SOLVED PAPER	NEET (UG) 17th July 2022	Code Q3

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. An electric lift with a maximum load of 2000 kg (lift + passengers) is moving up with a constant speed of 1.5 ms^{-1} The frictional force opposing the motion is 3000 N. The maximum power delivered by the motor to the lift in watts is : (g = 10 ms^{-2})

(1) 23000 **(2)** 20000

(3) 34500 **(4)** 23500

Q. 2. Two hollow conducting spheres of radii R_1 and R_2 ($R_1 >> R_2$) have equal charges. The potential would be :

(1) more on bigger sphere

(2) more on smaller sphere

(3) equal on both the spheres

(4) dependent on the material property of the sphere

Q. 3. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio 2 : 2 : 1. If the fragments having equal mass fly off along mutually perpendicular directions with speed v, the speed of the third (lighter) fragment is :

(1) v **(2)** $2\sqrt{2}\,v$

(3) $2\sqrt{2}\,v$ **(4)** $3\sqrt{2}\,v$

Q. 4. As the temperature increases, the electrical resistance :

(1) increases for both conductors and semiconductors

(2) decreases for both conductors and semiconductors

(3) increases for conductors but decreases for semiconductors

(4) decreases for conductors but increases for semiconductors

Q. 5. A long solenoid of radius 1 mm has 100 turns per mm. If 1 A current flows in the solenoid, the magnetic field strength at the centre of the solenoid is :

(1) 6.28×10^{-2} T **(2)** 12.56×10^{-2} T

(3) 12.56×10^{-4} T **(4)** 6.28×10^{-4} T

Q. **6.** If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is :

(1) 1 : 1 **(2)** $\sqrt{2}$: 1

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

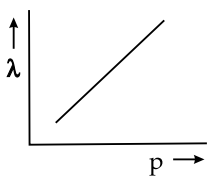
Q. 7. Two objects of mass 10 kg and 20 kg respectively are connected to the two ends of a rigid rod of length 10 m with negligible mass. The distance of the center of mass of the system from the 10 kg mass is :

(1) $\frac{10}{3}$m **(2)** $\frac{20}{3}$ m

(3) 10 m **(4)** 5 m

Q. 8. The graph which shows the variation of the de Broglie wavelength (λ) of a particle and its associated momentum

(1)



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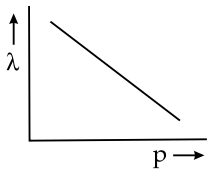

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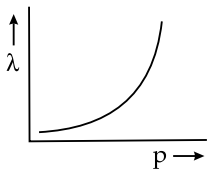

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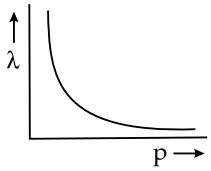
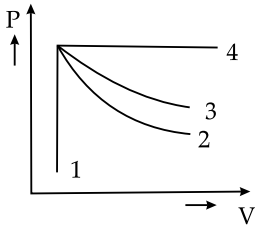


Q. 9. An ideal gas undergoes four different processes from the same initial state as shown in the figure below. Those processes are adiabatic, isothermal, isobaric and isochoric. The curve which represents the adiabatic process among 1, 2, 3 and 4 is :



(1) 1 **(2)** 2

(3) 3 **(4)** 4

Q. 10. Plane angle and solid angle have :

(1) Units but no dimensions

(2) Dimensions but no units

(3) No units and no dimensions

(4) Both units and dimensions

Q. 11. The angle between the electric lines of force and the equipotential surface is :

(1) 0° **(2)** 45°

(3) 90° **(4)** 180°

Q. 12. A copper wire of length 10 m and radius $(10^{-2} / \sqrt{\pi})$ m has electrical resistance of 10 Ω. The current density in the wire for an electric field strength of 10 (V/m) is :

(1) 10^4 A/m^2 **(2)** 10^6 A/m^2

(3) 10^{-5} A/m^2 **(4)** 10^5 A/m^2

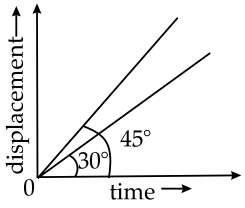
Q. 13. In the given nuclear reaction, the element X is :

$${}^{23}_{11}\text{Na} \rightarrow \text{X} + e^+ + \nu$$

(1) ${}^{23}_{11}\text{Na}$ **(2)** ${}^{23}_{10}\text{Ne}$

(3) ${}^{22}_{10}\text{Ne}$ **(4)** ${}^{22}_{12}\text{Mg}$

Q. 14. The displacement-time graphs of two moving particles make angles of 30° and 45° with the *x*-axis as shown in the figure. The ratio of their respective velocity is :



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

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

Q. 15. In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be :

(1) zero **(2)** 30 Hz

(3) 60 Hz **(4)** 120 Hz

Q. 16. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is :

(1) 2 : 1 **(2)** $\sqrt{2}:1$

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

Q. 17. When two monochromatic lights of frequency, ν and $\frac{\nu}{2}$ are incident on a photoelectric metal, their stopping potential becomes $\frac{V_s}{2}$ and V_s respectively. The threshold frequency for this metal is :

(1) 2ν **(2)** 3ν

(3) $\frac{2}{3}\nu$ (4) $\frac{3}{2}\nu$

Q. 18. The dimensions $[MLT^{-2}A^{-2}]$ belong to the :

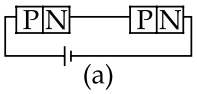
(1) magnetic flux

(2) self inductance

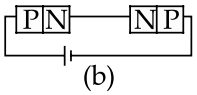
(3) magnetic permeability

(4) electric permittivity

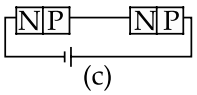
Q. 19.



