SOLVED PAPER	NEET (UG) 05th May 2024	Code T4

Total Time Duration: 200 Minutes **Maximum Marks: 720**

Important Instructions

1. *The test is of **3 hours 20 minutes** duration and test booklet contains **200** multiple choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**. **50** questions in each subject are divided into two **Section (A and B)** as per details given below:*
   - *(a) **Section A** shall consist of **35 (Thirty-five)** questions in each subject (Question Nos- 1 to 35, 51 to 85, 101 to 135 and 151 to 185). All questions are compulsory.*
   - *(b) **Section B** shall consist of **15 (Fifteen)** questions in each subject (Question Nos- 36 to 50, 86 to 100, 136 to 150 and 80 to 200). In Section B, a candidate needs to **attempt any 10 (Ten)** questions out of **15 (Fifteen)** in each subject.*

   Candidates are advised to read all 15 questions in each subject of Section B** before they start attempting the question paper. In the event of a candidate attempting more than ten questions, **the first ten questions answered by the candidate shall be evaluated.
2. *Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, one mark will be deducted from the total scores. **The maximum marks are 720.***
3. *Use **blue/black ball point pen only** for writing particulars on this page/marking responses on answer Sheet.*
4. *Use of electronic/manual calculator is prohibited.*
5. ***No part of the test booklet and answer sheet shall be detached under any circumstances.***
6. *The candidates will write the correct test booklet code as given in the test booklet/answer sheet in the attendance sheet.*
7. *Compensatory time of one hour five minutes will be provided for the examination of three hours and 20 minutes duration, whether such candidate (having a physical limitation to write) uses the facility of scribe or not.*

PHYSICS

Section A

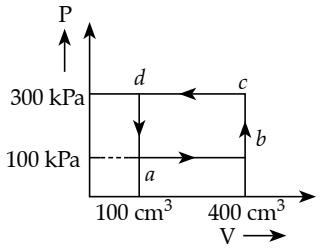
Q. 1. The moment of inertia of a thin rod about an axis passing through its mid point and perpendicular to the rod is 2400 g cm^2. The length of the 400 g rod is nearly:

(1) 20.7 cm **(2)** 72.0 cm
(3) 8.5 cm **(4)** 17.5 cm

Q. 2. A bob is whirled in a horizontal plane by means of a string with an initial speed of ω rpm. The tension in the string is T. If speed becomes 2ω while keeping the same radius, the tension in the string becomes:

(1) $\frac{T}{4}$ **(2)** $\sqrt{2}T$ **(3)** T **(4)** 4T

Q. 3. A thermodynamic system is taken through the cycle *abcda*. The work done by the gas along the path *bc* is:



(1) –90 J **(2)** –60 J **(3)** Zero **(4)** 30 J

Q. 4. $^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^+} Z \xrightarrow{\beta^-} P \xrightarrow{e^-} Q$

In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are:

(1) 288, 82 **(2)** 286, 81 **(3)** 280, 81 **(4)** 286, 80

Q. 5. An unpolarised light beam strikes a glass surface at Brewster's angle. Then

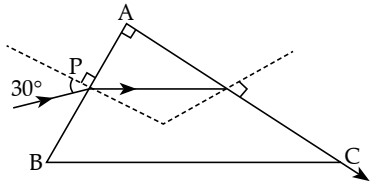
(1) both the reflected and refracted light will be completely polarised

(2) the reflected light will be completely polarised but the refracted light will be partially polarised
(3) the reflected light will be partially polarised
(4) the refracted light will be completely polarised

Q. 6. If c is the velocity of light in free space, the correct statements about photon among the following are:
(A) The energy of a photon is $E = h\nu$.
(B) The velocity of a photon is c.
(C) The momentum of a photon, $p = \frac{h\nu}{c}$
(D) In a photon-electron collision, both total energy and total momentum are conserved.
(E) Photon possesses positive charge
Choose the correct answer from the options given below:
(1) A, C and D only
(2) A, B, D and E only
(3) A and B only
(4) A, B, C and D only

Q. 7. Two bodies A and B of same mass undergo completely inelastic one dimensional collision. The body A moves with velocity v_1 while body B is at rest before collision. The velocity of the system after collision is v_2. The ratio $v_1 : v_2$ is
(1) 4 : 1 **(2)** 1 : 4 **(3)** 1 : 2 **(4)** 2 : 1

Q. 8. A light ray enters through a right angled prism at point P with the angle of incidence 30° as shown in figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:



(1) $\frac{\sqrt{3}}{4}$ **(2)** $\frac{\sqrt{3}}{2}$ **(3)** $\frac{\sqrt{5}}{4}$ **(4)** $\frac{\sqrt{5}}{2}$

Q. 9. If $x = 5 \sin\left(\pi t + \frac{\pi}{3}\right)$ m represents the motion of a particle executing simple harmonic motion, the amplitude and time period of motion, respectively, are:
(1) 5 cm, 1 s **(2)** 5 m, 1 s
(3) 5 cm, 2 s **(4)** 5 m, 2 s

Q. 10. At any instant of time t, the displacement of any particle is given by $2t - 1$ (SI unit) under the influence of force of 5N. The value of instantaneous power is (in SI unit):
(1) 7 **(2)** 6 **(3)** 10 **(4)** 5

Q. 11. A tightly wound 100 turns coil of radius 10 cm carries a current of 7 A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$ SI unit):
(1) 4.4 mT **(2)** 44 T **(3)** 44 mT **(4)** 4.4 T

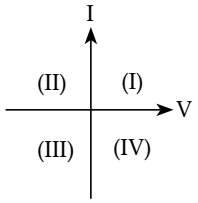
Q. 12. A particle moving with uniform speed in a circular path maintains:
(1) constant velocity but varying acceleration.
(2) varying velocity and varying acceleration
(3) constant velocity
(4) constant acceleration

Q. 13. A logic circuit provides the output Y as per the following truth table:

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

The expression for the output Y is:
(1) $\overline{B}$ **(2)** B
(3) $A.B + \overline{A}$ **(4)** $A.\overline{B} + \overline{A}$

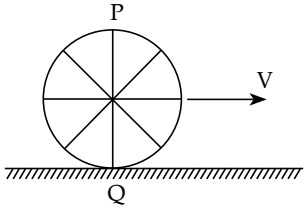
Q. 14. Consider the following statements A and B and identify the correct answer:



A. For a solar-cell the I-V characteristics lies in the (IV) quadrant of the given graph.
B. In a reverse biased p-n junction diode, the current measured in (μA), is due to majority charge carriers.
(1) Both A and B are correct.
(2) Both A and B are incorrect.
(3) A is correct but B is incorrect.
(4) A is incorrect but B is correct.

