SOLVED PAPER

NEET (UG)

07th May 2023

Code F3

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. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is

(1) along north-ward

(2) along north-east

(3) along south-west

(4) along east-ward

Q. 2. An ac source is connected to a capacitor C. Due to decrease in its operating frequency

(1) displacement current increases.

(2) displacement current decreases.

(3) capacitive reactance remains constant

(4) capacitive reactance decreases.

Q. 3. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to $\left(\frac{1}{16}\right)^{th}$ of its initial value?

(1) 40 minutes

(2) 60 minutes

(3) 80 minutes

(4) 20 minutes

Q. 4. The net magnetic flux through any closed surface is

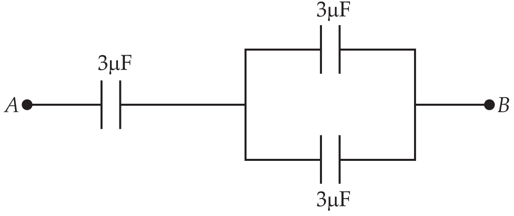
(1) Positive

(2) Infinity

(3) Negative

(4) Zero

Q. 5. The equivalent capacitance of the system shown in the following circuit is



(1) 3 μF

(2) 6 μF

(3) 9 μF

(4) 2 μF

Q. 6. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is

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

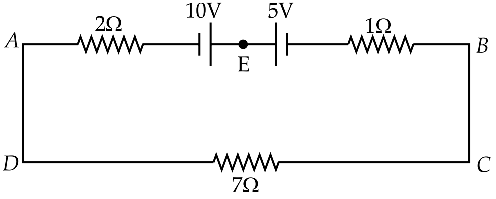
Q. 7. In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series is

(1) 4λ **(2)** 9λ
(3) 16λ **(4)** 2λ

Q. 8. A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(1) 2.7 A **(2)** 3.7 A
(3) 0.37 A **(4)** 0.27 A

Q. 9. The magnitude and direction of the current in the following circuit is



(1) 0.5 A from *A* to *B* through *E*
(2) $\frac{5}{9}$ A from *A* to *B* through *E*
(3) 1.5 A from *B* to *A* through *E*
(4) 0.2 A from *B* to *A* through *E*

Q. 10. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is

(1) 4 mJ **(2)** 8 mJ
(3) 8 μJ **(4)** 4 μJ

Q. 11. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be

(1) 4U **(2)** 8U
(3) 16U **(4)** 2U

Q. 12. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are

(1) Personal errors
(2) Least count errors
(3) Random errors
(4) Instrumental errors

Q. 13. Resistance of a carbon resistor determined from colour codes is (22000 ± 5%)Ω. The colour of third band must be

(1) Green **(2)** Orange
(3) Yellow **(4)** Red

Q. 14. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be

(1) 1.3% **(2)** 1.6%
(3) 1.4% **(4)** 1.2%

Q. 15. Light travels a distance x in time t_1 in air and $10x$ in time t_2 in another denser medium. What is the critical angle for this medium?

(1) $\sin^{-1}\left(\frac{10\,t_2}{t_1}\right)$ **(2)** $\sin^{-1}\left(\frac{t_1}{10\,t_2}\right)$
(3) $\sin^{-1}\left(\frac{10\,t_1}{t_2}\right)$ **(4)** $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

Q. 16. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 Vm^{-1}. Then the amplitude of oscillating magnetic field is (Speed of light in free space = 3×10^8 m s^{-1})

(1) 1.6×10^{-8}T **(2)** 1.6×10^{-7}T
(3) 1.6×10^{-6}T **(4)** 1.6×10^{-9}T

Q. 17. The ratio of radius of gyration of a solid sphere of mass *M* and radius *R* about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is

(1) 5 : 3 **(2)** 2 : 5
(3) 5 : 2 **(4)** 3 : 5

Q. 18. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly (surface tension of soap solution = 0.03 N m^{-1})

(1) 5.06×10^{-4}J **(2)** 3.01×10^{-4}J
(3) 50.1×10^{-4}J **(4)** 30.16×10^{-4}J

Q. 19. In a series *LCR* circuit, the inductance *L* is 10 mH, capacitance *C* is 1 μF and resistance *R* is 100Ω. The frequency at which resonance occurs is

(1) 15.9 kHz **(2)** 1.59 rad/s
(3) 1.59 kHz **(4)** 15.9 rad/s

Q. 20. If $\oint_s \vec{E}.\vec{dS} = 0$ over a surface, then

(1) the magnitude of electric field on the surface is constant.
(2) all the charges must necessarily be inside the surface.
(3) the electric field inside the surface is necessarily uniform.
(4) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

Q. 21. The venturi-meter works on

(1) Bernoulli's principle
(2) The principle of parallel axes
(3) The principle of perpendicular axes
(4) Huygen's principle

Q. 22. Two bodies of mass m and $9m$ are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (G = gravitational constant)

(1) $-\frac{12\,Gm}{R}$ **(2)** $-\frac{16\,Gm}{R}$
(3) $-\frac{20\,Gm}{R}$ **(4)** $-\frac{8\,Gm}{R}$

Q. 23. The temperature of a gas is –50° C. To what temperature the gas should be heated so that the rms speed is increased by 3 times?