(a)



(b)



(c)

In the given circuits (a), (b) and (c), the potential drop across the two *p-n* junctions are equal in :

(1) Circuit (a) only

(2) Circuit (b) only

(3) Circuit (c) only

(4) Both circuits (a) and (c)

Q. 20. The energy that will be ideally radiated by a 100 kW transmitter in 1 hour is :

(1) 36×10^7 J **(2)** 36×10^4 J

(3) 36×10^5 J **(4)** 1×10^5 J

Q. 21. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600 nm wavelength is used. If the wavelength of light is changed to 400 nm, then the number of fringes he would observe in the same-region of the screen is :

(1) 6 **(2)** 8

(3) 9 **(4)** 12

Q. 22. The peak voltage of the ac source is equal to:

(1) the value of voltage supplied to the circuit

(2) the rms value of the ac source

(3) $\sqrt{2}$ times the rms value of the ac source

(4) $1/\sqrt{2}$ times the rms value of the ac source

Q. 23. If a soap bubble expands, the pressure inside the bubble :

(1) decreases

(2) increases

(3) remains the same

(4) is equal to the atmospheric pressure

Q. 24. A biconvex lens has radii of curvature, 20 cm each. If the refractive index of the material of the lens is 1.5, the power of the lens is :

(1) + 2 D **(2)** + 20 D

(3) + 5 D **(4)** infinity

Q. 25. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second:

(1) 1 : 2 : 3 : 4

(2) 1 : 4 : 9 : 16

(3) 1 : 3 : 5 : 7

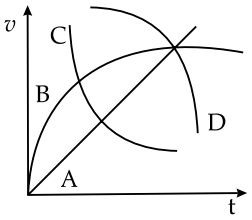
(4) 1 : 1 : 1 : 1

Q. 26. The angular speed of a fly wheel moving with uniform angular acceleration changes from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration in rad/s^2 is :

(1) 2 π **(2)** 4 π

(3) 12 π **(4)** 104 π

Q. 27. A spherical ball is dropped in a long column of a highly viscous liquid. The curve in the graph shown, which represents the speed of the ball (v) as a function of time (t) is :



(1) A **(2)** B

(3) C **(4)** D

Q. 28. Let T_1 and T_2 be the energy of an electron in the first and second excited states of hydrogen atom, respectively. According to the Bohr's model of an atom, the ratio $T_1 : T_2$ is :

(1) 1 : 4 **(2)** 4 : 1

(3) 4 : 9 **(4)** 9 : 4

Q. 29. A square loop of side 1 m and resistance 1 Ω is placed in a magnetic field of 0.5 T. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is :

(1) 2 weber **(2)** 0.5 weber

(3) 1 weber **(4)** zero weber

Q. 30. Two resistors of resistance, 100 Ω and 200 Ω are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in 100 Ω to that in 200 Ω in a given time is :

(1) 1 : 2 **(2)** 2 : 1

(3) 1 : 4 **(4)** 4 : 1

Q. 31. Given below are two statements :

Statement I :

Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only.

Statement II :

Biot-Savart's law is analogous to Coulomb's inverse square law of charge q, with the former being related to the field produced by a scalar source. Idl while the latter being produced by a vector source, q.

In light of above statements choose the most appropriate answer from the options given below :

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is correct and Statement II is incorrect

(4) Statement I is incorrect and Statement II is correct

Q. 32. Match List-I with List-II :

	List-I (Electromagnetic Waves)	**List-II (Wavelength)**
(1)	AM radio waves	(i) 10^{-10} m
(2)	Microwaves	(ii) 10^{2} m
(3)	Infrared radiations	(iv) 10^{-2} m
(4)	X-rays	(iv) 10^{-4} m

(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(2) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)

(3) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(4) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Q. 33. A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60°. The angle between the refracted and reflected rays would be :

(1) 30° **(2)** 60°

(3) 90° **(4)** 120º

Q. 34. When light propagates through a material medium of relative permittivity ε_r and relative permeability μ_r, the velocity of light, v is given : (c-velocity of light in vacuum) :

(1) $v = c$ **(2)** $v = \sqrt{\frac{\mu_r}{\varepsilon_r}}$

(3) $v = \sqrt{\frac{\varepsilon_r}{\mu_r}}$ **(4)** $v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$