Q. 15. In an ideal transformer, the turns ratio is $\frac{N_p}{N_s} = \frac{1}{2}$. The ratio $V_s : V_p$ is equal to (the symbols carry their usual meaning):
(1) 1 : 1 **(2)** 1 : 4 **(3)** 1 : 2 **(4)** 2 : 1

Q. 16. A wheel of a bullock cart is rolling on a level road as shown in the figure below. If its linear speed is v in the direction shown, which one of the following options is correct (P and Q are any highest and lowest points on the wheel, respectively)?

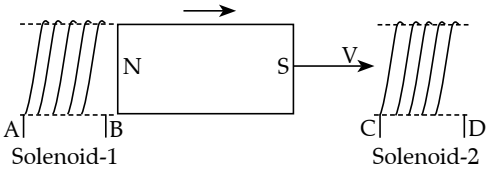


(1) Both the points P and Q move with equal speed.
(2) Point P has zero speed.
(3) Point P moves slower than point Q.
(4) Point P moves faster than point Q.

Q. 17. If the monochromatic source in Young's double slit experiment is replaced by white light, then
(1) there will be a central bright white fringe surrounded by a few coloured fringes.

(2) all bright fringes will be of equal width.
(3) interference pattern will disappear.
(4) there will be a central dark fringe surrounded by a few coloured fringes.

Q. 18.



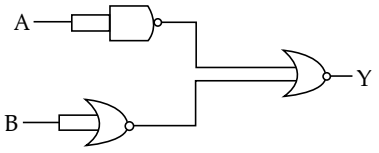
In the above diagram, a strong bar magnet is moving towards solenoid-2 from solenoid-1. The direction of induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:

(1) AB and CD **(2)** BA and DC
(3) AB and DC **(4)** BA and CD

Q. 19. In a vernier calipers, (N + 1) divisions of vernier scale coincide with N divisions of main scale. If 1 MSD represents 0.1 mm, the vernier constant (in cm) is:

(1) 100 N **(2)** 10(N + 1)
(3) $\frac{1}{10N}$ **(4)** $\frac{1}{100(N+1)}$

Q. 20. The output (Y) of the given logic gate is similar to the output of an/a:



(1) OR gate **(2)** AND gate
(3) NAND gate **(4)** NOR gate

Q. 21. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**
Assertion (A): The potential (V) at any axial point, at 2 m distance (r) from the centre of the dipole of dipole moment vector $\vec{P}$ of magnitude, 4×10^{-6} Cm, is $\pm 9 \times 10^3$ V.

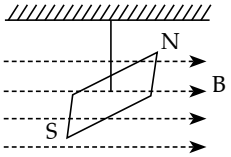
(Take $\frac{1}{4\pi\varepsilon_0} = 9\times10^9$ SI units)

Reason (R): $V = \pm\frac{2P}{4\pi\varepsilon_0 r^2}$, where r is the distance of any axial point, situated at 2 m from the centre of the dipole.

In the light of the above statements, choose the correct answer from the options given below:

(1) A is true but R is false.
(2) A is false but R is true.
(3) Both A and R are true and R is the correct explanation of A.
(4) Both A and R are true and R is NOT the correct explanation of A.

Q. 22. In a uniform magnetic field of 0.049 T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kgm^2. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am^2; then the value of 'x' is:



(1) 50 π^2 **(2)** 1280 π^2 **(3)** 5 π^2 **(4)** 128 π^2

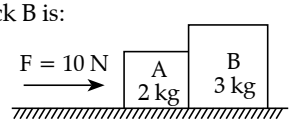
Q. 23. Match List-I with List-II

List-I (Material)	List-II (Susceptibility)
A. Diamagnetic	**I.** $\chi = 0$
B. Ferromagnetic	**II.** $0 > \chi \geq -1$
C. Paramagnetic	**III.** $\chi >> 1$
D. Non-magnetic	**IV.** $0 < \chi < \varepsilon$ (a small positive number)

Choose the correct answer from the options given below:

(1) A-III, B-II, C-I, D-IV
(2) A-IV, B-III, C-II, D-I
(3) A-II, B-III, C-IV, D-I
(4) A-II, B-I, C-III, D-IV

Q. 24. A horizontal force 10 N is applied to a block A as shown in figure. The mass of blocks A and B are 2 kg and 3 kg, respectively. The blocks slide over a frictionless surface. The force exerted by block A on block B is:

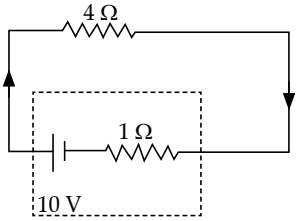


(1) 6 N **(2)** 10 N **(3)** zero **(4)** 4 N

Q. 25. Given below are two statements:
Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.
Statement II: Atoms of each element are stable and emit their characteristic spectrum.
In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is correct but Statement II is incorrect.
(2) Statement I is incorrect but Statement II is correct.
(3) Both Statement I and Statement. II are correct.
(4) Both Statement I and Statement II are incorrect.

