CODE **ANURAG-4**

SPECTRUM

GATEWAY TO IITS

CLASS PRACTICE TEST-6
(PHYSICS)
ALTERNATING CURRENT & ELECTROMAGNETIC INDUCTION

Test Date:.....

Time: 1:30 hours ***Maximum marks: 200***

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS

A. General:

1. This booklet is your Question Paper containing 60 questions. The booklet has 14 pages.
2. The question paper CODE is printed on the right hand top corner of this booklet.
3. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers, and electronic gadgets in any form are not allowed to be carried inside the examination hall.
4. The answer sheet, a machine–readable Objective Response Sheet (ORS), is provided separately.
5. DO NOT TAMPER WITH / MUTILATE THE ORS OR THE BOOKLET.

B. Filling the ORS

6. On the lower part of the ORS, write in ink, your name in box L1, your Registration No. in box L2 and Name of the Centre in box L3. **Do not write these anywhere else.**
7. Write your Registration No. in ink, in the box L4 provided in the lower part of the ORS and darken the appropriate bubble **UNDER** each digit of your Registration No. with a good quality HB pencil.
8. The ORS has a **CODE** printed on its lower and upper parts.
9. Make sure the CODE on the ORS is the same as that on this booklet and put your signature in ink in box L5 on the ORS affirming that you have verified this.
10. IF THE CODES DO NOT MATCH, ASK FOR A CHANGE OF THE BOOKLET.

D. Marking Scheme:

16. For each questions in **Section I**, you will be **awarded 4 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (–1) mark** will be awarded.

Name of the Student

Roll Number

I have read all the instructions and shall abide by them

……..……

Signature of the Candidate

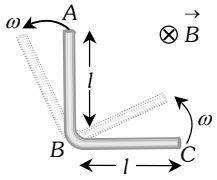
I have verified all the information filled in by the Candidate

……..

Signature of the Invigilator

PHYSICS : Electromagnetic Induction & Alternating Current

1. A conducting rod of length $2l$, bent at its middle and rotated in a uniform magnetic filed B with a constant angular speed ω as shown. The potential difference between the points A and C is



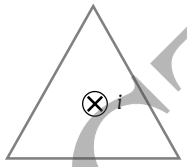
(a) $Bl^2\omega$

(b) $\frac{Bl^2\omega}{2}$

(c) 0

(d) $\frac{Bl^2\omega}{4}$

2. A current carrying straight wire passes inside a triangular coil as shown in the figure. The current in the wire is perpendicular to paper inwards. If current in wire is increasing then the direction of induced current in the coil is



(a) Clockwise

(b) Anticlockwise

(c) No current induces

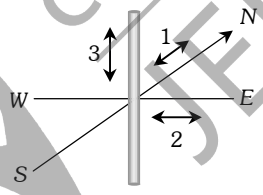
(d) First clockwise then anticlockwise.

3. What inductance would be needed to store 1 *kWH* of energy in a coil carrying 200 *A* current

(a) 100 *H* (b) 200 *H*

(c) 180 *H* (d) 50 *H*

4. A metallic rod moves in earth magnetic field with a constant speed towards north or south (path 1), towards east or west (path 2) towards up or down (path 3), If e is the induced emf across the rod then



(a) $e_1 > e_2 > e_3$

(b) $(e_1 = e_2) > e_3$

(c) $e_1 > e_3 > e_2$

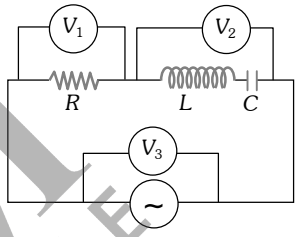
(d) $e_2 > (e_1 = e_3)$

5. A coil of resistance R and inductance L is switched to a *dc* supply of V volts. The initial rate of increase of current is

(a) 0 (b) $\frac{E}{R}$

(c) $\frac{E}{L}$ (d) $\frac{2E}{L}$

6. In the following figure, three *ac* voltmeters have been connected. At resonance which voltmeter shows zero reading



(a) V_1

(b) V_2

(c) V_3

(d) All of the above

7. A bulb and a capacitor are in series with an *ac* source. On increasing frequency how will glow of the bulb change

(a) The glow decreases

(b) The glow increases

(c) The glow remains the same

(d) The bulb quenches

8. An induced emf is produced when a magnet is plunged into a coil. The magnitude of induced emf does not depend upon

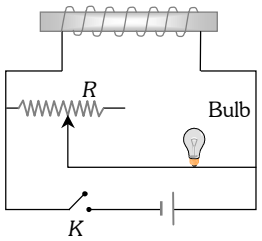
(a) The number of turns in the coil

(b) The speed with which the magnet is moved

(c) The strength of the magnet

(d) The specific resistance of the wire of the coil

9. Figure shows a solenoid connected with a resistance R, a bulb and a source of emf as shown. The resistance R is adjusted so that when K is closed the bulb just glows. Then the switch K is suddenly opened. The bulb will