(1) 3295° C
(2) 3097 K
(3) 223 K
(4) 669° C

Q. 24. The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to

(1) $\frac{1}{V}$
(2) $\frac{1}{\sqrt{V}}$
(3) V^2
(4) $\sqrt{V}$

Q. 25. A vehicle travels half the distance with speed v and the remaining distance with speed 2 v. Its average speed is

(1) $\frac{2v}{3}$
(2) $\frac{4v}{3}$
(3) $\frac{3v}{4}$
(4) $\frac{v}{3}$

Q. 26. The angular acceleration of a body, moving along the circumference of a circle, is

(1) along the radius towards the centre
(2) along the tangent to its position
(3) along the axis of rotation
(4) along the radius, away from centre

Q. 27. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight W attached at its free end. The longitudinal stress at any point of cross-sectional area A of the wire is

(1) $\frac{W}{A}$
(2) $\frac{W}{2A}$
(3) Zero
(4) $\frac{2W}{A}$

Q. 28. A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?

(1) p-n junction diodes
(2) Capacitor
(3) Load resistance
(4) A centre-tapped transformer

Q. 29. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 NC^{-1}. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.

(1) 6 mC
(2) 4 mC
(3) 2 mC
(4) 8 mC

Q. 30. A Carnot engine has an efficiency of 50% when its source is at a temperature 327° C. The temperature of the sink is

(1) 15° C
(2) 100° C
(3) 200° C
(4) 27° C

Q. 31. For Young's double slit experiment, two statements are given below:

Statement 1: If screen is moved away from the plane of slits, angular separation of the fringes remains constant.

Statement II: If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

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

(1) Both **Statement I** and **Statement II** are false.
(2) **Statement I** is true but **Statement II** is false.
(3) **Statement I** is false but **Statement II** is true.
(4) Both **Statement I** and **Statement II** are true.

Q. 32. The work functions of Caesium (Cs), Potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(1) Both Na and K
(2) K only
(3) Na only
(4) Cs only

Q. 33. Given below are two statements:

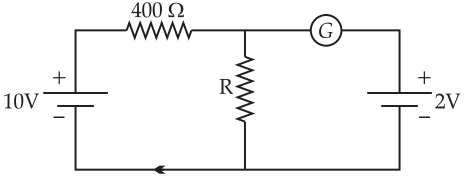
Statement 1: Photovoltaic devices can convert optical radiation into electricity.

Statement II: Zener diode is designed to operate under reverse bias in breakdown region.

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

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

Q. 34. If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by



(1) 50 Ω
(2) 100 Ω
(3) 400 Ω
(4) 200 Ω

Q. 35. A bullet is fired from a gun at the speed of 280 m s^{-1} in the direction 30° above the horizontal. The maximum height attained by the bullet is ($g=9.8$ m s^{-2}, $\sin 30° = 0.5$)

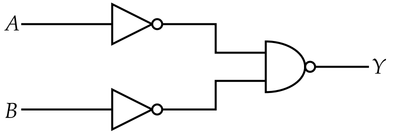
(1) 2000 m
(2) 1000 m
(3) 3000 m
(4) 2800 m

Section B

Q. 36. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $\frac{3\pi}{Gd}$ represents

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

Q. 37. For the following logic circuit, the truth table is



(1)

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

(2)

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

(3)

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

(4)

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

Q. 38. The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom?

(1) 1.06 Å **(2)** 1.59 Å

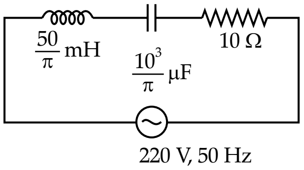
(3) 4.77 Å **(4)** 0.53 Å

Q. 39. A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field $\vec{B} = \left(2\hat{i} + 3\hat{j} - 4\hat{k}\right)$ T. The magnitude of the magnetic force acting on the wire is

(1) $\sqrt{5}\, IL$ **(2)** $5\, IL$

(3) $\sqrt{3}\, IL$ **(4)** $3\, IL$

Q. 40. The net impedance of circuit (as shown in figure) will be



(1) 15 Ω **(2)** $5\sqrt{5}$ Ω

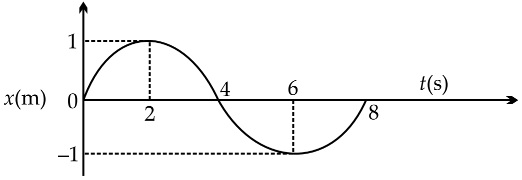
(3) 25 Ω **(4)** $10\sqrt{2}$ Ω

Q. 41. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is

(1) 100 **(2)** 1

(3) 1000 **(4)** 10

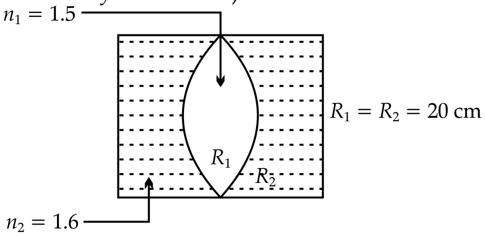
Q. 42. The x-t graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at $t = 2$ s is



(1) $-\frac{\pi^2}{8}$ m s^{-2} **(2)** $\frac{\pi^2}{16}$ m s^{-2}

(3) $-\frac{\pi^2}{16}$ m s^{-2} **(4)** $\frac{\pi^2}{8}$ m s^{-2}

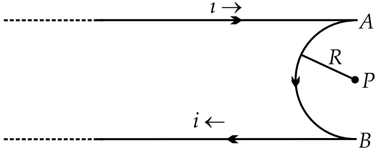
Q. 43. In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin)?