Q. 35. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is :

(1) 0.05 N/kg **(2)** 50 N/kg

(3) 20 N/kg **(4)** 180 N/kg

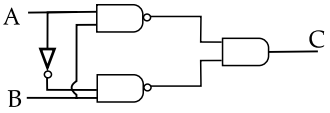
Section—B

Q. 36. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is :

(1) 11 **(2)** 9

(3) 10 **(4)** 8

Q. 37.



The truth table for the given logic circuit is :

(1)

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

(2)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

(3)

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

(4)

A	B	C
0	0	0
0	1	1
1	0	0
1	1	1

Q. 38. A series LCR circuit with inductance 10 H, capacitance 10 μF, resistance 50 Ω is connected to an ac source of voltage, V = 200 sin (100t) volt. If the resonant frequency of the LCR circuit is ν_o and the frequency of the ac source is ν, then:

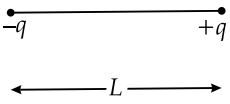
(1) $\nu_o = \nu = 50$ Hz

(2) $\nu_o = \nu = \frac{50}{\pi}$ Hz

(3) $\nu_o = \frac{50}{\pi}$ Hz, $\nu = 50$ Hz

(4) $\nu = 100$ Hz, $\nu_o = \frac{100}{\pi}$ Hz

Q. 39. Two points charges – q and + q are placed at a distance of L, as shown in the figure :

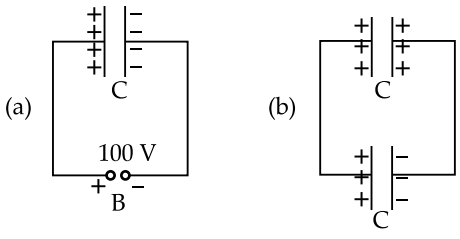


The magnitude of electric field intensity at a distance R ($R >> L$) varies as :

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

(3) $\frac{1}{R^4}$ **(4)** $\frac{1}{R^6}$

Q. 40. A capacitor of capacitance C = 900 pF is charge fully by 100 V battery B as shown in figure (a). Then it is disconnected from the battery and connected to another uncharged capacitor of capacitance C = 900 pF as shown in figure (b). The electrostatic energy stored by the system (b) is:



(1) 4.5×10^{-6} J **(2)** 3.25×10^{-6} J

(3) 2.25×10^{-6} J **(4)** 1.5×10^{-6} J

Q. 41. Given below are two statements : One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : The stretching of a spring is determined by the shear modulus of the material of the spring.

Reason (R) : A coil spring of copper has more tensile strength than a steel spring of same dimensions.

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

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

Q. 42. The transparent media A and B are separated by a plane boundary. The speed of light in those media are 1.5×10^8 m/s and 2.0×10^8 m/s, respectively. The critical angle for a ray of light for these two media is :

(1) $\sin^{-1}(0.500)$ **(2)** $\sin^{-1}(0.750)$

(3) $\tan^{-1}(0.500)$ **(4)** $\tan^{-1}(0.750)$

Q. 43. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is :

(1) 5.6×10^6 m^3 **(2)** 5.6×10^3 m^3

(3) 5.6×10^{-3} m^3 **(4)** 5.6 m^3

Q. 44. A nucleus of mass number of 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is :

(1) 1 : 1 **(2)** 4 : 5

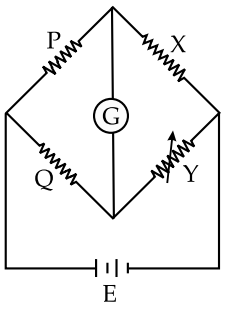
(3) 5 : 4 **(4)** 25 : 16

Q. 45. The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is :

(1) 138×10^1 **(2)** 1382

(3) 1382.5 **(4)** 14×10^2

Q. 46. A wheatstone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q :



(1) should be approximately equal to 2X

(2) should be approximately equal and are small

(3) should be very large and unequal

(4) do not play any significant role

Q. 47. A ball is projected with a velocity, 10 ms^{-1}, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be :

(1) Zero **(2)** $5\sqrt{3}$ ms^{-1}

(3) 5 ms^{-1} **(4)** 10 ms^{-1}

Q. 48. Match List-I with List-II :

	List-I		**List-II**
(1)	Gravitation constant (G)	(i)	$[L^2T^{-2}]$
(2)	Gravitational potential energy	(ii)	$[M^{-1}L^3T^{-2}]$
(3)	Gravitational potential	(iii)	$[LT^{-2}]$
(4)	Gravitational intensity	(iv)	$[ML^2T^{-2}]$

Choose the correct answer from the options given below :

(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(2) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

(3) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

(4) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

Q. 49. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is :

(1) uniform and remains constant for both the regions

(2) a linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region

(3) a linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $1/r$ dependence for the outside region.