Q. 26. The terminal voltage of the battery, whose emf is 10V and internal resistance 1Ω, when connected through an external resistance of 4Ω as shown in the figure is:



(1) 8 V **(2)** 10 V **(3)** 4 V **(4)** 6 V

Q. 27. A wire of length 'l' and resistance 100 Ω is divided into 10 equal parts. The first 5 parts are connected

in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:

(1) 55 Ω **(2)** 60 Ω **(3)** 26 Ω **(4)** 52 Ω

Q. 28. The maximum elongation of a steel wire of 1 m length if the elastic limit of steel and its Young's modulus, respectively, are 8×10^8 Nm^{-2} and 2×10^{11} Nm^{-2}, is:

(1) 40 mm **(2)** 8 mm
(3) 4 mm **(4)** 0.4 mm

Q. 29. A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If surface tension of water is 0.07 Nm^{-1}, then the excess force required to take it away from the surface is:

(1) 1.98 mN **(2)** 99 N
(3) 19.8 mN **(4)** 198 N

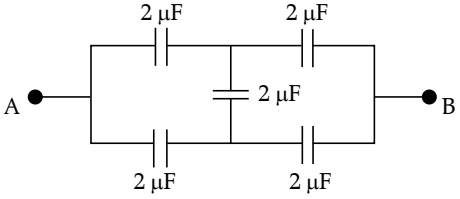
Q. 30. Match List I with List II.

List-I (Spectral Lines of Hydrogen for transitions from)		**List-II (Wavelengths (nm))**	
A.	$n_2 = 3$ to $n_1 = 2$	**I.**	410.2
B.	$n_2 = 4$ to $n_1 = 2$	**II.**	434.1
C.	$n_2 = 5$ to $n_1 = 2$	**III.**	656.3
D.	$n_2 = 6$ to $n_1 = 2$	**IV.**	486.1

Choose the correct answer from the options given below:

(1) A-IV, B-III, C-I, D-II **(2)** A-I, B-II, C-III, D-IV
(3) A-II, B-I, C-IV, D-III **(4)** A-III, B-IV, C-II, D-I

Q. 31. In the following circuit, the equivalent capacitance between terminal A and terminal B is:



(1) 0.5 μF **(2)** 4 μF **(3)** 2 μF **(4)** 1 μF

Q. 32. The mass of a planet is $\frac{1}{10}$th that of the earth and its diameter is half that of the earth. The acceleration due to gravity on that planet is:

(1) 4.9 ms^{-2} **(2)** 3.92 ms^{-2}
(3) 19.6 ms^{-2} **(4)** 9.8 ms^{-2}

Q. 33. The graph which shows the variation of $\left(\frac{1}{\lambda^2}\right)$ and its kinetic energy, E is (where λ is de Broglie wavelength of a free particle):

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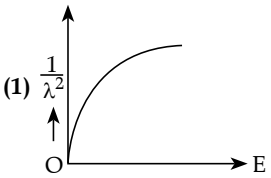
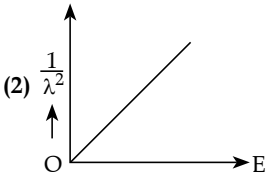


(2)


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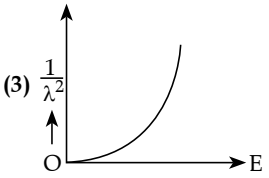

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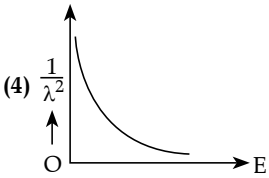
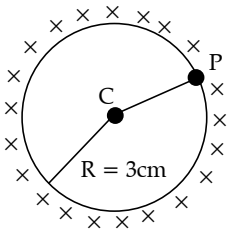


Q. 34. The quantities which have the same dimensions as those of solid angle are:

(1) strain and arc
(2) angular speed and stress
(3) strain and angle
(4) stress and angle

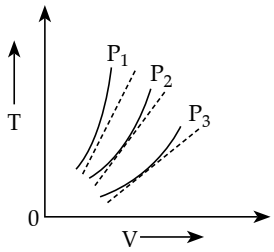
Q. 35. A thin spherical shell is charged by some source. The potential difference between the two points C and P (in V) shown in the figure is:

(Take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ SI units)



(1) 0.5×10^5 **(2)** zero
(3) 3×10^5 **(4)** 1×10^5

Q. 36. The following graph represents the T – V curves of an ideal gas (where T is the temperature and V the volume) at three pressures P_1, P_2 and P_3 compared with those of Charles's law represented as dotted lines.



(1) $P_2 > P_1 > P_3$ **(2)** $P_1 > P_2 > P_3$
(3) $P_3 > P_2 > P_1$ **(4)** $P_1 > P_3 > P_2$

Q. 37. The property which is not of an electromagnetic wave travelling in free space is that :

(1) they travel with a speed equal to $\frac{1}{\sqrt{\mu_o \varepsilon_0}}$

(2) they originate from charges moving with uniform speed.

(3) they are transverse in nature.

(4) the energy density in electric field is equal to energy density in magnetic field.

Q. 38. A small telescope has an objective of focal length 140 cm and an eye piece of focal length 5.0 cm. The magnifying power of telescope for viewing a distant object?

(1) 17 **(2)** 32 **(3)** 34 **(4)** 28

Q. 39. A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates:

(1) displacement current of magnitude equal to I flows in a direction opposite to that of I.

(2) displacement current of magnitude greater than I flows but can be in any direction.

(3) there is no current.

(4) displacement current of magnitude equal to I flows in the same direction as I.