(1) – 40 cm **(2)** – 100 cm

(3) – 50 cm **(4)** 40 cm

Q. 44. A very long conducting wire is bent in a semi-circular shape from A to B as shown in figure. The magnetic field at point P for steady current configuration is given by



(1) $\frac{\mu_0 i}{4R}$ pointed away from the page

(2) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed away from page

(3) $\frac{\mu_0 i}{4R}\left[1-\frac{2}{\pi}\right]$ pointed into the page

(4) $\frac{\mu_0 i}{4R}$ pointed into the page

Q. 45. Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 (g = 10 ms^{-2})

(1) 150 ms^{-2} **(2)** 1.5 ms^{-2}

(3) 50 ms^{-2} **(4)** 1.2 ms^{-2}

Q. 46. Two thin lenses are of same focal lengths (f), but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be

(1) $\frac{f}{4}$ **(2)** $\frac{f}{2}$

(3) Infinite **(4)** Zero

Q. 47. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity 4 m s^{-1}. The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take g = 10 ms^{-2})

(1) 60 m **(2)** 64 m

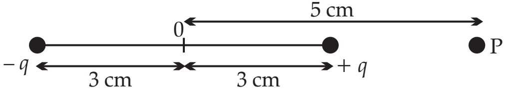
(3) 68 m **(4)** 56 m

Q. 48. The resistance of platinum wire at 0°C is 2Ω and 6.8Ω at 80°C. The temperature coefficient of resistance of the wire is

(1) $3 \times 10^{-3}\,°C^{-1}$ **(2)** $3 \times 10^{-2}\,°C^{-1}$

(3) $3 \times 10^{-1}\,°C^{-1}$ **(4)** $3 \times 10^{-4}\,°C^{-1}$

Q. 49. An electric dipole is placed as shown in the figure.



The electric potential (in 10^2 V) at point P due to the dipole is (ε_0 = permittivity of free space and $\frac{1}{4\pi\varepsilon_0} = K$)

(1) $\left(\frac{5}{8}\right)$ qK **(2)** $\left(\frac{8}{5}\right)$ qK

(3) $\left(\frac{8}{3}\right)$ qK **(4)** $\left(\frac{3}{8}\right)$ qK

Q. 50. A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet becomes $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is

(1) 24 cm **(2)** 28 cm

(3) 30 cm **(4)** 27 cm

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Booklet

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Student's Signature

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Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Avoid Improper Marking

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50 ① ② ③ ④

Q. No.	Answer Key	Topic's Name	Chapter Name
		PHYSICS (SECTION-A)	
1	2	Acceleration	Kinematics
2	2	Displacement Current	Alternating Current
3	3	Radioactivity	Nucleus
4	4	Gauss Law In Magnetism	Magnetism
5	4	Combination of Capacitos	Capacitors
6	1	Fundamental Mode Of Vibration In Organ Pipe	Waves
7	1	Hydrogen Spectrum	Atoms
8	4	Transformer	Electro Magnetic Induction
9	1	Electrical Circuits	Current Electricity
10	3	Magnetic Energy	Electromagnetic Induction
11	3	Spring Potential Energy	Work Power And Energy
12	3	Errors	Units And Measurement
13	2	Colour Code of Resistance	Current Electricity
14	2	Errors	Units And Measurement
15	3	Total Internal Reflection	Geometrical Optics
16	2	Electromagnetic Wave	Electromagnetic Wave
17	4	Moment of Inertia	Rigid Body Mechanics
18	2	Surface Tension	Fluid Mechanics
19	3	LCR Series Circuit	Alternating Current
20	4	Gauss Law I Electrostatics	Electrostatics
21	1	Venturimeter	Fluid Mechanics
22	2	Gravitational Potential	Gravitation
23	1	Molecular Speeds Of Ideal Gases	Kinetic Theory of Gases
24	1	X-Rays	Dual Nature of Matter And Radiation
25	2	Average Velocity	One Dimensional Motion
26	3	Circular Motion	Circular Motion
27	1	Stress	Mechanics Of Solid
28	2	Rectifier	Semiconductors
29	3	Torque Experienced by an Electric Dipole Placed in External Field	Electrostatics
30	4	Carnot Engine	Thermodynamics
31	2	Youngs Double Slit Experiment	Wave Optics
32	4	Photoelectric Effect	Dual Nature of Matter And Radiation
33	4	Optoelectronic Devices	Semiconductors
34	2	Current Circuits	Current Electricity
35	2	Projectile Motion	Motion in a Plane
36	1	Gravitation	Gravitation
37	1	Logic Gate	Semiconductors
38	3	Bohrs Model	Atoms
39	2	Force on a Current Carrying Conductor in A magnetic Field	Magnetism
40	2	LCR Series Circuit	Alternating Current
41	1	Current Circuits	Current Electricity