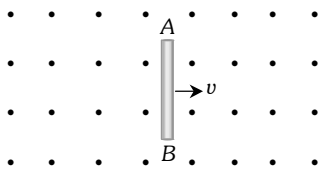
(a) Remain lit as before

(b) Die out

(c) Glows more brightly

(d) None of these

10. A rod AB moves with a uniform velocity v in a uniform magnetic field as shown in figure then



(a) The rod becomes electrically charged

(b) The end A becomes positively charged

(c) The end B becomes positively charged

(d) The rod becomes hot because of joules heating

11. A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf is induced in the loop if

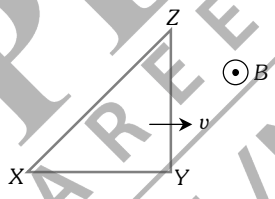
(a) It is translated

(b) It is rotated about its axis

(c) It is rotated about a diameter

(d) None of these

12. A right angled triangle XYZ made of copper wire is moving with velocity v in a uniform magnetic field B as shown. The emf induced in side XZ is



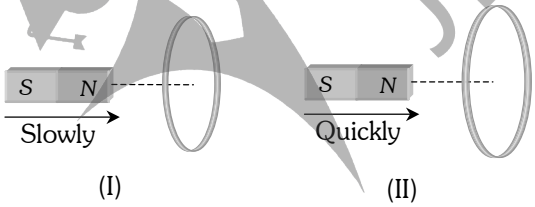
(a) $Bv(XY)$, with X-positive

(b) Bv (XY), with Z-positive

(c) Bv (ZY), with Z-positive

(d) Bv (ZY), with X-positive

13. A magnet is moved towards a coil according to two different situations as shown in the figure. If W is the work done in this process then

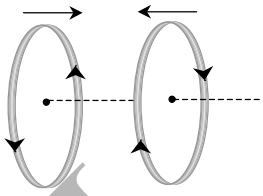


(I) (II)

(a) $W_I = W_{II}$ (b) $W_I > W_{II}$

(c) $W_I < W_{II}$ (d) None of these

14. When two current carrying coils carries currents in the opposite direction and moves towards each other then



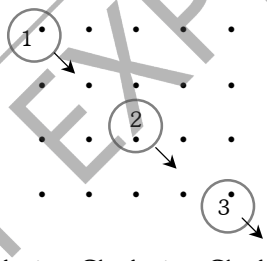
(a) Current through coil A increases and through coil B decreases

(b) Current through coil A decreases and current through coil B increases

(c) Current through both the coils decreases

(d) Current through both the coils increases

15. A circular loop of metallic wire passes from a uniform magnetic field with constant speed. What is the direction of induced current in the loop at the locations 1, 2 and 3 respectively



(a) Clockwise, Clockwise, Clockwise

(b) Clockwise, zero, Anticlockwise

(c) Anticlockwise, zero, Clockwise

(d) Anticlockwise in all situation

16. Initially plane of coil is parallel to the uniform magnetic field B. In time t it becomes perpendicular to magnetic field, then charge flows in it depend on this time as

(a) $\propto t$ (b) $\propto 1/t$

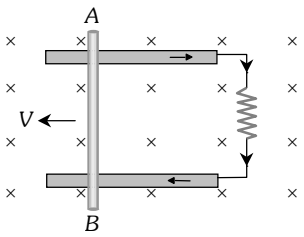
(c) $\propto t^0$ (d) $\propto t^2$

17. In a step-up transformer, the turn ratio is 1 : 2. A Leclanche cell (*emf* E volt) is connected across the primary. The voltage developed in the secondary would be

(a) $2E$ volt (b) $E/2$ volt

(c) E volt (d) None of these

18. Consider the situation shown in the figure. The wire *AB* is sliding on the fixed rails with a constant velocity. If the wire *AB* is replaced by semicircular wire, the magnitude of the induced current will



