

Electromagnetic Induction — NEET Physics PYQ (2006-2021)

Class 12 Physics · 13 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 \gg R_2$, the mutual inductance M between them will be directly proportional to :

- (A) R_1/R_2
- (B) R_2/R_1
- (C) R_1^2/R_2
- (D) R_2^2/R_1

NEET 2019 · Q41

2. A 800 turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field $5 \times 10^{-5} \text{ T}$. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s , the emf induced in the coil will be:

- (A) 2 V
- (B) 0.2 V
- (C) $2 \times 10^{-3} \text{ V}$
- (D) 0.02 V

NEET 2018 · Q21

3. The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance

- (A) 1.389 H
- (B) 138.88 H
- (C) 0.138 H
- (D) 13.89 H

NEET 2017 (Gujarati paper) · Q164

4. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s . The induced e.m.f. in the coil is: (Take $H_E = 3.0 \times 10^{-5} \text{ T}$)

- (A) $1.4 \times 10^{-2} \text{ V}$
- (B) $2.6 \times 10^{-2} \text{ V}$
- (C) $3.8 \times 10^{-3} \text{ V}$
- (D) $6.6 \times 10^{-4} \text{ V}$

NEET 2016 Phase 1 · Q42

5. A long solenoid has 1000 turns. When a current of 4A flows through it, the magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3} \text{ Wb}$. The self-inductance of the solenoid is:

- (A) 4 H
- (B) 3 H
- (C) 2 H
- (D) 1 H

NEET 2013

6. A wire loop is rotated in a magnetic field. The frequency of change of direction of the induced e.m.f. is -

- (A) once per revolution
- (B) twice per revolution
- (C) four times per revolution
- (D) six times per revolution

7. A coil of resistance $400\ \Omega$ is placed in a magnetic field. If the magnetic flux ϕ (Wb) linked with the coil varies with time t (s) as $\phi = 50t^2 + 4$, the current in the coil at $t = 2$ s is

- (A) 1 A
- (B) 0.5 A
- (C) 0.1 A
- (D) 2 A

8. A conducting circular loop is placed in a uniform magnetic field, $B = 0.025$ T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mm s^{-1} . The induced emf when the radius is 2 cm is

- (A) $2\ \mu\text{V}$
- (B) $2\pi\ \mu\text{V}$
- (C) $\pi\ \mu\text{V}$
- (D) $(\pi/2)\ \mu\text{V}$

9. A rectangular, a square, a circular and an elliptical loop, all in the (x–y) plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for:

- (A) the circular and the elliptical loops
- (B) only the elliptical loop
- (C) any of the four loops
- (D) the rectangular, circular and elliptical loops

10. A conducting circular loop is placed in a uniform magnetic field 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s . The induced emf in the loop when the radius is 2 cm is:

- (A) $4.8\pi\ \mu\text{V}$
- (B) $0.8\pi\ \mu\text{V}$
- (C) $1.6\pi\ \mu\text{V}$
- (D) $3.2\pi\ \mu\text{V}$

11. A circular disc of radius 0.2 metre is placed in a uniform magnetic field of induction $(1/\pi)\text{ Wb/m}^2$ in such a way that its axis makes an angle of 60° with B . The magnetic flux linked with the disc is

- (A) 0.01 Wb
- (B) 0.02 Wb
- (C) 0.06 Wb
- (D) 0.08 Wb

12. A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3}\text{ Wb}$. The self-inductance of the solenoid is

- (A) 4.0 henry
- (B) 2.5 henry
- (C) 2.0 henry
- (D) 1.0 henry

13. Two coils of self-inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is :

- (A) 8 mH
- (B) 12 mH
- (C) 4 mH
- (D) 16 mH

Answer key and explanations

1. Answer: (D) R_2^2/R_1

A current I in the large loop gives $B = \mu_0 I / (2R_1)$ at its centre, nearly uniform over the small loop. Flux through the small loop $= (\mu_0 I / 2R_1) \pi R_2^2$, so $M = \mu_0 \pi R_2^2 / (2R_1) \propto R_2^2 / R_1$.