Q. 40. A metallic bar of Young's modulus, 0.5×10^{11} N m^{-2} and coefficient of linear thermal expansion 10^{-5} °C^{-1}, length 1 m and area of cross-section 10^{-3} m^2 is heated from 0°C to 100°C without expansion of bending. The compressive force developed in it is:

(1) 100×10^3 N **(2)** 2×10^3 N

(3) 5×10^3 N **(4)** 50×10^3 N

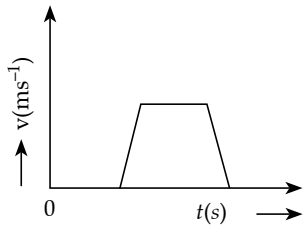
Q. 41. Two heaters A and B have power rating of 1 KW and 2 KW, respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:

(1) 1 : 2 **(2)** 2 : 3 **(3)** 1 : 1 **(4)** 2 : 9

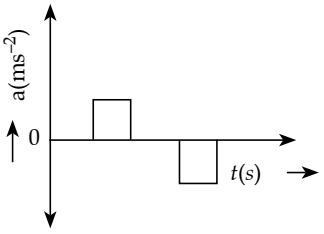
Q. 42. An iron bar of length l has magnetic moment M. It is bent at the middle of its length such that the two arms make an angle 60° with each other. The magnetic moment of this new magnet is:

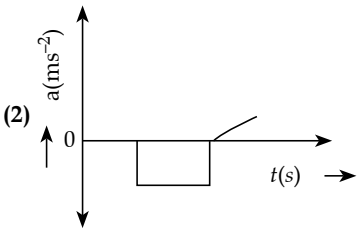
(1) 2 M **(2)** $\frac{M}{\sqrt{3}}$ **(3)** M **(4)** $\frac{M}{2}$

Q. 43. The velocity (v) – time (t) plot of the motion of a body is shown below :



The acceleration (a) – time (t) graph that best suits this motion is :

(1)


(2)


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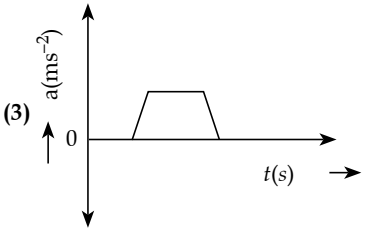

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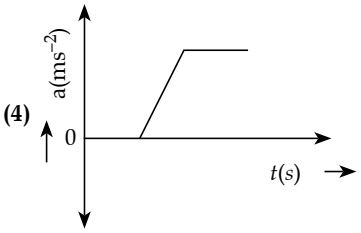
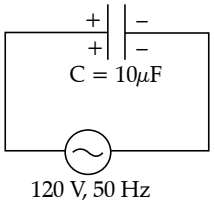


Q. 44. A 10 μF capacitor is connected to a 210 V, 50 Hz source as shown in figure. The peak current in the circuit is nearly ($\pi = 3.14$):

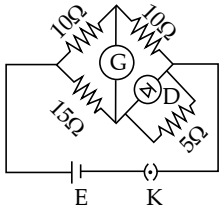


(1) 1.20 A **(2)** 0.35 A **(3)** 0.58 A **(4)** 0.93 A

Q. 45. A force defined by $F = \alpha t^2 + t$ acts on a particle at a given time t. The factor which is dimensionless, if α and β are constants, is:

(1) $\alpha\beta t$ **(2)** $\alpha\beta/t$ **(3)** $\beta t/\alpha$ **(4)** $\alpha t/\beta$

Q. 46. Choose the correct circuit which can achieve the bridge balance.

(1)


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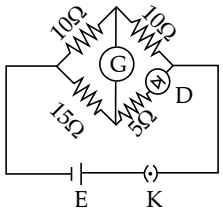

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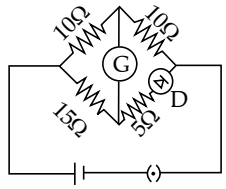
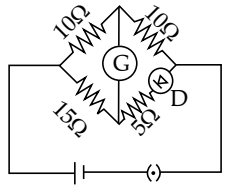


(4)



Q. 47. If the mass of the bob in a simple pendulum is increased to thrice its original mass and its length is made half its original length, then the new time period of oscillation is $\frac{x}{2}$ times its original time period. Then the value of x is

(1) $2\sqrt{3}$ **(2)** 4 **(3)** $\sqrt{3}$ **(4)** $\sqrt{2}$

Q. 48. If the plates of a parallel plate capacitor connected to a battery are moved close to each other, then

A. the charge stored in it. increases.

B. the energy stored in it, decreases.

C. its capacitance increases.

D. the ratio of charge to its potential remains the same.

E. the product of charge and voltage increases.

Choose the most appropriate answer from the options given below:

(1) B, D and B only **(2)** A, B and C only

(3) A, B and E only **(4)** A, C and E only

Q. 49. The minimum energy required to launch a satellite of mass m from the surface of earth of mass M and radius R in a circular orbit at an altitude of 2R from the surface of the earth is:

(1) $\frac{GmM}{2R}$ **(2)** $\frac{GmM}{3R^2}$

(3) $\frac{5GmM}{6R}$ **(4)** $\frac{2GmM}{3R}$

Q. 50. A sheet is placed on horizontal surface in front of a strong magnetic pole. A force is needed to :

A. hold the sheet there is it is magnetic.

B. hold the sheet there if it is non-magnetic.

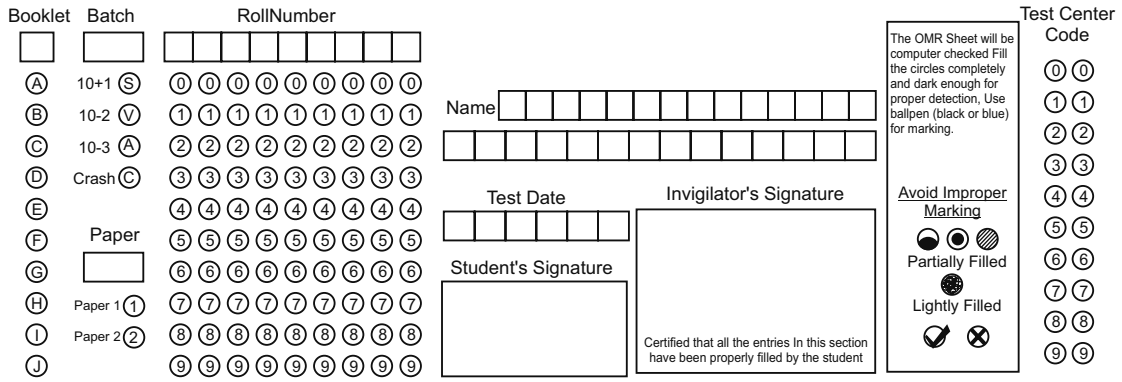
C. move the sheet away from the pole with uniform velocity if it is conducting.

