DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

PHYSICS 41

SYLLABUS : MAGNETIC EFFECTS OF CURRENT-3 (Magnetic dipole, Current carrying loop in magnetic field,Galvanometer)

Max. Marks : 116 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 29 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.20) : There are 20 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 A circular coil has radius 4 cm and 20 number of turns carries a current of 3 ampere. It is placed in a magnetic field of intensity 0.5 weber/m^2. The magnetic dipole moment of the coil is $\left(\text{Take } \pi = \frac{22}{7}\right)$

(a) 0.15 ampere m^2 (b) 0.3 ampere m^2
(c) 0.45 ampere m^2 (d) 0.6 ampere m^2

Q.2 A circular coil of radius 4 cm has 50 turns. In this coil a current of 2 A is flowing. It is placed in a magnetic field of 0.1 weber/m^2. The amount of work done in rotating it through 180° from its equilibrium position will be

(a) 0.1 J (b) 0.2 J (c) 0.4 J (d) 0.8 J

Q.3 The deflection in a moving coil galvanometer is

(a) directly proportional to the torsional constant
(b) directly proportional to the number of turns in the coil
(c) inversely proportional to the area of the coil
(d) inversely proportional to the current flowing

Q.4 A moving coil galvanometer has N number of turns in a coil of effective area A. It carries a current I. The magnetic field B is radial. The torque acting on the coil is

(a) NA^2B^2I (b) $NABI^2$ (c) N^2ABI (d) $NABI$

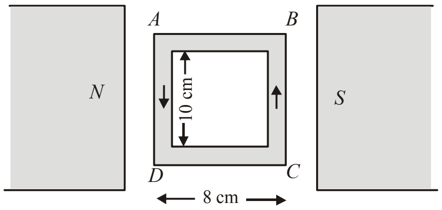
Q.5 A current carrying loop is free to turn in a uniform magnetic field. The loop will then come into equilibrium when its plane is inclined at

(a) 0° to the direction of the field
(b) 45° to the direction of the field
(c) 90° to the direction of the field
(d) 135° to the direction of the field

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 A 100 turns coil shown in figure carries a current of 2 amp in a magnetic field B = 0.2Wb/m^2. The torque acting on the coil is



(a) 0.32 Nm tending to rotate the side *AD* out of the page
(b) 0.32 Nm tending to rotate the side *AD* into the page
(c) 0.0032 Nm tending to rotate the side *AD* out of the page
(d) 0.0032 Nm tending to rotate the side *AD* into the page

Q.7 A rectangular coil of size 20 cm × 20 cm has 100 turns and carries a current of 1 A. It is placed in a uniform magnetic field $B = 0.5\ T$ with the direction of magnetic field parallel to the plane of the coil. The magnitude of the torque required to hold this coil in this position is
(a) zero (b) 200 Nm
(c) 2 Nm (d) 10 Nm

Q.8 A circular loop of area 0.01m^2 carrying a current of 10 A, is held perpendicular to a magnetic field of intensity 0.1 T. The torque acting on the loop is
(a) zero (b) 0.01 Nm
(c) 0.001 Nm (d) 0.8 Nm

Q.9 The magnetic moment of a current carrying circular coil is
(a) directly proportional to the length of the wire
(b) inversely proportional to the length of the wire
(c) directly proportional to the square of the length of the wire
(d) inversely proportional to the square of the length of the wire

Q.10 What is the shape of magnet in moving coil galvanometer to make the radial magnetic field?
(a) Concave cylindrical (b) Horse shoe magnet
(c) Convex cylindrical (d) None of these

Q.11 Current *i* is carried in a wire of length *L*. If the wire is turned into a circular coil, the maximum magnitude of torque in a given magnetic field *B* will be
(a) $\frac{LiB^2}{2}$ (b) $\frac{Li^2B}{2}$ (c) $\frac{L^2iB}{4\pi}$ (d) $\frac{Li^2B}{4\pi}$

Q.12 In ballistic galvanometer, the frame on which the coil is wound is non-metallic. It is
(a) to avoid the production of induced e.m.f.
(b) to avoid the production of eddy currents
(c) to increase the production of eddy currents
(d) to increase the production of induced e.m.f.