(4) a linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region

Q. 50. A big circular coil of 1000 turns and average radius 10 m is rotating about its horizontal diameter at 2 rad s^{-1}. If the vertical component of earth's magnetic field at that place is 2×10^{-5} T and electrical resistance of the coil is 12.56 Ω, then the maximum induced current in the coil will be :

(1) 0.25 A **(2)** 1.5 A

(3) 1 A **(4)** 2 A

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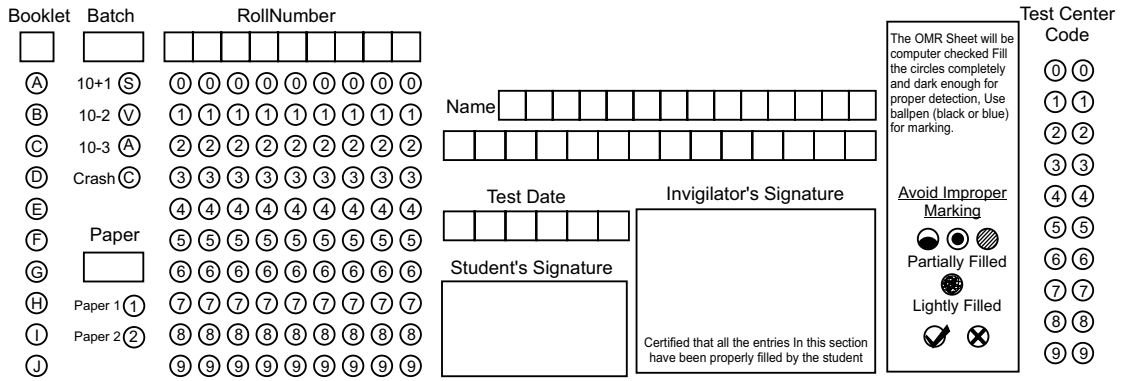


1	①	②	③	④
2	①	②	③	④
3	①	②	③	④
4	①	②	③	④
5	①	②	③	④

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
25	①	②	③	④

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

Q. No.	Answer Key	Topic's Name	Chapter's Name
		SECTION-A (PHYSICS)	
1	3	Work, Energy and Power	Work, Energy and Power
2	2	Electrostatic Potential and Capacitance	Electrostatics
3	3	Laws of Motion	Laws of Motion
4	3	Electronic Devices	Electronic Devices
5	2	Magnetic Effects of Current	Magnetic Effects of Current and Magnetism
6	3	Waves	Oscillations and Waves
7	2	Motion of System of Particles and Rigid Body	Motion of System of Particles and Rigid Body
8	4	Dual Nature of Matter and Radiation	Dual Nature of Matter and Radiation
9	2	Thermodynamics	Thermodynamics
10	1	Units and Measurement	Physical World and Measurement
11	3	Electrostatic Potential and Capacitance	Electrostatics
12	4	Current Electricity	Current Electricity
13	3	Nuclei	Atoms and Nuclei
14	4	Motion in a Straight Line	Kinematics
15	3	Electronic Devices	Electronic Devices
16	2	Motion of System of Particles and Rigid Body	Motion of System of Particles and Rigid Body
17	1	Dual Nature of Matter and Radiation	Dual Nature of Matter and Radiation
18	3	Units and Measurement	Physical World and Measurement
19	4	Electronic Devices	Electronic Devices
20	1	Work, Energy and Power	Work, Energy and Power
21	4	Wave Optics	Wave Optics
22	3	Alternating Current	Electromagnetic Induction and Alternating Current
23	1	Mechanical Properties of Fluids	Properties of Bulk Matter
24	3	Ray Optics and Optical Instruments	Optics
25	3	Motion in a Straight Line	Kinematics
26	2	Motion of System of Particles and Rigid Body	Motion of System of Particles and Rigid Body
27	2	Mechanical Properties of Fluids	Properties of Bulk Matter
28	4	Atoms	Atoms and Nuclei
29	2	Magnetic Effects of Current	Magnetic Effect of Current and Magnetism
30	2	Current Electricity	Current Electricity
31	3	Magnetic Effects of Current	Magnetic Effects of Current and Magnetism
32	4	Electromagnetic Waves	Electromagnetic Waves
33	3	Ray Optics and Optical Instruments	Optics
34	4	Electromagnetic Waves	Electromagnetic Waves
35	2	Gravitation	Gravitation

Q. No.	Answer Key	Topic's Name	Chapter's Name
		SECTION-B (PHYSICS)	
36	1	Oscillations	Oscillations and Waves
37	3	Electronic Devices	Electronic Devices
38	2	Alternating Current	Electromagnetic Induction and Alternating Current
39	2	Electric Charges and Fields	Electrostatics
40	3	Electrostatic Potential and Capacitance	Electrostatics
41	3	Mechanical Properties of Solids	Properties of Bulk Matter
42	2	Ray Optics and Optical Instruments	Optics
43	4	Behavior of Perfect Gas and Kinetic Theory	Behavior of Perfect Gas and Kinetic Theory
44	3	Nuclei	Atoms and Nuclei
45	4	Units and Measurements	Physical World and Measurement
46	2	Current Electricity	Current Electricity
47	2	Concept of Vector and Motion in a Plane	Kinematics
48	2	Gravitation	Gravitation
49	3	Magnetics Effects of Current	Magnetic Effect of Current and Magnetism
50	3	Electromagnetic Induction	Electromagnetic Induction and Alternating Current

NEET (UG)
17th July 2022 Paper

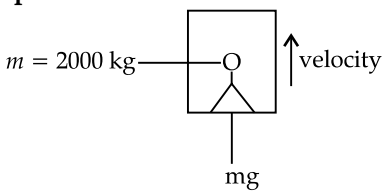
ANSWERS WITH EXPLANATION

PHYSICS

Section—A

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

Explanation:



$$T = W + f$$
$$= mg + f$$
$$= (2000)\,(10) + 3000$$
$$= 23000 \text{ N}$$
$$\text{Power} = \text{Force} \times \text{velocity}$$
$$= 23000 \times 1.5$$
$$= 34500 \text{ W}$$

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

Explanation: As,

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r},$$

or, $$V \propto \frac{1}{r}$$

Hence, lesser the radius/distance, more will be the potential.