D. move the sheet away from the pole with uniform velocity if it is both, non-conducting and nonpolar.

Choose the correct statement(s) from the options given below:

(1) A, C and D only **(2)** C only

(3) B and D only **(4)** A and C only



1	①	②	③	④
2	①	②	③	④
3	①	②	③	④
4	①	②	③	④
5	①	②	③	④

6	①	②	③	④
7	①	②	③	④
8	①	②	③	④
9	①	②	③	④
10	①	②	③	④

11	①	②	③	④
12	①	②	③	④
13	①	②	③	④
14	①	②	③	④
15	①	②	③	④

16	①	②	③	④
17	①	②	③	④
18	①	②	③	④
19	①	②	③	④
20	①	②	③	④

21	①	②	③	④
22	①	②	③	④
23	①	②	③	④
24	①	②	③	④
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26	①	②	③	④
27	①	②	③	④
28	①	②	③	④
29	①	②	③	④
30	①	②	③	④

31	①	②	③	④
32	①	②	③	④
33	①	②	③	④
34	①	②	③	④
35	①	②	③	④

36	①	②	③	④
37	①	②	③	④
38	①	②	③	④
39	①	②	③	④
40	①	②	③	④

41	①	②	③	④
42	①	②	③	④
43	①	②	③	④
44	①	②	③	④
45	①	②	③	④

46	①	②	③	④
47	①	②	③	④
48	①	②	③	④
49	①	②	③	④
50	①	②	③	④

Answer Key			
Q. No.	**Answer**	**Topic's Name**	**Chapter Name**
PHYSICS			
1	3	Moment of Inertia	Rotational Motion
2	4	Centripetal Force	Laws of Motion
3	3	Workdone in Cyclic Process	Thermodynamics
4	2	Radioactive Decay	Nuclei
5	2	Brewster's Law	Wave Optics
6	4	Einstein's Photo electric Effect	Dual Nature of Matter and Radiation
7	4	Inelastic Collision	Work, Energy and Power
8	4	Refraction of Prism, Critical Angle	Ray Optics
9	4	Simple Harmonic Motion	Oscillations
10	3	Power	Work, Energy and Power
11	1	Magnetic Field in a coil	Magnetic Effects of Current
12	2	Uniform Circular Motion	Motion in a Plane
13	1	Logic Gates	Electronic Devices
14	3	Solar Cells	Electronic Devices
15	4	Transformer	Alternating Current
16	4	Motion of Centre of Mass	Rotational Motion
17	1	Young's Double Slit Experiment	Wave Optics
18	3	Lenz's Law	Electromagnetic Induction
19	4	Vernier Caliper	Experimental Skills
20	2	Logic Gates	Electronic Devices
21	1	Potential due to a dipole	Electric Potential and Capacitance
22	2	Oscillation of a Freely Suspended Magnet	Magnetism and Matter
23	3	Magnetic Materials	Magnetism and Matter
24	1	Motion of Connected Bodies	Laws of Motion
25	1	Atoms	Atoms
26	1	Terminal Potential Difference	Current Electricity
27	4	Combination of Resistances	Current Electricity
28	3	Young's Modulus of Elasticity	Mechanical Properties of Solids
29	3	Surface Energy	Mechanical Properties of Fluids
30	4	Hydrogen Spectrum	Atoms
31	3	Combination of Capacitors	Electric Potential and Capacitance
32	2	Acceleration due to Gravity	Gravitation
33	2	de-Broglie Wavelength	Dual Nature of Matter and Radiation
34	3	Dimensional Analysis	Physics and Measurement
35	2	Potential due to a Spherical Shell	Electic Potential and Capacitance
36	2	Ideal Gas Equation	Kinetic Theory of Gases
37	2	Electromagnetic Waves	Electromagnetic Waves
38	4	Telescope	Ray Optics
39	4	Parallel plate Capacitor	Electric Potential and Capacitance
40	4	Thermal Expansion	Thermal Properties of Matter
41	4	Electric Power	Current Electricity
42	4	Magnetic Moment	Magnetism and Matter

43	1	Velocity-time, Acceleration-time Graphs	Motion in a Straight line
44	4	Purely Capacitive Circuit	Alternating Current
45	4	Dimensional Analysis	Physics and Measurement
46	3	Baising in Diodes	Electronic Devices
47	4	Time Period of a Pendulum	Oscillations
48	4	Capacitor	Electric Potential and Capacitance
49	3	Potential Energy of a Satellite	Gravitation
50	4	Electromagnetic Induction	Electromagnetic Induction

NEET (UG)
Examination
5th May 2024 Paper

ANSWERS WITH EXPLANATION

PHYSICS

1. **Option (3) is correct.**

Explanation: The moment of inertia of a thin rod about an axis passing through its mid-point and perpendicular to the rod is,

$$\frac{ML^2}{12} = 2400$$

$$\Rightarrow \quad L^2 = \frac{12\times 2400}{400} = \sqrt{72}$$

$$\Rightarrow \quad L \approx 8.5 \text{ cm}$$

2. **Option (4) is correct.**

Explanation: Centripetal force $F_c = mr\omega^2 = T$

Now $T' = mr(2\omega)^2$

$= 4mr\omega^2$

$= 4T$

3. **Option (3) is correct.**

Explanation: Along the path *bc*, volume is constant. So, the work done will be zero.

4. **Option (2) is correct.**

Explanation: $^{290}_{82}X \xrightarrow{\alpha} {}^{286}_{80}Y \xrightarrow{e^+} {}^{286}_{79}Z \xrightarrow{\beta^-} {}^{286}_{80}P \xrightarrow{e^-} {}^{286}_{81}Q$

5. **Option (2) is correct.**

Explanation: At Brewster's angle, the reflected light is completely polarised perpendicular to the plane of incidence. This means the reflected light wave's electric field vibrates in a single plane. However, the refracted light is not fully polarised.