Q.13 A solenoid of length 0.4 m and having 500 turns of wire carries a current of 3 amp. A thin coil having 10 turns of wire and of radius 0.01 m carries a current of 0.4 amp. The torque (in Nm) required to hold the coil in the middle of the solenoid with its axis perpendicular to the axis of the solenoid is ($\mu_0 = 4\pi \times 10^{-7}$ V-s/A-m)
(a) 59.2×10^{-6} (b) 5.92×10^{-6}
(c) 0.592×10^{-6} (d) 0.592×10^{-4}.

Q.14 If an electron is moving with velocity v in an orbit of radius r in a hydrogen atom, then the equivalent magnetic moment is
(a) $\frac{\mu_0 e}{2r}$ (b) $\frac{ev}{r^2}$ (c) $\frac{ev \times 10^{-7}}{r^3}$ (d) $\frac{evr}{2}$

Q.15 In a moving coil galvanometer, the deflection of the coil θ is related to the electrical current *i* by the relation
(a) $i \propto \tan\theta$ (b) $i \propto \theta$
(c) $i \propto \theta^2$ (d) $i \propto \sqrt{\theta}$

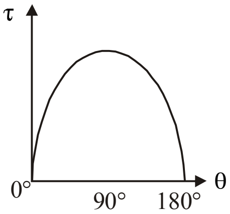
Q.16 A thin circular wire carrying a current *I* has a magnetic moment *M*. The shape of the wire is changed to a square and it carries the same current. It will have a magnetic moment
(a) M (b) $\frac{4}{\pi^2}M$ (c) $\frac{4}{\pi}M$ (d) $\frac{\pi}{4}M$

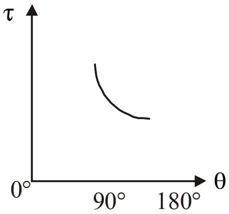
Q.17 A ring of radius *R*, made of an insulating material carries a charge *Q* uniformly distributed on it. If the ring rotates about the axis passing through its centre and normal to plane of the ring with constant angular speed ω, then the magnitude of the magnetic moment of the ring is
(a) $Q\omega R^2$ (b) $\frac{1}{2}Q\omega R^2$ (c) $Q\omega^2 R$ (d) $\frac{1}{2}Q\omega^2 R$

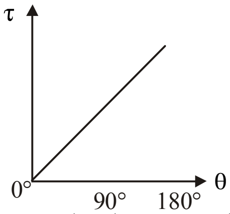
RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ			

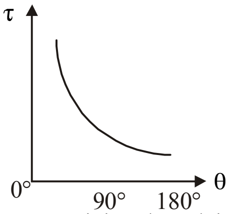
Space for Rough Work

Q.18 The $(\tau - \theta)$ graph for a current carrying coil placed in a uniform magnetic field is

(a) 

(b) 

(c) 

(d) 

Q.19 A rectangular loop carrying a current i is placed in a uniform magnetic field B. The area enclosed by the loop is A. If there are n turns in the loop, the torque acting on the loop is given by

(a) $ni\vec{A}\times\vec{B}$ (b) $ni\vec{A}.\vec{B}$

(c) $\frac{1}{n}(i\vec{A}\times\vec{B})$ (d) $\frac{1}{n}(i\vec{A}.\vec{B})$

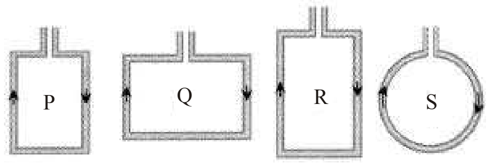
Q.20 The pole pieces of the magnet used in a pivoted coil galvanometer are

(a) plane surfaces of a bar magnet
(b) plane surfaces of a horse-shoe magnet
(c) cylindrical surfaces of a bar magnet
(d) cylindrical surfaces of a horse-shoe magnet

DIRECTIONS (Q.21-Q.23) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :
(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.21 Four wires each of length 2.0 metre are bent into four loops *P, Q, R* and *S* and then suspended into uniform magnetic field. Same current is passed in each loop. Which statements are incorrect?