(a) Increase

(b) Remain the same

(c) Decrease

(d) Increase or decrease depending on whether the semicircle bulges towards the resistance or away from it

19. A coil having an inductance of 0.5 *H* carries a current which is uniformly varying from zero to 10 ampere in 2 second. The *emf* (in volts) generated in the coil is

(a) 10 (b) 5

(c) –2.5 (d) 2.5

20. The coefficient of mutual inductance of two coils is 6 *mH*. If the current flowing in one is 2 *ampere*, then the induced *emf* in the second coil will be

(a) 3 *mV* (b) 2 *mV*

(c) 3 *V* (d) Zero

21. A rectangular coil of 300 turns has an average area of average area of $25\ cm \times 10\ cm$. The coil rotates with a speed of 50 *cps* in a uniform magnetic field of strength $4 \times 10^{-2} T$ about an axis perpendicular of the field. The peak value of the induced *emf* is (in volt)

(a) 3000π (b) 300π

(c) 30π (d) 3π

22. The wing span of an aeroplane is 20 *metre*. It is flying in a field, where the vertical component of magnetic field of earth is 5×10^{-5} *tesla*, with velocity 360 *km/h*. The potential difference produced between the blades will be

(a) 0.10 *V* (b) 0.15 *V*

(c) 0.20 *V* (d) 0.30 *V*

23. If a coil of 40 turns and area 4.0 cm^2 is suddenly removed from a magnetic field, it is observed that a charge of $2.0 \times 10^{-4} C$ flows into the coil. If the resistance of the coil is 80Ω, the magnetic flux density in Wb/m^2 is

(a) 0.5 (b) 1.0

(c) 1.5 (d) 2.0

24. The magnetic flux linked with coil, in weber is given by the equation, $\phi = 5t^2 + 3t + 16$. The induced *emf* in the coil at $t = 3$ second is

(a) 10 *V* (b) 30 *V*

(c) 33 *V* (d) 90 *V*

25. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is

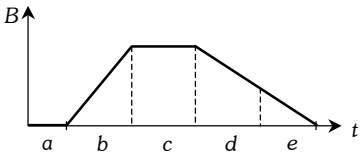
(a) Equal to that due to gravity

(b) Less than that due to gravity

(c) More than that due to gravity

(d) Depends on the diameter of the ring and the length of the magnet

26. The graph gives the magnitude $B(t)$ of a uniform magnetic field that exists throughout a conducting loop, perpendicular to the plane of the loop. Rank the five regions of the graph according to the magnitude of the emf induced in the loop, greatest first



(a) $b > (d = e) < (a = c)$ (b) $b > (d = e) > (a = c)$

(c) $b < d < e < c < a$ (d) $b > (a = c) > (d = e)$

27. A circular coil and a bar magnet placed near by are made to move in the same direction. The coil covers a distance of 2 *m* in 1 *sec* and the magnet a distance of 240 *m* in 2 *min*. The induced emf produced in the coil

(a) Zero

(b) 1 *V*

(c) 0.5 *V*

(d) Cannot be determined from the given information

28. The horizontal component of the earth's magnetic field at a place is 3×10^{-4} *T* and the dip is $\tan^{-1}\left(\frac{4}{3}\right)$. A metal rod of length 2 *m* placed in the north-south position and is moved at a constant speed of 20 *cm/s* towards the east. The emf induced in the rod will be

(a) 80 *mV* (b) 120 μV

(c) 1.2 *V* (d) 160 μV

29. A small coil is introduced between the poles of an electromagnet so that its axis coincides with the magnetic field direction. The number of turns is *n* and the cross sectional area of the coil is *A*. When the coil turns through 180° about its diameter, the charge flowing through the coil is *Q*. The total resistance of the circuit is *R*. What is the magnitude of the magnetic induction

(a) $\frac{QR}{nA}$ (b) $\frac{2QR}{nA}$

(c) $\frac{Qn}{2RA}$ (d) $\frac{QR}{2nA}$

30. An ac generator produced an output voltage $E = 170\sin 377\,t\,volts$, where *t* is in seconds. The frequency of ac voltage is

(a) 50 *Hz* (b) 110 *Hz*

(c) 60 *Hz* (d) 230 *Hz*

31. In a *LCR* circuit having *L* = 8.0 *henry*, *C* = 0.5 μF and *R* = 100 *ohm* in series. The resonance frequency in *per second* is