42	3	SHM	SHM
43	2	Combination of Lens	Geometrical Optics
44	3	Magnetic Field	Magnetic Effects of Current
45	2	Friction	Laws of Motion
46	3	Combination of Lens	Geometrical Optics
47	2	Equations of Kinematics	Kinematics
48	2	Resitance Dependent on Temperature	Current Electricity
49	4	Electrostatic Potential	Electrostatic
50	4	Equation of Kinematics	Kinematics

NEET (UG)

7th May 2023 Paper

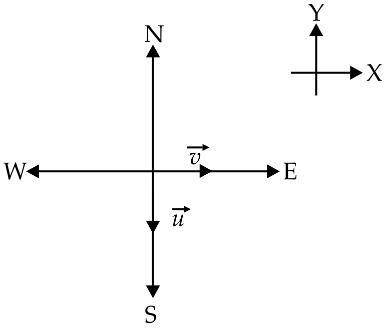
ANSWERS WITH EXPLANATION

PHYSICS

Section—A

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

Explanation: Let's his speed is V



Force will act along the direction of acceleration.

And acceleration $= \dfrac{\text{Change in velocity}}{\text{time interval}}$

Change in velocity,

$$\Delta\vec{v} = \vec{v} - \vec{u}$$

$$\vec{u} = v\left(-\hat{j}\right)$$

$$\vec{v} = v\hat{i}$$

$$\text{So, } \Delta\vec{v} = v\hat{i} - v\left(-\hat{j}\right)$$

$$= v\hat{i} + v\hat{j}$$

So, $\Delta\vec{v}$ is along N–E direction.

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

Explanation: Displacement current, (i_d) = Conduction current (i_c)

$i_d = i_c = \dfrac{V}{X_c}$, where X_c=Capacitive reactance.

$X_c = \dfrac{1}{wc}$, where, ω =angular frequency and

C = capacitance.

$\omega = 2\pi f$, where f = frequency,

When f decreases, ω decreases, than X_c increases so i_c or i_d decreases.

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

Explanation:

$$\frac{A}{A_0} = \frac{1}{2^n}$$

n = no. of half – lives.

$$\frac{A}{A_0} = \frac{1}{16} = \frac{1}{2^4}$$

n = 4 half – lives

So total time, $t = n \times T_{\frac{1}{2}}$

$= 4 \times 20$

$= 80$ minute.

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

Explanation:

Magnetic monopole doesn't exist.

So, $\oint \vec{B}.d\vec{s} = 0$

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

Explanation: The equivalent capacitance in parallel is 3μF + 3μF = 6μF.

& 6μF is in series with 3μF.

So, $C_{\text{equivalent}} = \dfrac{3\times 6}{3+6} = 2\mu\text{F}$.

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

Explanation: Fundamental mode of vibration for open pipe is $\dfrac{V}{2l}$ and the that of closed pipe is $\dfrac{V}{4l}$.

So, their ratio $\dfrac{\frac{V}{2l}}{\frac{V}{4l}} = 2:1$. Where V is the speed of sound & l in length.

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

Explanation:

$$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right]$$

For minimum Wavelength, Energy is maximum, So, $n_i = \infty$

For Balmer series, $n_f = 2$, and for Brackett series, $n_f = 4$.

$$\frac{1}{\lambda} = \frac{R}{4}$$

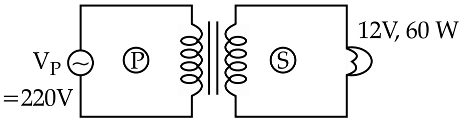
$$\frac{1}{\lambda_{\text{brackett}}} = \frac{R}{16}$$

$$\frac{\lambda_{\text{brackett}}}{\lambda} = \frac{R}{4} \times \frac{16}{R}$$

$$\lambda_{\text{brackett}} = 4\lambda$$

8. Option (4) is correct.

Explanation:



As transformer is ideal.

