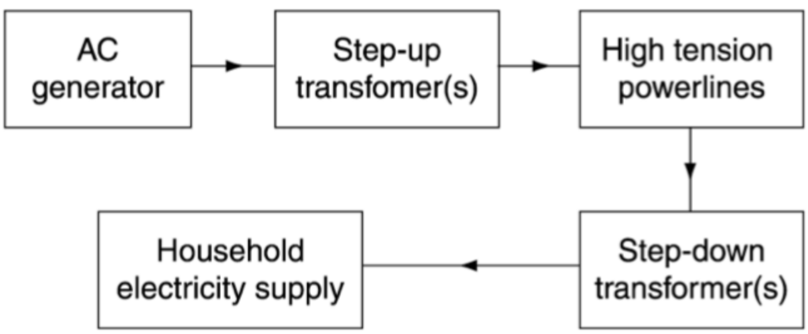
Question 25

Sample answer:

As the magnets fall, they will produce a changing magnetic flux in the walls of both tubes. Lenz's Law says that this will set up a current (eddy current) that will produce a magnetic field to try to oppose this change. This is possible for the magnet *A* tube, since the eddy current can flow around the complete circumference. This results in a strong braking force on the magnet. For the slotted tube, the eddy currents cannot flow because the slots break the current path and no braking results. This means that magnet *B* will fall faster and reach the end of the tube first.

Question 26 (a)

Sample answer:



2010:
8) C
9) C
10) D
11) D

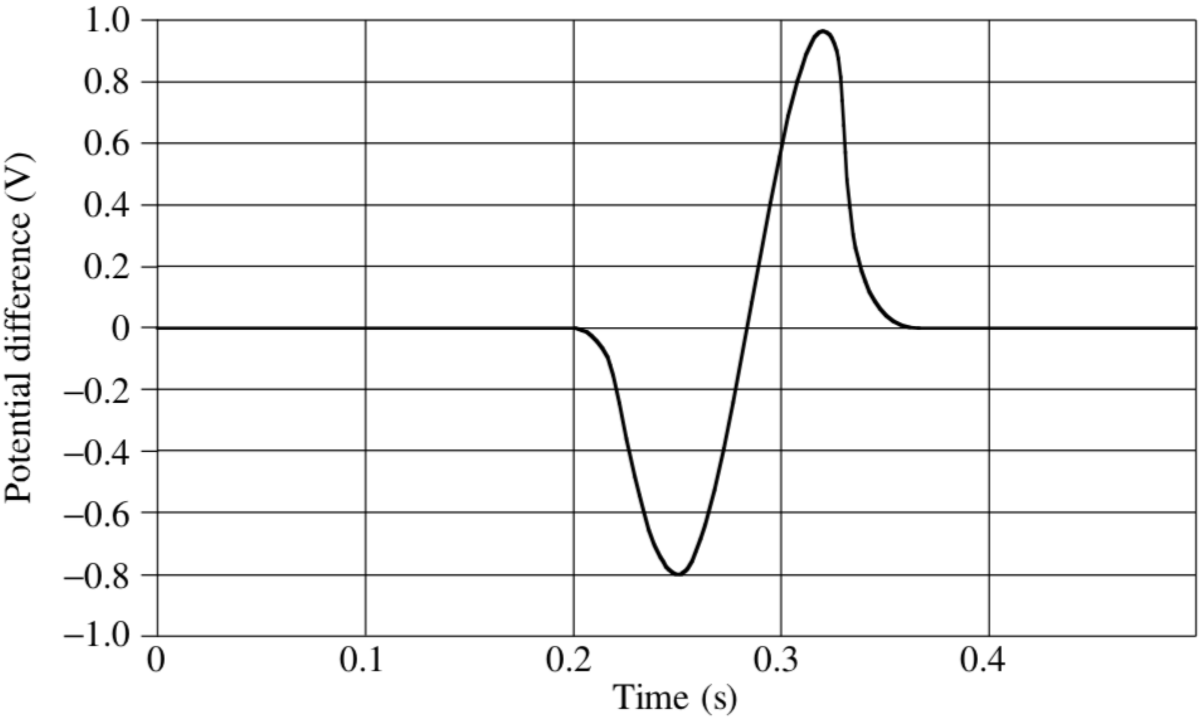
Question 26 (a)

Sample answer:

X is the potential difference as the magnet enters the top of the coil and Y is the potential difference as it leaves the coil. The magnet is accelerating as it falls under the action of gravity and hence the rate of flux change as it leaves the coil is greater than as it enters the coil and hence the voltage has a greater magnitude at Y.

Question 26 (b)

Sample answer:



2009:
8) C

Before 2009 there were no answers given for short answer please use a book like Excel Physics

2006:
10) A

2005:
6) B

8) C
9) C

2004:
7) A
8) C

2003:
8) C
10) A

2002:
6) A
9) C

2001:
8) D
11) D