6. **Option (4) is correct.**

Explanation: E = hv (statement A is correct)

Photon travels with the speed of light (c), hence statement B is correct.

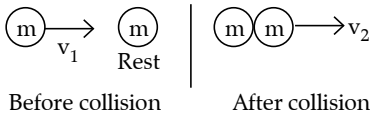
Momentum of photon is $\frac{hv}{c}$, so statement C is correct.

Total energy and momentum are conserved in a photo-electron collision. Statement D is also correct.

Photons are electrically neutral, and are massless. Hence statements E is incorrect.

7. **Option (4) is correct.**

Explanation: Applying principle of conservation of momentum, $mv_1 + 0 = 2mv_2$



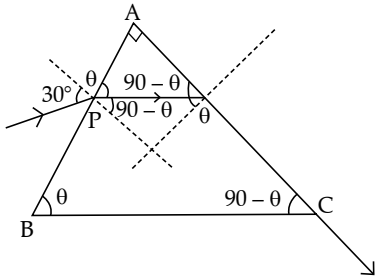
$$\Rightarrow \quad v_2 = \frac{v_1}{2}$$

Now $\frac{v_1}{v_2} = \frac{v_1}{v_1/2} = v_1 \times \frac{2}{v_1} = 2$

$$\Rightarrow \quad v_1 : v_2 = 2 : 1$$

8. **Option (4) is correct.**

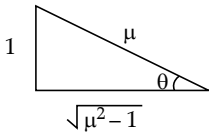
Explanation:



For surface *AC*, using snell's law

$$\mu \sin\theta = 1$$

$$\Rightarrow \quad \sin\theta = \frac{1}{\mu}$$



For Surface AB, using Snell's law

$$\sin 30° = \mu \sin(90 - \theta)$$

$$\sin 30° = \mu \cos\theta$$

$$\frac{1}{2} = \mu \times \frac{\sqrt{\mu^2 - 1}}{\mu}$$

$$\frac{1}{2} = \sqrt{\mu^2 - 1}$$

$$\Rightarrow \quad \mu = \frac{\sqrt{5}}{2}$$

9. **Option (4) is correct.**

Comparing with the equation $x = A \sin(\omega t + \Phi)$

We get $\omega = \pi$ rads^{-1}

$$T = \frac{2\pi}{\omega} = 2 \text{ s}$$

And amplitude is 5 m.

10. **Option (3) is correct.**

Explanation: Instantaneous velocity, $v = \frac{ds}{dt}$

$= \frac{d}{dt}(2t-1) = 2\ \text{ms}^{-1}$

Instantaneous power $P = FV$

$= 5 \times 2 = 10\ \text{W}$

11. Option (1) is correct.

Explanation: Magnetic field $B = \frac{\mu_0 NI}{2R}$

$= \frac{4\pi \times 10^{-7} \times 100 \times 7}{2 \times 10 \times 10^{-2}}$

$= \frac{28\pi \times 10^{-4}}{2}$

$= 14\pi \times 10^{-4}\ \text{T}$

$\approx 44 \times 10^{-4} \times 10^{3}\ \text{mT}$

$\approx 4.4\text{mT}$

12. Option (2) is correct.

Explanation: When a particle moves in a circular path with uniform speed, its velocity is constantly changing because velocity is a vector quantity, and its direction changes as it moves along the circular path. Additionally, since velocity is changing, acceleration is present which is also changing.

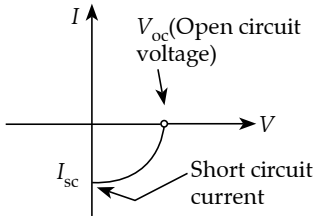
13. Option (1) is correct.

Explanation: Truth table clearly indicates that out (Y) is just inverse of $\overline{B}$ i.e., output Y is B. So, option (1) is correct.

14. Option (3) is correct.

Explanation: In a reverse biased $p - n$ junction diode, the current is due to the minority charge carriers.

And the $I - V$ characteristics of a solar cell is



15. Option (4) is correct.

Explanation: For an ideal transformer

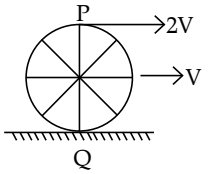
$$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{1}{2}$$

$$\Rightarrow \quad \frac{V_s}{V_p} = \frac{2}{1}$$

Or, $V_s : V_p = 2 : 1$

16. Option (4) is correct.

Explanation:



V = 0

Point P moves at a speed twice the speed of v.

While $v = 0$ (at point Q)

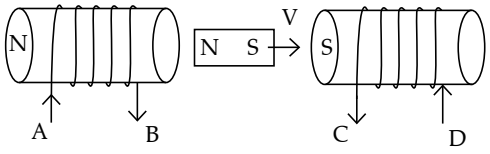
17. Option (1) is correct.

Explanation: White light consists of a mixture of different wavelengths corresponding to various colors. When white light is used in the double-slit experiment, the different colors of light will interfere with each other, creating an interference pattern. However, because each color has a different wavelength, they will interfere differently, resulting in colored fringes. The central fringe will appear white because all colors combine to produce white light, but the surrounding fringes will exhibit colors due to variations in the interference patterns for different wavelengths.

18. Option (3) is correct.

Explanation: According to Lenz's law, the induced magnetic field in a loop of wire will oppose the change in magnetic flux through the loop.