So, $P_{output} = P_{input} = 60$

$$\Rightarrow \quad I_p V_p = 60$$

$$\Rightarrow \quad I_p = \frac{60}{V_p}$$

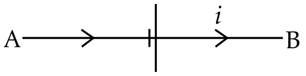
$$= \frac{60}{220} = \frac{3}{11}$$

$$= 0.27 \text{ A}$$

9. Option (1) is correct.

Explanation: The two batteries are opposing, So $\varepsilon_{net} = 10V - 5V = 5V$ and $R_{net} = 2 + 1 + 7 = 10\Omega$

$i = \frac{\varepsilon_{net}}{R_{net}} = \frac{5}{2} = 0.5A$, from A to B though E, as



10. Option (3) is correct.

Explanation: Magnetic energy stored in an inductor is

$$\frac{1}{2}Li^2 = \frac{1}{2} \times (4\mu H) \times 2^2 = 8\mu J$$

11. Option (3) is correct.

Explanation: PE stored in a stretched spring in $\frac{1}{2}kx^2$, where k = spring const. and x is extension.

$$U = \frac{1}{2}k(2)^2$$

And $$U' = \frac{1}{2}k(8)^2$$

$$\Rightarrow \quad \frac{U}{U'} = \frac{1}{16}$$

$$\Rightarrow \quad U' = 16U$$

12. Option (3) is correct.

Explanation: As the cause of errors in unpredictable, this kind of error is random error.

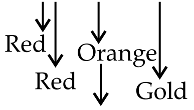
13. Option (2) is correct.

Explanation:

Colour	Number	Multiplies	Tolerance
Black	0	10^0	
Brown	1	10^1	
Red	2	10^2	
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	
Blue	6	10^6	
Violet	7	10^7	
Gray	8	10^8	
White	9	10^9	
Gold		10^{-1}	5%
Silver		10^{-2}	10%

So,

$R = 22 \times 10^3 \pm 5\%$

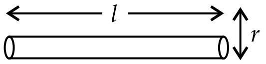


multiplier is the 3rd band.

14. Option (2) is correct.

Explanation:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$



$$d = \frac{m}{\pi r^2 l}$$

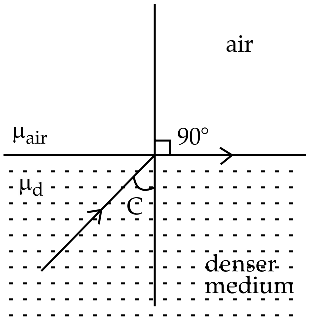
$$\left(\pm\frac{\Delta d}{d}\right)\% = \pm\left(\frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta l}{l}\right) \times 100$$

$$= \pm\left(\frac{0.002}{0.4} + 2\frac{0.001}{0.3} + \frac{0.02}{5}\right) \times 100$$

$$= 1.6\ \%$$

15. Option (3) is correct.

Explanation:



$\mu_d \sin C = \mu_{air} \sin 90^\circ$

$$\frac{e}{V_d}\sin C = \frac{C}{V_{air}} \qquad \left[\because \mu_{medium} = \frac{C}{V_{medium}}\right]$$

$$\sin C = \frac{V_d}{V_{air}} = \frac{\frac{10x}{t_2}}{\frac{x}{t_1}} = \frac{10t_1}{t_2}$$

$$C = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$$

16. Option (2) is correct.

Explanation:

$$C=\frac{E_0}{B_0}$$

Where symbols have their usual meanings.

So, $B_0=\frac{E_0}{C}$

$$=\frac{48}{3\times10^8}$$

$$=1.6\times10^{-7}\,T$$

17. Option (4) is correct.

Explanation:

$$I_{\text{solid sphese}}=\frac{2}{5}MR^2=MK^2_{\text{solid}}$$

$$\Rightarrow\ K_{\text{soild}}=\sqrt{\frac{2}{5}}R$$

Similarly, that of hollow sphere

$$I_{\text{hollow}}=\frac{2}{3}MR^2=MK^2_{\text{hollow}}$$

$$\Rightarrow K_{\text{hollow}}=\sqrt{\frac{2}{3}}$$

So, $\frac{K_{\text{soild}}}{K_{\text{hollow}}}=\frac{\sqrt{\frac{2}{5}}}{\sqrt{\frac{2}{3}}}=\sqrt{\frac{3}{5}}=\sqrt{3}:\sqrt{5}$

18. Option (2) is correct.

Explanation: Surface tension $=\frac{\text{Work done}}{\Delta\text{ Area}}$

A soap bubble has 2 free surface.

So, area, $A=2\times4r\pi r^2=8\pi r^2$

$\Rightarrow$ Work done $=$ surface tension $\times 8\pi r^2$

$$=(0.03)\times8\times\pi\times(2\times10^{-2})^2$$

$$=3.01\times10^{-4}J.$$

19. Option (3) is correct.

Explanation: In Resonance condition of LCR circuit.

$$X_L=X_c$$

$$\Rightarrow \omega_r L=\frac{1}{\omega_r C}$$

$$\Rightarrow \omega_r=\frac{1}{\sqrt{LC}}$$

$$\Rightarrow f_r=\frac{1}{2\pi\sqrt{LC}}$$

$$=\frac{1}{2\sqrt{10\times10^{-3}\times10^{-6}}}$$

$$=1.59\text{ kHz.}$$

(Where symbols have their usual meanings.)

20. Option (4) is correct.

Explanation: According to gauss law of electrostatics.

The net flux $\phi_E=\oint\vec{E}.\vec{dS}=\frac{q_{en}}{\lambda_o}$

So, here net flux is zero, that means net charge enclosed by the surface is Zero.