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

Explanation: By law of conservation of momentum,

$$m \times 0 = \frac{2m}{5}(-v\hat{i}) + \frac{2}{5}m(v\hat{j}) + \frac{m}{5}(v')$$

$$\Rightarrow \quad m(0) = (-2mv\hat{i}) + (2mv\hat{j}) + (mv')$$

$$\Rightarrow \quad v' = \sqrt{(2v)^2 + (2v)^2}$$

$$\Rightarrow \quad v' = \sqrt{8v^2}$$

$$\Rightarrow \quad v' = 2\sqrt{2}\,v$$

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

Explanation: As temperature increases, the electrical resistance decreases for semi-conductors and insulators while increases for conductors.

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

Explanation: $$B = \mu_0 nI = \frac{\mu_0 N}{l} I$$

$$\therefore \quad B = 4\pi \times 10^{-7} \times \frac{100}{1\times10^{-3}} \times 1$$

$$= 12.56 \times 10^{-2} \text{ T}$$

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

Explanation: $$v \propto \sqrt{T}$$

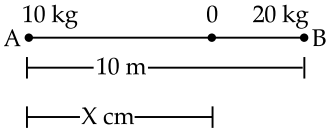
$$\frac{v_i}{v_f} = \sqrt{\frac{T_1}{T_2}}$$

$$\Rightarrow \quad \frac{v_i}{v_f} = \sqrt{\frac{T}{2T}}$$

$$v_i : v_f = 1 : \sqrt{2}$$

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

Explanation:



$$X_{cm} = \frac{M_1 \times M_2}{M_1 + M_2}$$
$$= \frac{10\times20}{10+20}$$
$$= \frac{200}{30} = \frac{20}{3} \text{m}$$

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

Explanation:

$$\text{As, } \lambda = \frac{h}{p}$$

i.e., $$\lambda \propto \frac{1}{p}$$

Hence, the graph will be hyperbolic.

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

Explanation: The given processes are;

1 → Isochoric

2 → Adiabatic

3 → Isothermal

$4 \rightarrow$ Isobaric

10. Option (1) is correct.

Explanation: Plane angle and solid angle are dimensionless, while having units.

11. Option (3) is correct.

Explanation: Electric field lines are always perpendicular to the equipotential surface.

12. Option (4) is correct.

Explanation: Given: $l = 10$ m, $r = \frac{10^{-2}}{\pi} m$,

$R = 10\ \Omega$, $E = 10$ V/m

As, $J = \rho E$

or, $J = \frac{E}{\rho} = \frac{El}{RA}$

$= \frac{10 \times 10}{10 \times \pi r^2}$

$= \frac{10 \times 10}{10 \times 3.14 \times \left(\frac{10^{-2}}{\pi}\right)^2}$

$= \frac{10 \times 10 \times (3.14)^2}{10 \times 3.14 \times 10^{-4}}$

$= 3.14 \times 10^5$ A/m^2

13. Option (3) is correct.

Explanation: The represented or given reaction shows β^+-decay.

Hence, ${}^{22}_{11}\text{Na} \longrightarrow {}^{22}_{10}\text{Ne} + e^+ + \nu$

14. Option (4) is correct.

Explanation: Slope of displacement-time graph gives velocity.

$$\text{Slope} = v = \frac{dx}{dt} = \tan\theta$$

Hence, $\frac{v_1}{v_2} = \frac{\tan\theta_1}{\tan\theta_2} = \frac{\tan 30°}{\tan 45°}$

$\frac{v_1}{v_2} = \frac{1}{\sqrt{3}}$

15. Option (3) is correct.

Explanation: In half-wave rectification,

input frequency = output frequency

16. Option (2) is correct.

Explanation: $I_1 = \frac{Mr^2}{2}$ (about at centre)

$I_2 = \frac{Mr^2}{4}$ (about at diameter)

As, $I = MK^2$

Hence, $K = \sqrt{\frac{I}{M}}$

$\frac{K_1}{K_2} = \sqrt{\frac{I_1}{I_2}}$

$= \sqrt{\frac{\frac{Mr^2}{2}}{\frac{Mr^2}{4}}}$

$= \sqrt{2} : 1$

17. Option (1) is correct.

Explanation: Apply Einstein's photoelectric equation

$$eV_s = h\nu - h\nu_0$$

or, $\nu_0 = \frac{h\nu - eV_s}{h}$ …(i)