Hence using this law, we get



19. Option (4) is correct.

Explanation: According to the question

$(N + 1)\text{VSD} = N\ \text{MSD}$

So, $1\ \text{VSD} = \left(\frac{N}{N+1}\right)\text{MSD}$

Now vernier constant = 1 MSD – 1 VSD

$= 1\,\text{MSD} - \left(\frac{N}{N+1}\right)\text{MSD}$

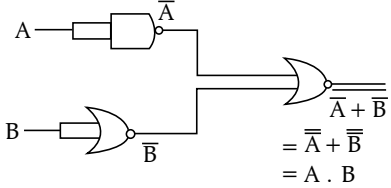
$= \left(\frac{N}{N+1}\right)\text{MSD}$

$= \frac{1}{N+1} \times 0.1\ \text{mm}$

$= \frac{1}{100(N+1)}\text{cm}$

20. Option (2) is correct.

Explanation:



A.B = (AND Gate)

21. Option (1) is correct.

Explanation: Potential at an axial point due to a dipole

$$V = \pm \frac{1}{4\pi\varepsilon_0} \frac{p}{r^2}$$

$$= \pm 9\times10^{9}\times\frac{4\times10^{-6}}{4}$$

$$= \pm 9 \times 10^{3} \text{ volt}$$

So, the assertion is true but the reason is false.

22. Option (2) is correct.

Explanation: Given

$T = \frac{5}{20}$s

$I = 9.8 \times 10^{-6}$ kgm^2

$m = x \times 10^{-5}$ Am^2

$B = 0.049$ T

Now $T = 2\pi\sqrt{\frac{I}{mB}}$

$$\Rightarrow \quad \frac{5}{20} = 2\pi\sqrt{\frac{9.8\times10^{-6}}{x\times10^{-5}\times0.049}}$$

$$\Rightarrow \quad \frac{5}{20} = 2\pi\sqrt{\frac{200\times10^{-1}}{x}}$$

$$\Rightarrow \quad \frac{25}{400} = 4\pi^2\left(\frac{20}{x}\right)$$

$$\Rightarrow \quad x = 16\times4\pi^2 \times 20$$

$$\Rightarrow \quad x = 1280\pi^2$$

23. Option (3) is correct.

Explanation: For diamagnetic material, $0 > \chi \geq -1$

For ferromagnetic material, $\chi >> 1$

For paramagnetic material, $0 < \chi < \varepsilon$ (a small positive number)

For a non-magnetic material, $\chi = 0$

24. Option (1) is correct.

Explanation: Acceleration $a = \frac{10}{5} = 2$ ms^{-2}

Now normal reaction $R = m_B \times a = 3 \times 2 = 6$ N

25. Option (1) is correct.

Explanation: Statement II is incorrect because while atoms of each element do emit characteristic spectra, they are not necessarily always stable. Atoms can undergo various processes such as radioactive decay or chemical reactions, leading to instability and changes in their properties.

26. Option (1) is correct.

Explanation: Terminal potential difference

$V = E - Ir$

$$= 10 - \left(\frac{10}{4+1}\right)\times1$$

$= 10 - 2$

$= 8$ V

27. Option (4) is correct.

Explanation: Resistance of each part

$(R) = \frac{100}{10} = 10\Omega$

The total resistance of series Connection

$R_s = nR = 50\Omega$

The total resistance of parallel connection

$R_p = R/n = 2\Omega$

Now $R_{equivalent} = R_s + R_p$

$= 50 + 2$

$= 52\Omega$

28. Option (3) is correct.

Explanation: Young's modulus, $Y = \frac{\text{stress}}{\frac{\Delta l}{l}}$

$$\Rightarrow \quad \Delta l = \frac{\text{stress}\times l}{Y}$$

$$\Rightarrow \quad \Delta l = \frac{8\times10^{8}\times1}{2\times10^{11}}$$

$$\Rightarrow \quad \Delta l = 4 \times 10^{-3} \text{ m} = 4 \text{ mm}.$$

29. Option (3) is correct.

Explanation: The excess force required

$F = (2\pi R)T$

$= 2\pi \times 4.5 \times 10^{-2} \times 0.07$

$= 9\pi \times 7 \times 10^{-4}$

$= \frac{9\pi\times7}{10}\times10^{-3}$

$= \frac{63\pi}{10}$mN

$= 19.8$ mN

30. Option (4) is correct.

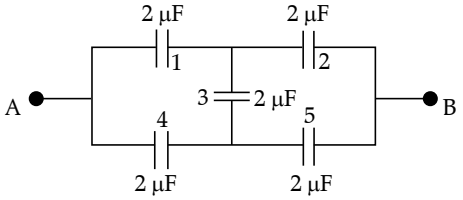
Explanation: We have $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Here value of n_1 is fixed, so $n_2 \propto \frac{1}{\lambda}$

i.e n_2 increases wavelength decreases.

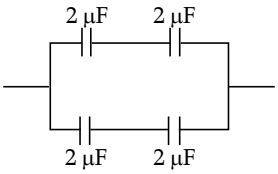
31. Option (3) is correct.

Explanation:



As the bridge is balanced, the capacitor 3 can be neglected.

Hence,



C_1 and C_2 are in series

$C_{S_1} = 1\mu$F

again C_4 and C_5 are in series

$C_{S_2} = 1\mu$F

Now $C = C_{S_1} + C_{S_2} = 1 + 1 = 2\mu$F

32. Option (2) is correct.

Explanation: Acceleration due to gravity, $g = \frac{GM}{R^2}$

Now, $g' = \frac{M/10}{\frac{R^2}{4}} \times G$

$\Rightarrow g' = \frac{GM}{10} \times \frac{4}{R^2} = \frac{4GM}{10R^2}$

$\Rightarrow g' = \frac{4}{10} \times g$

$\Rightarrow g' = \frac{4}{10} \times 9.8 = 3.92 \text{ ms}^{-2}$

33. Option (2) is correct.

Explanation: We have $\lambda = \frac{h}{\sqrt{2mE}}$

$\Rightarrow \sqrt{E} \propto \frac{1}{\lambda}$

$\Rightarrow E \propto \frac{1}{\lambda^2}$

34. Option (3) is correct.

Explanation: Solid angle, strain and angle are dimensionless quantities.

35. Option (2) is correct.

Explanation: Electric potential due to a uniform charged spherical shell is constant everywhere inside the shell and its value is equal to that on the surface of the shell,

Hence $V_c = V_p$

$\therefore$ Potential difference = 0

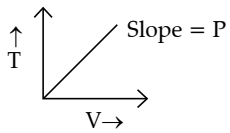
36. Option (2) is correct.