(a) 600 *radian* (b) 600 *Hz*

(c) 500 *radian* (d) 500 *Hz*

32. The *r.m.s.* current in an ac circuit is 2 *A*. If the wattless current be $\sqrt{3}A$, what is the power factor

(a) $\frac{1}{\sqrt{3}}$ (b) $\frac{1}{\sqrt{2}}$

(c) $\frac{1}{2}$ (d) $\frac{1}{3}$

33. The self inductance of a choke coil is 10 *mH*. When it is connected with a 10*V* dc source, then the loss of power is 20 *watt*. When it is connected with 10 *volt* ac source loss of power is 10 *watt*. The frequency of ac source will be

(a) 50 *Hz* (b) 60 *Hz*

(c) 80 *Hz* (d) 100 *Hz*

34. A resistor *R*, an inductor *L* and a capacitor *C* are connected in series to an oscillator of frequency *n*. if the resonant frequency is n_r, then the current lags behind voltage, when

(a) $n = 0$ (b) $n < n_r$

(c) $n = n_r$ (d) $n > n_r$

35. The instantaneous values of current and voltage in an ac circuit are $i = 100\sin 314\,t\,amp$ and $e = 200\sin(314\,t + \pi/3)V$ respectively. If the resistance is 1Ω then the reactance of the circuit will be

(a) $-200\sqrt{3}\,\Omega$ (b) $\sqrt{3}\,\Omega$

(c) $-200/\sqrt{3}\,\Omega$ (d) $100\sqrt{3}\,\Omega$

36. When the speed of a dc motor increases the armature current

(a) Increases

(b) Decreases

(c) Does not change

(d) Increases and decreases continuously

37. A coil of 100 *turns* and area 5 *square centimetre* is placed in a magnetic field B = 0.2 *T*. The normal to the plane of the coil makes an angle of 60° with the direction of the magnetic field. The magnetic flux linked with the coil is

(a) $5\times10^{-3}Wb$ (b) $5\times10^{-5}\,Wb$

(c) $10^{-2}\,Wb$ (d) $10^{-4}\,Wb$

38. When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance

(a) Remains the same (b) Is halved

(c) Is doubled (d) Becomes four times

39. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

(a) The currents in the two coils

(b) The rates at which currents are changing in the two coils

(c) Relative position and orientation of the two coils

(d) The materials of the wires of the coils

40. A coil of $N = 100$ turns carries a current $I = 5\ A$ and creates a magnetic flux $\phi = 10^{-5} Tm^{-2}$ per turn. The value of its inductance L will be

(a) 0.05 mH (b) 0.10 mH

(c) 0.15 mH (d) 0.20 mH

41. Alternating current can not be measured by dc ammeter because

(a) ac cannot pass through dc ammeter

(b) Average value of complete cycle is zero

(c) ac is virtual

(d) ac changes its direction

42. In a circuit, the value of the alternating current is measured by hot wire ammeter as 10 *ampere*. Its peak value will be

(a) 10 A (b) 20 A

(c) 14.14 A (d) 7.07 A

43. A bulb is connected first with dc and then ac of same voltage then it will shine brightly with

(a) AC

(b) DC

(c) Brightness will be in ratio 1/1.4

(d) Equally with both

44. An alternating voltage $E = 200\sqrt{2}\sin(100\,t)$ is connected to a 1 *microfarad* capacitor through an ac ammeter. The reading of the ammeter shall be

(a) 10 mA (b) 20 mA

(c) 40 mA (d) 80 mA

45. The average power dissipation in a pure capacitance in ac circuit is

(a) $\frac{1}{2}CV^2$ (b) CV^2

(c) $\frac{1}{4}CV^2$ (d) Zero

Note : In the following questions 46 to 50, a statement of assertion (A) is followed by a statement of reason (R)

(a) If both assertion and reason are true and reason is a correct explanation of assertion

(b) If both assertion and reason are true but reason is not the correct explanation of assertion

(c) If assertion is true and reason is false

(d) If both assertion and reason are false

46. Assertion : In series LCR circuit resonance can take place.

Reason : Resonance takes place if inductive and capacitive reactances are equal and opposite.

47. Assertion : A bulb connected in series with a solenoid is connected to ac source. If a soft iron core is introduced in the solenoid, the bulb will glow brighter.

Reason : On introducing soft iron core in the solenoid, the inductance decreases.

48. Assertion : Faraday's laws are consequences of conservation of energy.

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

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

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

50. Assertion : An induced *emf* is generated when magnet is withdrawn from the solenoid.

Reason : The relative motion between magnet and solenoid induces *emf*.