Electromagnetic Induction

Assertion & Reason Type Questions

Directions: In the following questions a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

b. Both Assertion (A) and (R) are true but Reason (R) is not the correct explanation of Assertion (A).

c. Assertion (A) is true but Reason (R) is false.

d. Both Assertion (A) and Reason (R) are false.

Q1. Assertion (A): Changing magnetic flux can produced induced emf.

Reason (R): Faraday established induced emf experimentally.

Answer : (b) emf induces, when there is change in magnetic flux. The magnitude of induced emf depends upon the rate at which the magnetic flux changes. When magnetic flux is steady or constant, no emf is induced. Faraday did experiment in which, there is relative motion between the coil and magnet, the flux linked with the coil changes and emf induces.

Q2. Assertion (A): Induced emf depends on number of turns and area of the coil.

Reason (R): Induced emf increases with increases in number of turns of coil.

Answer :

(b) According to Faraday's law, the induced emf (ε) is given by $\varepsilon = \frac{-d(N\phi)}{dt} = -\frac{d(NBA)}{dt} = -NA\frac{dB}{dt}$. Thus, induced emf depends on the rate of change of magnetic flux, number of turns of coil and area of the coil. If any of these factor increases (or decreases), then induced e.m.f. also increases (or decreases).

Q3. Assertion (A): An induced emf is generated when magnet is withdrawn from the solenoid.

Reason (R): The relative motion between magnet and solenoid induces emf.

Answer : (a) According to Faraday's law of electromagnetic induction, induced emf will be generated in the solenoid because of the relative motion between magnet and solenoid.

Q4. Assertion (A): The quantity L/R possesses dimensions of time.

Reason (R): To reduce the rate of increase of current through a solenoid should increase the time constant (L/R).

Answer :

(b) The relation of induced emf is $e = \frac{Ldl}{dt}$ and current I is given by $I = \frac{e}{R} = \frac{1}{R}.\frac{Ldl}{dt} \Rightarrow \frac{dl}{dt} = I\frac{R}{L} = \frac{I}{L/R}$ in order to decrease the rate of increase of current through solenoid. We have to increase the time constant $\frac{L}{R}$.

Q5. Assertion (A): Inductance coils are made of copper.

Reason (R): Induced current is more in wire having less resistance.

Answer : (a) The inductance coils made of copper will have very small ohmic resistance. Due to change in magnetic flux, a large induced current will be produced in such an inductance, which will offer appreciable opposition to the flow of current.

Q6. Assertion (A): When number of turns in a coil doubled, coefficient of self inductance of the coil becomes four times.

Reason (R): Coefficient of self inductance is proportional to the square of number of turns.

Answer : (a) The coefficient of self inductance of the coil is given by

$$L = \frac{\mu_0 N^2 A}{l}$$

where N is number of turns l is length of the coil and A is area of coil, so $L \propto N^2$.

Q7. Assertion (A): When two coils are wound on each other, the mutual induction between the coils is maximum.

Reason (R): Mutual induction does not depend on the orientation of the coils.

Answer : (c) The manner in which the two coils are oriented, determines the coefficient of coupling between them.

$$M = K^2.L_1L_2$$

When the two coils are wound on each other, the coefficient of coupling is maximum and hence mutual inductance between the coil is maximum.

Q8. Assertion: Induced emf will always occur whenever there is change in magnetic flux.

Reason: Current always induces whenever there is change in magnetic flux.

Q9. Assertion: Faraday's laws are consequence of conservation of energy.

Reason: In a purely resistive ac circuit, the current legs behind the emf in phase.

Q10. Assertion: Only a change in magnetic flux will maintain an induced current in the coil.

Reason: The presence of large magnetic flux through a coil maintain a current in the coil of the circuit is continuous.

Q11. Assertion: Lenz's law violates the principle of conservation of energy.

Reason: Induced emf always opposes the change in magnetic flux responsible for its production.

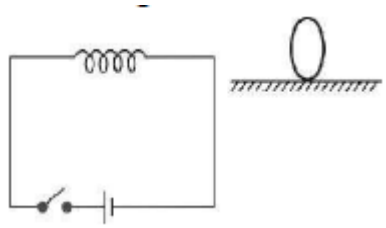
Q12. Assertion: An induced current has a direction such that the magnetic field due to the current opposes the change in the magnetic flux that induces the current.

Reason: Above statement is in accordance with conservation of energy.

Q13. Assertion: Acceleration of a magnet falling through a long solenoid decreases.

Reason: The induced current produced in a circuit always flow in such direction that it opposes the change to the cause that produced it.

Q14. Assertion: Figure shows a horizontal solenoid connected to a battery and a switch. A copper ring is placed on a smooth surface, the axis of the ring being horizontal. As the switch is closed, the ring will move away from the solenoid.

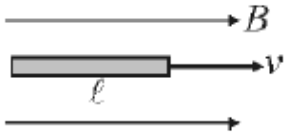


Reason: Induced emf in the ring, $e=-d\Phi/dt$

Q15. Assertion: An emf can be induced by moving a conductor in a magnetic field.

Reason: An emf can be induced by changing the magnetic field.

Q16. Assertion: Figure shows a metallic conductor moving in magnetic field. The induced emf across its ends is zero.



Reason: The induced emf across the ends of a conductor is given by $e = Bv\ell \sin\theta$.

Q17. Assertion: Eddy currents are produced in any metallic conductor when magnetic flux is changed around it.

Reason: Electric potential determines the flow of charge.

Q18. Assertion: An induced emf appears in any coil in which the current is changing.

Reason: Self induction phenomenon obeys Faraday's law of induction.

Q19. Assertion: When number of turns in a coil is doubled, coefficient of self-inductance of the coil becomes 4 times.

Reason: This is because $L \alpha N^2$.

ANSWER KEY 8 to 19

Q8 : (c) Emf will always induces whenever, there is change in magnetic flux. The current will induced only in closed loop.

Q9 : (c) In purely resistive circuit, the current and emf are in the same phase.

Q10 : (c)

Q11 : (a) Lenz's law (that the direction of induced emf is always such as to oppose the change that cause it) is direct consequence of the law of conservation of energy.

Q12 : (b)

Q13 : (a)

Q14 : (a) When switch is closed , the magnetic flux through the ring will increase and so ring will move away form the solenoid so as to compensate this flux. This is according to Lenz's law.

Q15 : (b) In both the cases, the magnetic flux will change, and so there is an induced current.

Q16 : (a)

Q17 : (b) Both the statements are independently correct.

Q18 : (b)

Q19 : (b)