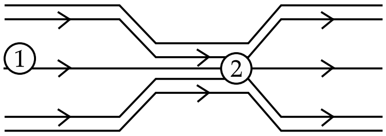
So the flux entering the surface is equal to flux leaving the surface in same.

21. Option (1) is correct.

Explanation: Bernoulli's principle is based on conservation of energy, that is the total work done by pressure, gravity and change in KE is constant for an ideal fluid flowing in a closed tube.

$$P+\frac{1}{2}\rho v^2+\rho gh=\text{const}$$

Venturie–meter works on this principle.



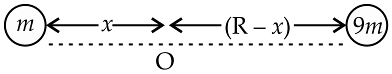
$$P_1+\frac{1}{2}\rho v_1{}^2+\rho gh=P_2+\frac{1}{2}\rho v_2{}^2+\rho gh$$

Perpendicular and parallel axes theorem helps to find moment inertia at different axes of rotation

Huygens theory explain the wave nature of light.

22. Option (2) is correct.

Explanation:



At 'O' field due to mass $m\times9m$ is zero. So

$$\frac{Gm}{x^2}=\frac{G(9m)}{(R-x)^2}$$

$$\Rightarrow\frac{1}{x}=\frac{3}{R-x}$$

$$\Rightarrow x=\frac{R}{4}\times(R-x)=\frac{3R}{4}$$

So, potential at that point will be

$$\frac{-Gm}{\left(\frac{R}{4}\right)}+\frac{-G9m}{\left(\frac{3R}{4}\right)}=\frac{-16Gm}{R}$$

23. Option (1) is correct.

Explanation: The rms speed is

$$V=\sqrt{\frac{3RT}{M}}$$

When it is increased by 3 times, i.e.,

$$4V=\sqrt{\frac{3RT'}{M}}$$

(where symbols have their usual meanings)

$$\Rightarrow \quad T' = 16\,T$$
$$= 16\,(273–50)$$
$$= 3568\text{ K}$$
$$= 3295^{\circ}\text{ C}.$$

24. Option (1) is correct.

Explanation: Minimum wave length of X-Rays is

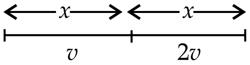
$$\lambda_{\min} = \frac{hc}{eV},$$

Hence $\lambda_{\min} \propto \frac{1}{V}$

25. Option (2) is correct.

Explanation: Average speed,

$$v_{avg} = \frac{\text{Total distance}}{\text{Total time}}$$



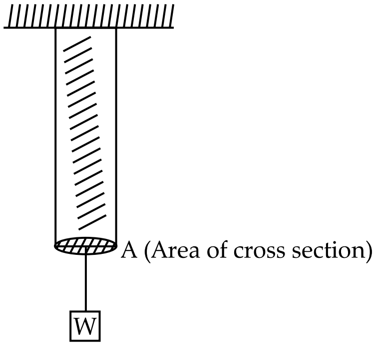
$$\text{So, } v_{avg} = \frac{2x}{\frac{x}{v} + \frac{x}{2v}} = \frac{2\,(v)(2v)}{v + 2v} = \frac{4v}{3}$$

26. Option (3) is correct.

Explanation: Angular displacement, angular velocity and angular acceleration are axial vectors, So, their direction is always along the axis of rotation.

27. Option (1) is correct.

Explanation:

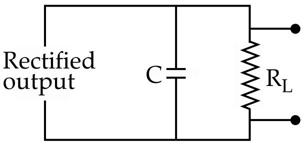


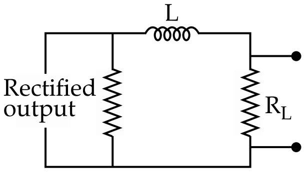
Stress is, restoring force per unit area. As there in no mass of Rod. Restoring force is equal to the applied force in magnitude.

$$\text{So, stress} = \frac{W}{A}$$

28. Option (2) is correct.

Explanation: To remove the ac ripples from the rectified output, a filter circuit is connected, which contains capacitor or inductor, as capacitor allows the ac while inductor allows the dc.





29. Option (3) is correct.

Explanation: $\tau = p\,E\,\text{Sin}\theta$ & $p = q \times l$

Where symbols have their usual meanings.

$$\Rightarrow 4 = (q \times 2 \times 10^{-2})\,(2 \times 10^{5}) \times \text{Sin } 30°$$
$$\Rightarrow q = 2 \times 10^{-3}\text{ C}$$
$$= 2\text{ m C}$$

30. Option (4) is correct.

Explanation: Efficiency of carnot engine,

$$\eta = \left(1 - \frac{T_L}{T_H}\right) = \frac{50}{100}$$
$$\Rightarrow \frac{1}{2} = 1 - \frac{T_L}{T_H}$$
$$\Rightarrow \frac{T_L}{T_H} = \frac{1}{2}$$
$$\Rightarrow \frac{T_L}{273 + 327} = \frac{1}{2}$$
$$\Rightarrow T2 = 300\text{ K}$$
$$= 300 - 273$$
$$= 27^{\circ}\text{ C}$$

Where T_L = sink temp (in K)
& T_H = source temp (in K)

31. Option (2) is correct.

Explanation: Angular fringe width, $\theta = \frac{\lambda}{d}$, where λ = wavelength of light & d is the slit separation.
So θ is independent of separation between screen and slit (D).
If λ increases, then θ must increase.

