Q.1. Three sound waves of equal amplitudes have frequencies (v – 1), v, (v + 1). They *superpose* to give beats. The number of beats produced per second will be:

1. 1
2. 4
3. 3
4. 2

Answer: (4)

Q.2. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where g = the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth is:

1. $\sqrt{2}\,R$
2. 2R
3. $\frac{R}{\sqrt{2}}$
4. R/2

Answer: (2)

Q.3. One kg of a diatomic gas is at a pressure of $8\times10^4\ N/m^2$. The density of the gas is 4 kg/m^3. What is the energy of the gas due to its thermal motion?

1. $8\times10^4 J.$

2. $3 \times 10^4 J.$

3. $5 \times 10^4 J.$

4. $6 \times 10^4 J.$

ans: 3

Q.4. Assuming the gas to be ideal the work done on the gas in taking it from A to B is:

1. **500 R**
2. **200 R**
3. **300 R**
4. **400 R**

Sol: 4

Q.5. The work done on the gas in taking it from D to A is:

1. **+ 690 R**
2. **– 414 R**
3. **+ 414 R**
4. **– 690 R**

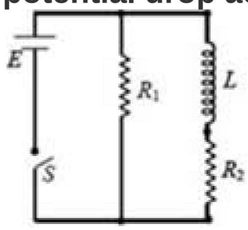
Sol: 2

Q.6. The net work done on the gas in the cycle ABCDA is:

1. **1904 R**
2. **Zero**
3. **276 R**
4. **1076 R**

Sol: 3

Q.7. An inductor of inductance L = 400 mH and resistors of resistances $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at t = 0. The potential drop across L as a function of time is:



1. $12e^{-5t}V$
2. $6e^{-5t}V$
3. $\frac{12}{t}e^{-3t}V$
4. $6\,(1 - e^{-t/0.2})V$

Answer: (1)

Q.8. A mixture of light, consisting of wavelength 590 nm and an unknown wavelength, illuminates Young's double slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe of the unknown light. From this data, the wavelength of the unknown light is:

1. **776.8 *nm***
2. **393.4 *nm***
3. **885.0 *nm***
4. **442.5 *nm***

Answer: (4)

Q.9. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electric force on Q is zero, then Q/q equals:

1. $-\frac{1}{\sqrt{2}}$
2. $-2\sqrt{2}$
3. **-1**
4. **1**

Answer: (2)

Q.10. In an optics experiment, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance *u* and the image distance *v*, from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 450 with the x-axis meets the experimental curve at *P*. The coordinates of *P* will be

1. **(4f, 4f)**
2. **(2f, 2f)**
3. $\left(\frac{f}{2}, \frac{f}{2}\right)$
4. **(f, f)**

`

Answer: (2)

Q.11. A thin uniform rod of length *l* and mass *m* is swinging freely about a horizontal axis passing through its end. Its maximum angular speed is ω. Its centre of mass rises to a maximum height of :

1. $\frac{1}{6}\frac{l^2\omega^2}{g}$

2. $\frac{1}{3}\frac{I^2 \omega^2}{g}$

3. $\frac{1}{6}\frac{I\omega}{g}$

4. $\frac{1}{2}\frac{I^2 \omega^2}{g}$

Answer: (1)

Q.12. $Let\ P(r) = \frac{Q}{\pi R^4} r$ **be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'p' inside the sphere at distance r1 from the centre of the sphere, the magnitude of electric field is:**

1. $\frac{Q r_1^2}{3\pi \in_0 R^4}$

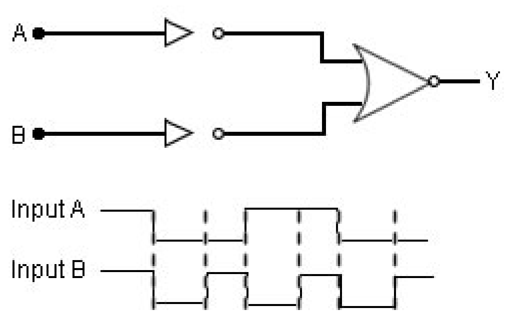
2. 0

3. $\frac{Q}{4\pi \in_0 R_1^2}$

4. $\frac{Q r_1^2}{4\pi \in_0 R^4}$

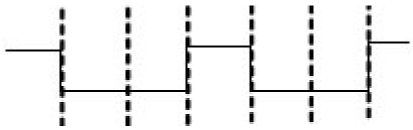
Answer: (4)

Q.13. The logic circuit shown below has the input waveforms 'A' and 'B' as shown. Pick out the correct output waveform.