Explanation: From ideal gas equation

$PV = nRT$

$\Rightarrow T = \left(\frac{P}{nR}\right)V$

i.e. $T \propto V$ and slope will be $\frac{P}{nR}$



So, $P_1 > P_2 > P_3$

37. Option (2) is correct.

Explanation: Electromagnetic waves are produced by accelerating charges, not by charges moving with a uniform speed. This is a fundamental characteristic of electromagnetic waves and is known as Maxwell's equations.

38. Option (4) is correct.

Explanation: Magnifying power $m = \frac{f_0}{f_e}$

$= \frac{140}{5}$

$= 28$

39. Option (4) is correct.

Explanation: During the charging process of the capacitor through a resistor connected to a battery, the current I in the circuit primarily flows through the resistor. Simultaneously, there is a changing electric field between the plates of the capacitor, which induces a displacement current. According to Ampere's law with Maxwell's addition, the displacement current is equal in magnitude to the conduction current (I) and flows in the same direction.

40. Option (4) is correct.

Explanation: $F = Y A \alpha \Delta\theta$

$= 0.5 \times 10^{11} \times 10^{-3} \times 10^{-5} \times 100$

$= 50 \times 10^3 \text{ N}$

41. Option (4) is correct.

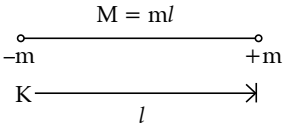
Explanation: $P_S = \frac{P_1 P_2}{P_1 + P_2} = \frac{2}{3}$ kW

$P_P = P_1 + P_2 = 3$ kW

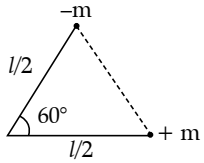
Now $\frac{P_S}{P_P} = \frac{2/3}{3} = \frac{2}{9}$

42. Option (4) is correct.

Explanation:



When the rod is bent at the middle,



$l_{\text{eff}} = 2 \times \frac{l}{2} \sin 30$

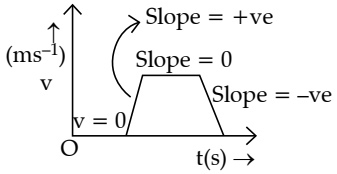
$= \frac{l}{2}$

So, $M' = m \times \frac{l}{2}$

$\Rightarrow M' = \frac{M}{2}$

43. Option (1) is correct.

Explanation:



So, option (1) will be the corresponding acceleration-time graph.

44. Option (4) is correct.

Explanation:

$V_{rms} = 210$ V

$= V_0 = 210\sqrt{2}$ V

$$I_0 = \frac{V_0}{X_C}$$
$$= V_0\omega C = V_0 \times 2\pi f \times C$$
$$= 210\sqrt{2} \times 2\pi \times 50 \times 10 \times 10^{-6}$$
$$= 0.93 \text{ A}$$

45. Option (4) is correct.

Explanation: $F = \alpha t^2 + \beta t$

Now $[\alpha T^2] = [M^1L^1T^{-2}]$

and $[\beta T] = [M^1L^1T^{-2}]$

So, $[\alpha] = [M^1L^1T^{-4}]$

and $[\beta] = [M^1L^1T^{-3}]$

Now $\left[\frac{\alpha t}{\beta}\right] = \frac{[M^1L^1T^{-4}] \times [T]}{[M^1L^1T^{-3}]}$

$= [M^0L^0T^0]$

46. Option (3) is correct.

Explanation: In fig - 1; the network is short circuited.

In fig - 4; the diode is in reverse biased.

In fig - 2; the diode is in reverse biased.

If fig - 3; the diode is in forward biased and bridge can be balanced if

$$\frac{P}{Q} = \frac{R}{S}$$
$$\frac{10}{15} = \frac{10}{5 + R_d}$$
$$R_d = 10\ \Omega$$

47. Option (4) is correct.

Explanation: Time period of a pendulum

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Now $T' = 2\pi\sqrt{\frac{l}{2g}} = \frac{1}{\sqrt{2}}T$

$$\Rightarrow \frac{x}{2} \times T = \frac{1}{\sqrt{2}}T$$
$$\Rightarrow \sqrt{2}x = 2$$
$$\Rightarrow x = \frac{2}{\sqrt{2}} = \sqrt{2}$$

48. Option (4) is correct.

Explanation: $C = \frac{\varepsilon_0 A}{d}$

if d decreases, then C increases.

As the battery is connected, then V = constant

Now $q \propto C$

i.e., if C increases, q also increases.

and we have energy stored $U = \frac{1}{2}CV^2$

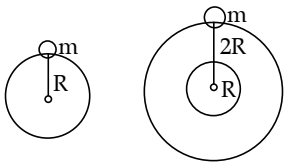
as C increases, U also increases.

$\frac{q}{V} = C$ increases

qV will also increase.

49. Option (3) is correct.

Explanation:



$$W = E_2 - E_1$$
$$= \frac{-GMm}{2 \times 3R} + \frac{GMm}{R}$$
$$= \frac{-GMm + 6GMm}{6R}$$
$$= \frac{5GMm}{6R}$$

50. Option (4) is correct.

Explanation:

Let's analyse each statement

A. Hold the sheet there if it is magnetic.

This statement seems correct because a magnetic material in a magnetic field would experience a force of attraction or repulsion. So, to hold the place we must apply some force.

B. Hold the sheet there if it is non-magnetic.

Non-magnetic materials do not interact strongly with magnetic fields, so they would not require a force to hold them in place in front of a magnetic pole.

C. Move the sheet away from the pole with uniform velocity if it is conducting.

If the sheet is conducting and moving away from the pole with uniform velocity, then eddy current will produced in the sheet and an electromagnetic force of attraction will be generated. To overcome this force, we must apply some force.

D. Move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar. Since non-conducting and non-polar materials don't interact significantly with magnetic fields, they wouldn't require a force to move away from the pole with uniform velocity.

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