From first condition,

$\nu \rightarrow \nu$ and $V_s \rightarrow \frac{V_s}{2}$

From equation (i)

$$\nu_0 = \left(h\nu - e\frac{V_s}{2}\right)\Big/h$$

$\nu_0 = \frac{2h\nu - eV_s}{2h}$ …(ii)

Again apply second condition,

$\nu \rightarrow \frac{\nu}{2}$ and $V_s \rightarrow V_s$

From equation (i),

$\nu_0 = \frac{h\nu - 2eV_s}{2h}$ …(iii)

Now, from equation (ii) and (iii)

$$2h\nu - eV_s = h\nu - 2eV_s$$

or, $h\nu = -eV_s$ …(iv)

Now from equation (i) and (iv)

$$\nu_0 h = h\nu + h\nu$$

$$\nu_0 = 2\nu$$

18. Option (3) is correct.

Explanation: Dimensions of given options are as follows;

(1) Magnetic flux — $[ML^2T^{-2}A^{-1}]$

(2) Self inductance — $[ML^2T^{-2}A^{-2}]$

(3) Magnetic permeability — $[ML^2T^{-2}A^{-2}]$

(4) Electric permittivity — $[M^{-1}L^{-3}T^4A^2]$

Hence, the option (3) is correct.

19. Option (4) is correct.

Explanation: The potential drop will be equal in both circuits (a) and (c), as both the junctions are in forward biasing, and hence offers equal resistance.

20. Option (1) is correct.

Explanation: As, energy = power × time

Hence, $E = 100 \times 10^3 \times 1 \times 60 \times 60$

$= 360000 \times 10^3$

$= 36 \times 10^7$ J

21. Option (4) is correct.

Explanation: In YDSE,

$$x = (n\lambda)\left(\frac{D}{d}\right)$$

According to question,

$$(n_1\lambda_1)\left(\frac{D}{d}\right) = (n_2\lambda_2)\left(\frac{D}{d}\right)$$

$= 8 \times 600 \times 10^{-9} = n_2 \times 400 \times 10^{-9}$

$$= n_2 = \frac{8\times600\times10^{-9}}{400\times10^{-9}} = 12$$

22. Option (3) is correct.

Explanation: Peak voltage is always $\sqrt{2}$ times of rms voltages in a.c.

$$V_0 = \sqrt{2}\, V_{rms}$$

23. Option (1) is correct.

Explanation: For soap bubble, $P - P_0 = \frac{4T}{R}$

As pressure is inverse in relation with radius, hence the pressure decreases as the soap bubble expands or radius increases.

24. Option (3) is correct.

Explanation: Given: $R_1 = R_2 = 20$ cm $= 0.2$m, $\mu = 1.5$

Power, $$P = \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$P = (1.5 - 1)\left\{\frac{1}{0.2} - \left(\frac{1}{-0.2}\right)\right\}$$

$$\begin{bmatrix}\text{for biconvex lens,}\\ R_1 = +ve\\ R_2 = -ve\end{bmatrix}$$

$$P = 0.5\left(\frac{1}{0.2} + \frac{1}{0.2}\right)$$

$$P = 0.5 \times \frac{2}{0.2} = 5\text{D}$$

25. Option (3) is correct.

Explanation: As,

$$S_{nth} = u + \frac{a}{2}(2n - 1)$$

Hence, $$S_{1st} = \frac{a}{2}\{2(1) - 1\} = \frac{a}{2}(1)$$

$$S_{2nd} = \frac{a}{2}\{2(2) - 1\} = \frac{a}{2}(3)$$

$$S_{3rd} = \frac{a}{2}\{2(3) - 1\} = \frac{a}{2}(5)$$

$$S_{4th} = \frac{a}{2}\{2(4) - 1\} = \frac{a}{2}(7)$$

As the body is freely falling, the initial velocity is zero and $a = g$ in above each case.

Now, $S_{1st} : S_{2nd} : S_{3rd} : S_{4th} = 1 : 3 : 5 : 7$

26. Option (2) is correct.

Explanation: Given:

$\omega_0 = 1200$ rpm

$\omega = 3120$ rpm

$t = 16$ seconds

$$\alpha = \frac{\omega - \omega_0}{t}$$

$$= \frac{3120 - 1200}{16}$$

$$= \frac{1920}{16} \text{ rpm}$$

$$= \frac{1920}{16} \times \frac{2\pi}{60} \text{ rad/s}^2$$

$= 4\pi$ rad/s^2

27. Option (2) is correct.

Explanation: Initially the velocity of the body falling in a viscous fluid increases but after some time it acquires a constant velocity known as terminal velocity. This is shown by point B.