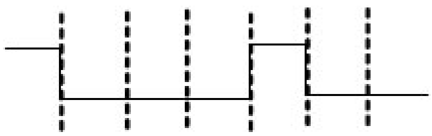


Output is

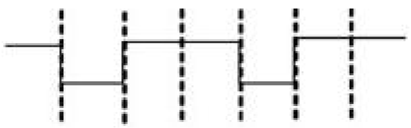
1.



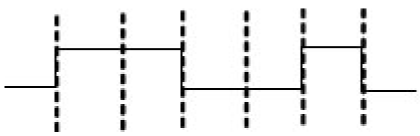
2.



3.



4.



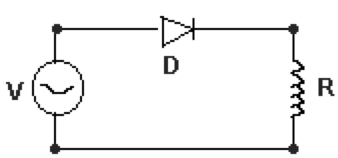
Answer: (2)

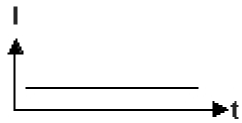
Q.14. If *x*, *v* and *a* denote the displacement, the velocity and the acceleration of particle executing simple harmonic motion of time period *T*, then, which of the following does *not* change with time?

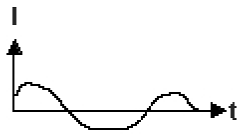
1. **aT/v**
2. $a^2T^2 + 4\pi^2 v^2$
3. **aT/x**
4. $aT + 2\pi v$

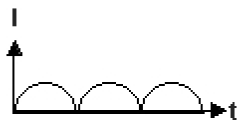
Answer: (3)

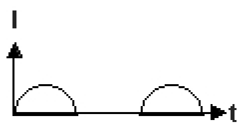
Q.15. A *p-n* junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit. The current (I) in the resistor (R) can be shown by



1. 

2. 

3. 

4. 

Answer: (4)

Q.16. A motor cycle starts from rest and accelerates along a straight path at 2 m/s^2. At the starting point of the motor cycle there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was at rest? (Speed of sound = 330 ms^{-1})

1. **196 m**
2. **49 m**
3. **98 m**
4. **147 m**

Answer: (3)

Q.17. Two points P and Q are maintained at the potentials of 10V and – 4V, respectively. The work done in moving 100 electrons from P to Q is :

1. $2.24 \times 10^{-16} J$

2. $-9.60 \times 10^{-17} J$

3. $9.60 \times 10^{-17} J$

4. $-2.24 \times 10^{-16} J$

Answer: (1)

Q.18. In an experiment the angles are required to be measured using an instrument. 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half-a- degree (= 0.50), then the least count of the instrument is:

1. **half degree**
2. **one minute**
3. **half minute**
4. **one degree**

Answer: (2)

Q.19. The surface of a metal is illuminated with the light of 400 *nm*. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is: (hc = 1240 eV.nm)

1. **1.68 eV**
2. **3.09 eV**
3. **1.41 eV**
4. **1.51 eV**

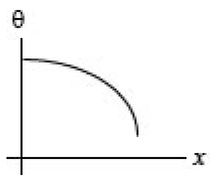
Answer: (3)

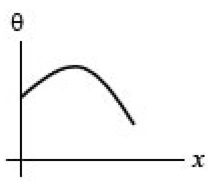
Q.20. A particle has an initial velocity of $3\hat{i} + 4\hat{j}$ **and an acceleration of** $4\hat{i} + 0.3\hat{j}$ **. Its speed after 10 s is:**

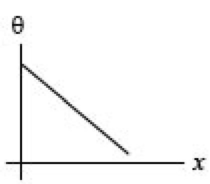
1. **8.5 units**
2. **10 units**
3. $7\sqrt{2}\ units$
4. **7 units**

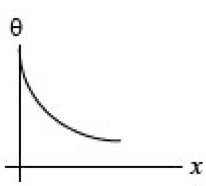
Answer: (3)

Q.21. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length *x* of the bar from its hot end is best described by which of the following figures?