2. Answer: (D) 0.02 V

Flux changes from NBA to zero: $\Delta\phi = 800 \times 5 \times 10^{-5} \times 0.05 = 2 \times 10^{-3}$ Wb. $\text{emf} = \Delta\phi / \Delta t = 2 \times 10^{-3} / 0.1 = 0.02$ V. 2×10^{-3} V is the flux change, not divided by the time.

3. Answer: (D) 13.89 H

$U = \frac{1}{2} LI^2$, so $L = 2U / I^2 = 2 \times 25 \times 10^{-3} / (60 \times 10^{-3})^2 = 0.05 / 0.0036 \approx 13.89$ H. Forgetting to square the current or the factor 2 gives the other values.

4. Answer: (C) 3.8×10^{-3} V

A 180° turn reverses the flux, so $\Delta\phi = 2NBA = 2 \times 500 \times 3.0 \times 10^{-5} \times \pi(0.1)^2 \approx 9.42 \times 10^{-4}$ Wb.

Average $\text{emf} = \Delta\phi / \Delta t = 9.42 \times 10^{-4} / 0.25 \approx 3.8 \times 10^{-3}$ V. The 2Ω resistance affects the current, not the emf ; dropping the factor 2 would give about 1.9×10^{-3} V.

5. Answer: (D) 1 H

Total flux linkage $N\Phi = LI$, so $L = N\Phi / I = 1000 \times 4 \times 10^{-3} / 4 = 1$ H. Forgetting to divide by the current gives 4 H.

6. Answer: (B) twice per revolution

The induced emf in a rotating loop is $e = NBA\omega \sin \omega t$, which changes sign twice in each full rotation (at 0 and π). So the direction reverses twice per revolution.

7. Answer: (B) 0.5 A

Induced emf $e = d\phi / dt = 100t$, which is 200 V at $t = 2$ s. Current $= e / R = 200 / 400 = 0.5$ A. The constant 4 in ϕ does not contribute to the emf .

8. Answer: (C) $\pi \mu\text{V}$

$\phi = B\pi r^2$, so $|\epsilon| = B\pi \cdot 2r \cdot (dr/dt) = 0.025 \times \pi \times 2 \times 0.02 \times 10^{-3} = \pi \times 10^{-6}$ V $= \pi \mu\text{V}$. Forgetting the factor 2 from $d(r^2)/dt$ gives $(\pi/2) \mu\text{V}$.

9. Answer: (A) the circular and the elliptical loops

Induced $\text{emf} = Bvl$, where l is the length of the loop lying on the field boundary as it leaves. For a rectangle or square moving perpendicular to a side, l is a constant side length, so the emf is constant; for a circle or ellipse the chord at the boundary changes continuously, so the emf changes. A shrinking flux alone does not make the emf vary; it is the rate of change of flux that matters.

10. Answer: (D) $3.2\pi \mu\text{V}$

$\text{Emf} = B dA/dt = B \times 2\pi r \times dr/dt = 0.04 \times 2\pi \times 0.02 \times 2 \times 10^{-3} = 3.2\pi \times 10^{-6}$ V $= 3.2\pi \mu\text{V}$. Missing the factor 2 from $d(\pi r^2)/dt$ gives $1.6\pi \mu\text{V}$.

11. Answer: (B) 0.02 Wb

The disc's area vector lies along its axis, so $\phi = BA \cos 60^\circ = (1/\pi)(\pi \times 0.2^2)(1/2) = 0.02$ Wb. Using $\sin 60^\circ$ (treating the angle as being with the plane of the disc) would give about 0.035 Wb.

12. Answer: (D) 1.0 henry

Total flux linkage $N\phi = LI$, so $L = 500 \times 4 \times 10^{-3} / 2 = 1.0$ H. 2.0 H would forget to divide by the current.

13. Answer: (C) 4 mH

With all the flux of one coil linking the other (coupling coefficient 1), $M = \sqrt{L_1 L_2} = \sqrt{2 \times 8} = 4$ mH. Adding the inductances (10 mH) or taking the larger one (8 mH) is incorrect.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.