28. Option (4) is correct.

Explanation: For first excited state, $n_1 = 2$

And for second excited state, $n_2 = 3$

As, $$T = -13.6\frac{z^2}{n^2}$$

$$T_1 = -13.6 \times \frac{(1)^2}{(2)^2}$$

$$T_2 = -13.6 \times \frac{(1)^2}{(3)^2}$$

$$T_1 : T_2 = \frac{1}{4} : \frac{1}{9} = 9 : 4$$

29. Option (2) is correct.

Explanation: Given:

$$a = 1\text{m}$$

$$R = 1\Omega$$

$$B = 0.5\text{T}$$

$$\text{Area of square} = (\text{side})^2 = a^2 = 1\ \text{m}^2$$

$$\phi = BA\cos\theta$$

$$= 0.5 \times 1 \times \cos 0°$$

$$= 0.5 \times 1 \times 1$$

$$= 0.5\ \text{Weber}$$

30. Option (2) is correct.

Explanation: In parallel combination, the potential remains same or constant.

As, $$P = \frac{V^2}{R}$$

$$P \propto \frac{1}{R}$$

$$\therefore \quad \frac{P_1}{P_2} = \frac{R_2}{R_1} = \frac{200}{100}$$

$$P_1 : P_2 = 2 : 1$$

And, $$P = \frac{\text{Work done/Energy}}{\text{time taken}}$$

$$P \propto E \quad \text{(at same duration)}$$

$$\therefore \quad E_1 : E_2 = 2 : 1$$

31. Option (3) is correct.

Explanation: As, $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\vec{dl}\sin\theta}{r^2}$, so the statement I is correct.

Statement-II is wrong as Biot Savart's law depends on current carrying element, which is also a vector quantity.

32. Option (4) is correct.

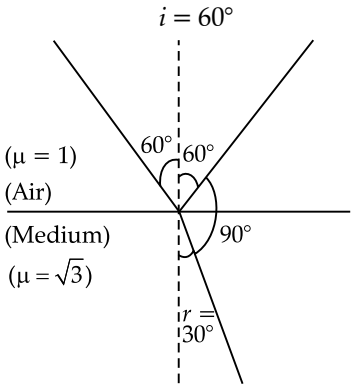
Explanation:

Waves	Wavelength (nearly)
AM Radio waves	10^2 m
Microwaves	10^{-2} m
Infrared Radiations	10^{-4} m
X-rays	10^{-10} m = 1 Å

33. Option (3) is correct.

Explanation: Given:

$$\mu = \sqrt{3}$$



By using Snell's law, we have;

$$\mu_1 \sin i = \mu_2 \sin r$$

$$1 \times \sin 60° = \sqrt{3}\sin r$$

$$\sin r = \frac{\sqrt{3}/2}{\sqrt{3}} = \frac{1}{2}$$

$$r = 30°$$

Hence, angle between reflected and refracted ray $= 60° + 30° = 90°$

34. Option (4) is correct.

Explanation: As, $\mu = \sqrt{\varepsilon_r \mu_r}$

And, $$\mu = \frac{c}{v}$$

Hence, $$v = \frac{c}{\mu} = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$$

35. Option (2) is correct.

Explanation: Gravitational Field Intensity (I_g) $= \frac{\text{Gravitational Force (F)}}{\text{Mass (M)}}$

$$I_g = \frac{3}{60 \times 10^{-3}}$$

$$I_g = 50\ \text{N/kg}$$

Section—B

36. Option (1) is correct.

Explanation: $(n)\,(T_l) = (n+1)\,(T_s)$

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

Hence, $$(n)\left(2\pi\sqrt{\frac{1.21}{9.8}}\right) = (n+1)\left(2\pi\sqrt{\frac{1}{9.8}}\right)$$

$$\Rightarrow \quad (n)\,(1.1) = (n+1)\,(1)$$

$$\Rightarrow \quad 1.1n = n + 1$$

$$\Rightarrow \quad 1.1n - n = 1$$

$$\Rightarrow \quad n\,(1.1 - 1) = 1$$

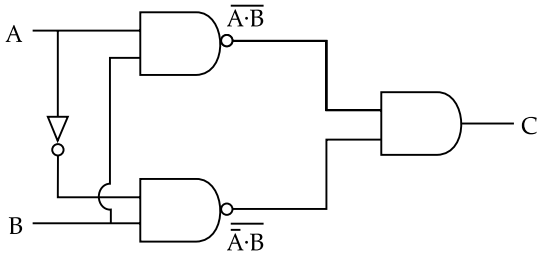
$\Rightarrow \quad 0.1n = 1$

$\Rightarrow \quad n = \frac{1}{0.1} = 10$

Now, Number of oscillation for shorter pendulum = $(n + 1) = 11$

37. Option (3) is correct.

Explanation:



$C = \overline{A \cdot B + \bar{A} \cdot B}$ (By using de-Morgan Theorem)

$C = \overline{B\,(A + \bar{A})} = \bar{B}$

Hence, option (3) is most accurate one.

38. Option (2) is correct.

Explanation: Given: $L = 10$ H, $C = 10$ μF, $R = 50\ \Omega$

$V = 200 \sin (100t)$

Standard equation is $V = V_0 \sin \omega t$

Hence, $\omega = 100$

$$n = \frac{\omega}{2\pi} = \frac{100}{2\pi} = \frac{50}{\pi}$$

$$n_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{1}{10 \times 10 \times 10^{-6}}}$$

$$= \frac{1}{2\pi} \times \sqrt{\frac{1}{10^{-4}}}$$

$$= \frac{1}{2\pi} \times 10^2 = \frac{50}{\pi}$$

$$n = n_0 = \frac{50}{\pi}\text{Hz}$$

39. Option (2) is correct.

Explanation: The provided figure is of an electric dipole.