(1) Couple on loop *P* will be the highest
(2) Couple on loop *Q* will be the highest
(3) Couple on loop *R* will be the highest
(4) Couple on loop *S* will be the highest

Q.22 The sensitivity of a moving coil galvanometer can be increased by

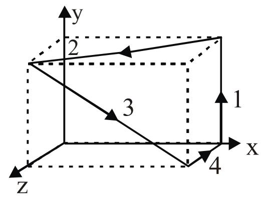
(1) decreasing the couple per unit twist of the suspension
(2) increasing the number of turns in the coil
(3) decreasing the area of the coil
(4) decreasing the magnetic field

Q.23 A current carrying rectangular coil is placed in a uniform magnetic field. In which orientation, the coil will tend to rotate

(1) The magnetic field is parallel to the plane of the coil
(2) The magnetic field is at 45° with the plane of the coil
(3) In any orientation
(4) The magnetic field is perpendicular to the plane of the coil

DIRECTIONS (Q.24-Q.26) : Read the passage given below and answer the questions that follows :

A wire carrying a 10 A current is bent to pass through sides of a cube of side 10 cm as shown in figure. A magnetic field $\vec{B} = (2\hat{i} - 3\hat{j} + \hat{k})T$ is present in the region. Then, find



Q.24 The net force on the loop

(a) $\vec{F}_{net} = 0$ (b) $\vec{F}_{net} = (0.1\hat{i} - 0.2\hat{k})N$

(c) $\vec{F}_{net} = (0.3\hat{i} + 0.4\hat{k})N$ (d) $\vec{F}_{net} = (0.36\hat{k})N$

Q.25 The magnetic moment vector of the loop.

(a) $(0.1\hat{i} + 0.05\hat{j} - 0.05\hat{k})Am^2$ (b) $(0.1\hat{i} + 0.05\hat{j} + 0.05\hat{k})Am^2$

(c) $(0.1\hat{i} - 0.05\hat{j} + 0.05\hat{k})Am^2$ (d) $(0.1\hat{i} - 0.05\hat{j} - 0.05\hat{k})Am^2$

RESPONSE GRID					
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ		

Space for Rough Work

Q.26 The net torque on the loop.

(a) $-0.1\hat{i}+0.4\hat{k}$ Nm (b) $-0.1\hat{i}-0.4\hat{k}$ Nm

(c) $0.1\hat{i}-0.4\hat{k}$ Nm (d) $0.1\hat{i}-0.4\hat{k}$ Nm

DIRECTIONS (Q. 27-Q.29) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement-1 is False, Statement-2 is True.

(d) Statement-1 is True, Statement-2 is False.

Q.27 Statement-1 : The coil is bound over the metallic frame in moving coil galvanometer.

Statement-2 : The metallic frame help in making steady deflection without any oscillation.

Q.28 Statement-1 : Torque on the coil is maximum, when coil is suspended in a radial magnetic field.

Statement-2 : The torque tends to rotate the coil on its own axis.

Q.29 Statement-1 : A current carrying loop placed in equilibrium in a uniform magnetic field starts oscillating when disturbed from equilibrium.

Statement-2 : A system when disturbed slightly from stable equilibrium oscillates.