32. Option (4) is correct.

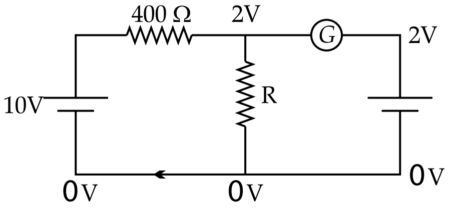
Explanation: According to Einstein's Photo electric equation.
$KE_{\max} = hv - \phi_0$
So, photoelectric effect is only possible, when the energy of incident radiation is larger than work function (ϕ_0).
Hence, in the given situation, Photoelectric effect is possible in case of Cs only, as 2.20 ev is larger than 2.14 ev, and lower from 2.30 ev and 2.75 ev as well.

33. Option (4) is correct.

Explanation: Photo voltaic cells (or solar cells). Convert radiation energy into electrical energy.
Zener diodes are heavily doped to operate at breakdown voltage in reverse bias.

34. Option (2) is correct.

Explanation:



As Galvanometer has no current, voltage across R will be 2V as shown.

So voltage applied is 10V and voltage across 400 Ω is 10 – 2 = 8V.

So current in the circuit is $i = \frac{8}{400}$amp.

That current will flow through R,

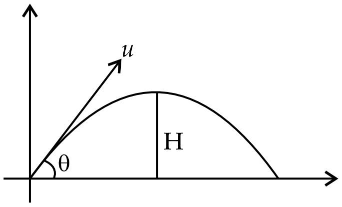
So, 2 = i R

$$= \frac{8}{400}R$$

$\Rightarrow$ R = 100 Ω

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

Explanation:



$$H = \frac{u^2 \sin^2 \theta}{2g}$$

$$\Rightarrow H = \frac{(280)^2 (\sin 30°)^2}{2 \times 9.8}$$

$$= 1000 \text{ m.}$$

Section—B

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

Explanation: It can be solved by dimensional analysis.

$$\frac{3\pi}{Gd} = \frac{1}{[M^{-1}L^3T^{-2}][ML^{-3}]} = [T^2]$$

OR

It can be derived from the formula.

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

$$= 2\pi\sqrt{\frac{R^3}{GM}}$$

$$= 2\pi\sqrt{\frac{\cancel{R}^3}{G \times \frac{4}{3}\pi\cancel{R}^3 \times d}}$$

$$\Rightarrow T^2 = \frac{4\pi^2 \times 3}{4\pi\ Gd}$$

$$= \frac{3\pi}{Gd}$$

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

Explanation:

$y = \overline{\overline{A}\,.\,\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}}$

$y = A + B$

Which is 'OR' gate.

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

Explanation: In bohr's model, the radius of n^{th} or bit is

$$r_{n^{th}} = r_0 \frac{\mathring{A}}{z}$$

(Symbols have their usual meanings)

For H – atom, and for n = 3

$r_{n^{th}} = r_0\ (3)^2$

$= 0.53 \times 9$

$= 4.77\mathring{A}.$

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

Explanation: The magnetic force (F), on a current (I) carrying conductor of length (L) in a magnetic field (B) is

$$\vec{F} = I\vec{L} \times \vec{B}$$

$$= IL\hat{i} \times (2\hat{i} + 3\hat{j} - 4\hat{k})$$

$$= 3IL\hat{k} + 4IL\hat{j}$$

$$|\vec{F}| = \sqrt{(3IL)^2 + (4IL)^2}$$

$$= 5IL$$

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

Explanation: $Z = \sqrt{R^2 + (X_C - X_L)^2}$

R = 10 Ω

$$X_C = \frac{1}{\omega C} = \frac{1 \times 10^6}{2\pi(50) \times \frac{10^3}{\pi}}$$

$$= 10\ \Omega$$

$$X_L = \omega L$$

$$= 2\pi(50) \times \frac{50}{\pi} \times 10^{-3}$$

$$= 5\Omega$$

$$\text{So } Z = \sqrt{10^2 + (10-5)^2}$$

$$= \sqrt{125}$$

$$= 5\sqrt{5}\ \Omega$$

Symbols have their usual meanings.

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

Explanation: Current, $i_s = \frac{E_{net}}{R_{net}}$

In series, $i_s = \frac{E}{10R}$

In parallel, $i_P = \frac{E}{\frac{R}{10}}$

$$\text{So, } \frac{i}{i_p} = \frac{E \times R}{10R \times E \times 10} = \frac{1}{100}$$

$$i_P = 100\, i_s\,, n = \frac{i_p}{i_s}$$

So, $n = 100$.