And the electric field intensity for a dipole is always inverse of cube root of distance.

Mathematically, $E = \frac{1}{4\pi\varepsilon_0}\frac{p}{R^3}$

Hence, $E \propto \frac{1}{R^3}$

40. Option (3) is correct.

Explanation: According to the question,

$C_1V_1 + C_2V_2 = (C_1 + C_2)V$

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

$$V = \frac{C \times 100 + C \times 0}{C + C}$$

$$V = \frac{100C}{2C} = 50\text{V}$$

Energy stored, $U = 2 \times \frac{1}{2} CV^2$

[For given system]

$U = CV^2$

$= 900 \times 10^{-12} \times 50 \times 50$

$= 2250000 \times 10^{-12}$

$= 2.25 \times 10^{-6}$ J

41. Option (3) is correct.

Explanation: In stretching a spring, its shape changes and hence the shear modulus. So, assertion (A) is correct.

Reason is incorrect as $Y_{steel} > Y_{Copper}$.

42. Option (2) is correct.

Explanation: As, $\mu = \frac{c}{v}$

Hence, $\mu \propto \frac{1}{v}$

Now, Critical angle,

$$\sin i_c = \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2}$$

$$= \frac{1.5 \times 10^8}{2 \times 10^8} = \frac{3}{4}$$

$$i_c = \sin^{-1}\left(\frac{3}{4}\right)$$

$$i_c = \sin^{-1}(0.750)$$

43. Option (4) is correct.

Explanation:

Required volume = number of moles × standard volume

$$= \frac{\text{given mass}}{\text{molar mass}} \times 22.4\ (\text{L})$$

$$= \frac{4.5 \times 10^3}{18} \times 22.4 \times 10^{-3}\ (\text{m}^3)$$

$$= \frac{4.5 \times 22.4}{18}$$

$= 5.6\ \text{m}^3$

44. Option (3) is correct.

Explanation: As, $R = R_0 A^{1/3}$

Hence, $$\frac{R_1}{R_2} = \frac{R_0(125)^{1/3}}{R_0(64)^{1/3}}$$

$$\frac{R_1}{R_2} = \left(\frac{125}{64}\right)^{1/3}$$

$$\frac{R_1}{R_2} = \frac{5}{4}$$

$$R_1 : R_2 = 5 : 4$$

45. Option (4) is correct.

Explanation: Area = length × breadth

$= 55.3 \times 25$

$= 1382.5\ \text{m}^2$

As least significant figure is two digits, hence resultant should be of two digits.

So, required answer should be

$$1400 = 14 \times 10^2\ \text{m}^2$$

46. Option (2) is correct.

Explanation: For precise measurement of unknown resistance, the resistances of arms P and Q should be approximately equal and small, as it maintains balancing.

47. Option (2) is correct.

Explanation: At highest point, only the horizontal component remains in consideration.

Hence, $u_x = u\cos\theta = 10\cos 30°$

$$10 \times \frac{\sqrt{3}}{2}$$

$= 5\sqrt{3}\ \text{ms}^{-1}$

48. Option (2) is correct.

Explanation: The dimensional formula for required parts are as follow:

Gravitational constant — $[M^{-1}L^3T^{-2}]$

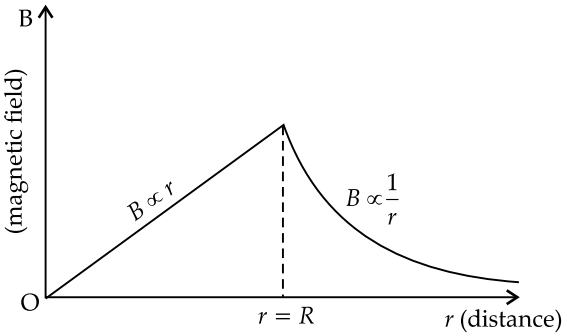
Gravitational potential energy — $[ML^2T^{-2}]$

Gravitational potential — $[L^2T^{-2}]$

Gravitational intensity — $[LT^{-2}]$

49. Option (3) is correct.

Explanation:



The graph clearly representing that given option (3) is correct.

50. Option (3) is correct.

Explanation: Given: $n = 1000$, $r = 10$ m, $B = 2 \times 10^{-5}$ T, $R = 12.56\ \Omega$ and $\omega = 2$ rad/s

As, $$I_{max} = \frac{E_{max}}{R} = \frac{NBA\omega}{R}$$

$$= \frac{1000 \times 2 \times 10^{-5} \times \pi \times 10 \times 10 \times 2}{12.56}$$

$$= \frac{2 \times 2 \times 3.14}{12.56} \times 10° \quad [\because \text{area} = \pi r^2]$$

$$= \frac{12.56}{12.56} \times 1 \qquad [\because 10° = 1]$$

$= 1$ A

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