RESPONSE GRID				
	26. (a)(b)(c)(d)	27. (a)(b)(c)(d)	28. (a)(b)(c)(d)	29. (a)(b)(c)(d)

DAILY PRACTICE PROBLEM SHEET 41 - PHYSICS			
Total Questions	29	Total Marks	116
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	30	Qualifying Score	48
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

41

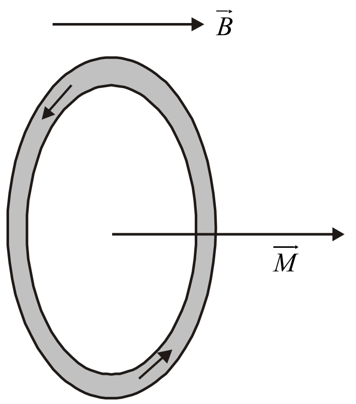
1. (b) $M = NiA = 20 \times \frac{22}{7}(4\times10^{-2})^2 \times 3 = 0.3A - m^2$

2. (a) The magnetic moment of current carrying loop
$M = niA = ni(\pi r^2)$
Hence the work done in rotating it through 180°
$W = MB(1-\cos\theta) = 2MB = 2(ni\pi r^2)B$
$= 2\times(50\times2\times3.14\times16\times10^{-4})\times0.1 = 0.1J$

3. (b) $\theta = \frac{NiAB}{C} \Rightarrow \theta \propto N$ (Number of turns)

4. (d) $\tau = MB\sin\theta \Rightarrow \tau_{max} = NiAB$, $(\theta = 90°)$

5. (c) In equilibrium angle between $\vec{M}$ and $\vec{B}$ is zero. It happens, when plane of the coil is perpendicular to $\vec{B}$



6. (a) $\tau = NBiA = 100\times0.2\times2\times(0.08\times0.1) = 0.32\ N\times m$

7. (c) $\tau = NBiA = 100\times0.5\times1\times400\times10^{-4} = 2\ N-m$

8. (a) $\tau = NiAB\sin\theta = 0 \quad (\because \theta = 0°)$

9. (c) $M = NiA \Rightarrow M \propto A \Rightarrow M \propto r^2$ (As $l = 2\pi r \Rightarrow l \propto r$)
$\Rightarrow M \propto l^2$

10. (a)

11. (c) $\tau_{max} = NiAB = 1\times i\times(\pi r^2)\times B$

$\left(2\pi r = L, \Rightarrow r = \frac{L}{2\pi}\right)$

$\tau_{max} = \pi i\left(\frac{L}{2\pi}\right)^2 B = \frac{L^2 iB}{4\pi}$

12. (b)

13. (b) The magnetic field at the centre of the solenoid is
$B = \mu_0 ni = (4\pi\times10^{-7})\times(500/0.4)\times3$ N/A.m.
The torque acting on a current-carrying coil having N turns (say), placed perpendicular to the axis at the centre of the solenoid is-

$\tau = BiNA = (4\pi\times10^{-7})\times(500/0.4)\times3\times0.4\times10\times\pi(0.01)^2$
$= 6\pi^2\times10^{-7} = 5.92\times10^{-6}$ N.m.

14. (d) The equivalent magnetic moment is
$M = iA = ef(\pi r^2)$

As $f = \frac{v}{2\pi r}$

$\therefore M = \frac{ev}{2\pi r}\pi r^2 = \frac{evr}{2}$

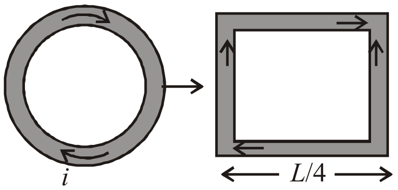
15. (b) $i = \frac{C\theta}{NAB} \Rightarrow i \propto \theta$

16. (d) Initially for circular coil $L = 2\pi r$ and $M = i\times\pi r^2$

$= i\times\pi\left(\frac{L}{2\pi}\right)^2 = \frac{iL^2}{4\pi}$ ...(i)

Finally for square coil

$M' = i\times\left(\frac{L}{4}\right)^2 = \frac{iL^2}{16}$ ...(ii)