42. Option (3) is correct.

Explanation: In Shm, acceleration,

$$\vec{a} = -\omega^2 \vec{x}$$

T = 8 sec,

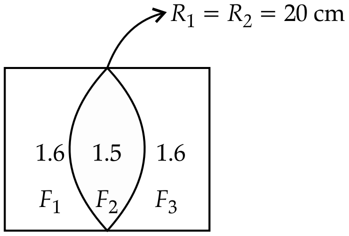
$$\omega = \frac{2\pi}{8}$$

at $t = 2s$, $x = +1$

$$\text{So } a = -\left(\frac{2\pi}{8}\right)^2 (+1) = \frac{-\pi^2}{16} \text{ m/s}^2$$

43. Option (2) is correct.

Explanation:



$$\frac{1}{f_1} = (1.6-1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = \frac{1}{f_3}$$

$$\Rightarrow \frac{1}{f_1} = \frac{1}{f_3} = \frac{-0.3}{10}$$

$$\frac{1}{f_2} = (1.5-1)\left[\frac{1}{20} + \frac{1}{20}\right]$$

$$= \frac{0.5}{10}$$

For combination of lens.

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

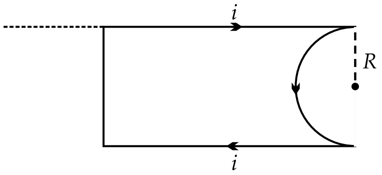
$$= \frac{-0.3}{10} + \frac{-0.3}{10} + \frac{0.5}{10}$$

$$= \frac{-1}{100}$$

$\Rightarrow$ F = –100 cm.

44. Option (3) is correct.

Explanation:



At the end of an current carrying conductor, magnetic field.

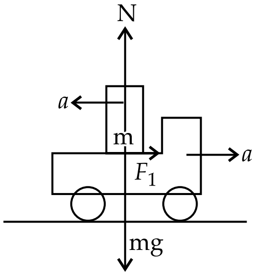
$B_1 = \frac{\mu_0 i}{4\pi R} \otimes$ (into the page) and for semicircles part, magnetic field, $B_2 = \frac{\mu_0 i}{4R} \Theta$ (Out of the page)

There are two straight conductors (having same direction of $\vec{B}$) and a circular wire.

So $B_{net} = \frac{\mu_0 i}{4R}\left(1 - \frac{2}{\pi}\right)$□ out of the page.

45. Option (2) is correct.

Explanation:



The block to move with the truck without sliding.

$ma \le F_1$

$ma_{max} = \mu N$

$\Rightarrow \cancel{m}\, a_{max} = \mu \cancel{m} g$

$= 0.15 \times 10$

$= 1.5 \text{ ms}^2$

46. Option (3) is correct.

Explanation: $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

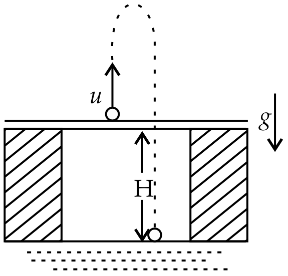
$$= \frac{1}{f} - \frac{1}{f} = 0$$

$\Rightarrow$ F= ∞

47. Option (2) is correct.

Explanation: $u = 4$ m/s

$t = 4$s



Applying equation of motion

$$\vec{s} = \vec{u}\,t + \frac{1}{2}\vec{a}\,t^2$$

$$-H = 4 \times 4 + \frac{1}{2}(-10) \times 4^2$$

–H= –64 m, H= 64 m

So height of the bridge is 64m.

48. Option (2) is correct.

Explanation: $R_{80^\circ} = 6.8$

$R_0 = 2$

$R_t = R_0\,(1+\alpha\Delta t)$

$\Rightarrow \quad 6.8 = 2[\,1+\alpha(80-0)]$

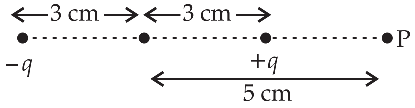
$\Rightarrow \quad \alpha = \dfrac{2.4}{80} = 3\times10^{-2}\,{}^\circ\mathrm{C}^{-1}$

(Symbols have their usual meanings)

49. Option (4) is correct.

Explanation:

Electrostatic potential



$$V_P = \frac{k(-q)}{8\text{cm}} + \frac{kq}{2\text{cm}}$$

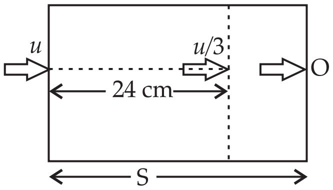
$$= Kq\left(\frac{1}{2cm} - \frac{1}{8cm}\right)$$

$$= \frac{3Kq}{8\times10^{-2}}\,\text{V}$$

$$= \frac{3}{8}Kq\times10^{2}\ \text{V}$$

50. Option (4) is correct.

Explanation:



By $v^2 - u^2 = 2as$

$$\left(\frac{u}{3}\right)^2 - u = 2(-a)\times24$$

$$\frac{u^2}{9} - u^2 = -48\,a$$

$$\frac{-8u^2}{9} = -48\,a$$

$$\frac{8u^2}{9} = 48a$$

Similarly

$0 = \ u^2 - 2as$

$u^2 = 2as$

$$\frac{8u^2}{9u^2} = \frac{48a}{2as}$$

s = 27 m

❑❑❑