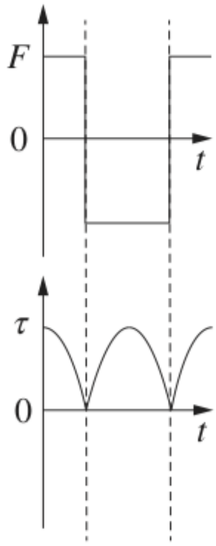
New Syllabus NESA Questions:

1) D
2) A
3) D
4)

Marking guidelines:

Criteria	Marks
• Draws graphs to compare the force on the wire and torque on the rotor as functions of time	4
• Draws graphs to show the force on the wire and torque on the rotor	3
• Draws a substantially correct graph to show the force on the wire OR torque on the rotor as a function of time	2
• Provides some relevant information	1

Sample answer:



5)

Marking guidelines:

Criteria	Marks
• Provides reasons for the observations • Clearly relates the observations to Lenz's Law and conservation of energy	5
• Provides reasons for the observations • Applies both Lenz's Law and conservation of energy	4
• Provides some reasons for the observations • Uses Lenz's Law and/or conservation of energy	3
• Shows some understanding of Lenz's Law and/or conservation of energy	2
• Provides some relevant information	1

Sample answer:

When the magnet is pushed into ring *B* the ring is repelled, but is attracted when the magnet is pulled back out. This is due to the fact that the moving magnet induces a current in the ring. Lenz's Law states that the induced current is in the direction such that the magnetic field produced by this current opposes the original change caused by the moving magnet. This means that pushing a magnet into the ring creates a 'like' pole, repelling the magnet, and pulling the ring out creates an 'opposite' pole, attracting the magnet. This is an application of the law of conservation of energy, as, if the current were in the other direction, the field produced would cause a movement that increases the change in flux even more, thereby producing even more current, and violating conservation of energy. When the magnet is pushed into ring *A*, no repulsive or attractive force is observed because the gap in the ring prevents a current from being induced, so no magnetic field is created as a result.

Past HSC Questions:

2018:

4) D
6) B
10) C

2017:

10) A
13) C
14) A
19) C

Question 22 (b)

Criteria	Marks
• Applies correct process to calculate torque and indicates the correct direction	3
• Applies correct process to calculate torque OR • Shows some relevant working for calculating the torque and indicates the correct direction	2
• Substitutes into a relevant formula OR • Indicates the correct direction	1

Sample answer:

Side BC: $F = BIl\sin\theta = 0.2 \times 7 \times 0.08 \times \sin 90° = 0.112$ N

For 15 turns, the total force = 0.112 N $\times$ 15 = 1.68 N.

$\tau = Fd$ = total force $\times$ total distance, where total distance is the distance from the axis of rotation to point B (0.03 m)

Therefore $\tau = 1.68$ N $\times$ 0.03 m = 0.05 Nm into the page.

Question 28

Criteria	Marks
• Contrasts the design of transformers and magnetic braking systems in terms of the effects that eddy currents have in each of these devices	6
• Contrasts the design of transformers and magnetic braking systems with some reference to the effects that eddy currents have in these devices	5
• Outlines design features of transformers and magnetic braking systems • Identifies at least one effect that eddy currents have in one of these devices	4
• Identifies features of transformers and/or magnetic braking systems and/or the effects of eddy currents	2–3
• Provides some relevant information	1

Sample answer:

A transformer uses changes in magnetic flux to induce current in a secondary coil. An iron core increases the flux but iron, being a conductor, will experience the induction of unwanted eddy currents, causing resistive heating losses. Laminating the iron core minimises the current pathway, thus minimising eddy currents and subsequent heating losses.

In contrast, magnetic braking systems need to maximise eddy currents since magnetic braking relies on converting kinetic energy to electrical current, and subsequently to heat. In order to maximise the current, magnetic braking systems need to provide substantial current pathway. This is done by providing large sheets or bulk volumes of conductive material, such as copper.

<u>2016:</u>

9) B

20) B

Question 30 (a)

Criteria	Marks
• Applies a correct method to calculate the maximum possible energy released	3
• Provides the main steps	2
• Substitutes into a relevant formula	1

Sample answer:

$$\Delta E = E_{pfinal} - E_{pinitial}$$

$$= \left(\frac{-Gm_1m_2}{r_{final}}\right) - \left(\frac{-Gm_1m_2}{r_{initial}}\right)$$

$$= \frac{-6.67\times10^{-11}\times6.39\times10^{23}\times2}{3376203} - \frac{\left(-6.67\times10^{-11}\times6.39\times10^{23}\times2\right)}{3376204}$$

$= -7.48$ J (lost by falling mass)

$\therefore$ light bulb released a maximum of 7.48 J of energy

Answers could include:

Assuming g_{mars} is constant over this range,

$\text{Work} = Fs$

$$= \frac{Gm_1m_2}{r^2}\times s$$

$$= \frac{-6.67\times10^{-11}\times6.39\times10^{23}\times2\times1}{3376203^2}$$

$= 7.48$ J

Question 30 (b)

Criteria	Marks
• Explains the difference in behaviour	3
• Provides some reasoning for the change in behaviour	2
• Identifies a change in behaviour	1

Sample answer:

When the switch is open, there is no longer any magnetic effect opposing the falling of the mass, so the mass now falls more quickly.