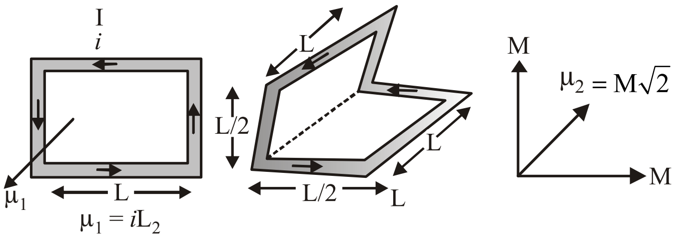
Solving equation (i) and (ii) $M' = \frac{\pi M}{4}$

17. (b) $M = iA = i\times\pi R^2$

also $i = \frac{Q\omega}{2\pi} \Rightarrow M = \frac{1}{2}Q\omega R^2$

18. (a) $\tau = NBiA\sin\theta$ so the graph between τ and θ is a sinusoidal graph.

19. (d) Initial magnetic moment = m1 = iL2



After folding the loop, M = magnetic moment due to each part $= i\left(\frac{L}{2}\right)\times L = \frac{iL^2}{2} = \frac{\mu_1}{2}$

$$\Rightarrow \quad \mu_2 = M\sqrt{2} = \frac{\mu_1}{2}\times\sqrt{2} = \frac{\mu_1}{\sqrt{2}}$$

20. **(a)**

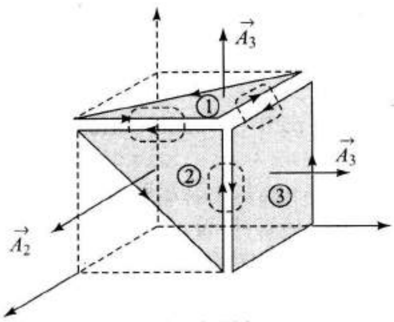
21. **(d)**

22. **(a)** Couple of force on loop S will be maximum because for same perimeter the area of loop will be maximum and magnetic moment of loop $= i \times A$. So, it will also be maximum for loop S.

23. **(b)** Sensitivity $S = \frac{\theta}{i} = \frac{nBA}{C}$

24. **(b)** $\tau = mB\sin\theta$ is zero for $\theta = 0°, 180°$.

25-27



25. **(a)** **26. (b)** **27. (b)**

(a) The net force on a current carrying loop of any arbitrary shape in a uniform magnetic field is zero.

$\vec{F}_{net} = 0$

(b) The given loop can be considered to be a superposition of three loops as shown in figure. The area vector of the three loops (1), (2) and (3) are

$$\vec{A}_1 = \left(\frac{1}{2}\times10\times10\times10^{-4}\right)\hat{j}\,m^2$$

$$\vec{A}_2 = \left(\frac{1}{2}\times10\times10\times10^{-4}\right)\hat{k}\,m^2$$

$$\vec{A}_3 = \left(\frac{1}{2}\times10\times10\times10^{-4}\right)\hat{i}\,m^2$$

Magnetic moment vector,

$$\vec{\mu} = i\vec{A} = 10(0.01\hat{i} + 0.005\hat{j} + 0.005\hat{k})Am^2$$

$$= (0.1\hat{i} + 0.05\hat{j} + 0.05\hat{k})Am^2$$

c. Torque,

$$\vec{\tau} = (0.1\hat{i} + 0.05\hat{j} + 0.05\hat{k})\times(2\hat{i} - 3\hat{j} + \hat{k})$$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.1 & 0.05 & 0.05 \\ 2 & -3 & 1 \end{vmatrix} = -0.1\hat{i} - 0.4\hat{k}\,Nm$$

28. **(a)** Due to metallic frame the deflection is only due to current in a coil and magnetic field, not due to vibration in the strings. If string start oscillating, presence of metallic frame in the field make these oscillations damped.

29. **(b)** The torque on the coil in a magnetic field is given by $\tau = nIBA\cos\theta$

For radial field, the coil is set with its plane parallel to the direction of the magnetic field B, then $\theta = 0°$ and $\cos\theta = 1 \Rightarrow$ Torque $= nIBA\,(1) = nIBA$ (maximum).

30. **(c)** Loop will not oscillate if in unstable equilibrium position.