Answers may include:

Information on Lenz's Law or conservation of energy.

2015:

12) D

Question 22 (a)

Criteria	Marks
• Applies correct method to calculate the magnetic forces on the two sides • Includes the direction of the force on *AB*	3
• Applies correct method to calculate both magnetic forces OR • Applies correct method to calculate force on *AB* and provides its direction	2
• Substitutes into a relevant formula OR • Determines the direction/magnitude of a force correctly	1

Sample answer:

$$F_{AB} = BI\ell \sin\theta = 0.01 \times 1.0 \times 0.05 \times \sin 90°$$

$$= 5 \times 10^{-4}\,\text{N into the page}$$

$$F_{BC} = 0.01 \times 1.0 \times 0.05 \times \sin 0° = 0$$

There is a force of 5×10^{-4} N directed into the page acting on side *AB* due to the magnetic field whereas there is no force acting on side *BC* due to the magnetic field.

Question 22 (b)

Criteria	Marks
• Explains how the direction of the torque is maintained	2
• Provides some information about the direction of the current in the loop	1

Sample answer:

The split ring commutator reverses the direction of the current through the loop (initially the direction of conventional current is *ABCD*; after 90°, *DCBA*), ensuring that the torque remains in the same direction. This current reversal occurs twice during a 360° rotation of the loop.

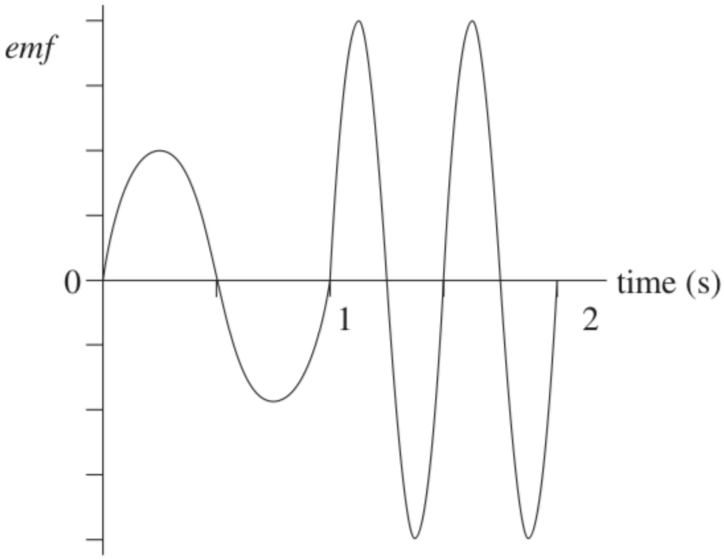
2014:
2) B
12) C
14) B

2013:
15) A
17) D

Question 27 (a)

Criteria	Marks
• Starting from zero, produces a single period AC curve for 0–1 seconds, followed by an AC curve of twice the frequency and amplitude for 1–2 seconds	3
• Produces a correct curve for 0–1 seconds OR 1–2 seconds AND • Includes a correct feature for the other second	2
• Identifies ONE correct feature	1

Sample answer:



Question 27 (b)

Criteria	Marks
• Demonstrates a sound understanding of the physics principles involved in a motor and a generator • Considers the energy changes and relates these to the motion of the vehicle both in propulsion and in braking • Clearly explains the physics principles involved in the propelling and braking of the vehicle	4
• Demonstrates an understanding of the physics principles involved in a motor and a generator • Describes relevant energy changes	3
• Demonstrates an understanding of the physics principles involved in a motor or generator OR • Shows some understanding of how a motor can act as a generator	2
• Identifies some relevant information	1

Sample answer:

A motor consists of a rotating coil in a magnetic field. When power is cut, this rotation causes an emf to be produced due to a change in magnetic flux. This allows the motor to act as a generator, which has essentially the same parts as a motor.

When acting as a motor, the vehicle converts electrical energy to kinetic energy due to the motor effect, thus propelling the vehicle. When it acts as a generator, kinetic energy is converted to electrical energy, and so by Lenz's law, the motion of the rotor is opposed. This acts to slow the vehicle.

2012:
1) D
16) C

2011:
6) C
12) A
18) B

Question 27 (a)

Sample answer:

$$F = BI\ell$$
$$B = 0.2\text{ T}$$
$$I = 10.0\text{ A}$$
$$\ell = 5\text{ cm} = 5\times10^{-2}\text{m}$$
$$\therefore F = 0.2\times10\times0.05\text{ Newtons}$$
$$= 0.1\text{ Newtons}$$

Question 27 (b)

Sample answer:

Because of the opposing direction of currents in sides AB and CD, the forces on the two sides are equal and opposite.

The same is true for the pair of sides AD and BC, $\therefore$ the net force on the coil is zero.

2010:
20) B

2009:
6) A
11) B

2008:

7) C

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

2007:
6) D
7) C
8) D
9) C

2006:
8) A
9) B

2005:
7) A

2004:
9) A

2003:
7) D

2002:
8) C
10) B

2001:
4) C