1. 

2. 

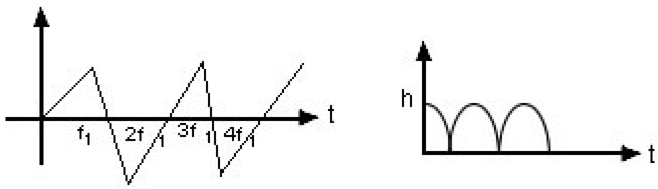
3. 

4. 

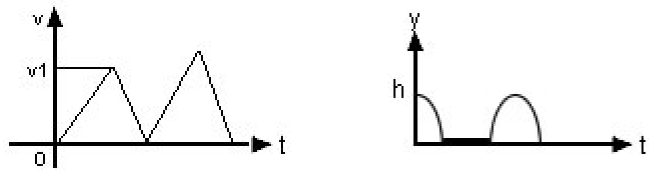
Answer: (3)

Q.22. Consider a rubber ball freely falling from a height *h* = 4.9 *m* onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then the velocity as a function of time and the height as a function of time will be

1.



2.



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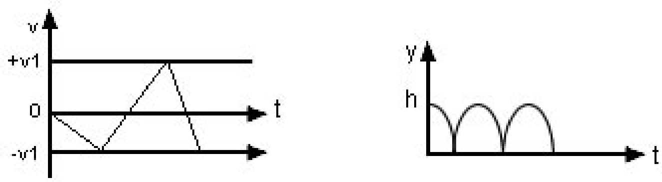

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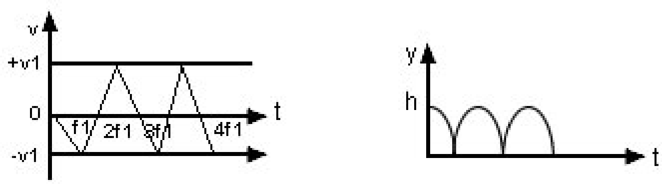
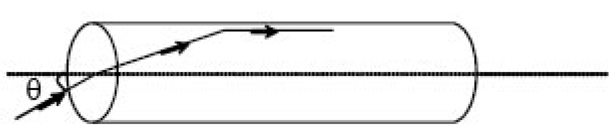


Answer: (4)

Q.23. A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid point of one end of the rod as shown in the figure. The incident angle Δ for which the light ray grazes along the wall of the rod is :



1. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$
2. $\sin^{-1}\left(\frac{1}{2}\right)$
3. $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$
4. $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

Correct choice: (1)

This question contains Statement-1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements.

Q.24. Statement –1: For a charged particle moving from point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q.

Statement –2: The net work done by a conservative force on an object moving along a closed loop is zero.

1. **Statement –1 is false, Statement- 2 is true**
2. **Statement –1 is true, Statement- 2 is false**
3. **Statement –1 is true, Statement- 2 is true; Statement -2 is the correct explanation for Statement-1**
4. **Statement –1 is true, Statement- 2 is true; Statement -2 is not the correct explanation for Statement-1**

Answer: (3)

Q.24. The transition from the state n = 4 to n = 3 in hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from:

1. $5 \to 4$
2. $2 \to 1$
3. $3 \to 2$
4. $4 \to 2$

Answer: (1)

This question contains Statement-1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements.

Q.26. Statement –1: The temperature dependence of resistance is usually given as $R = R_0\,(1+\alpha\,\Delta t)$. The resistance of a wire changes from 100 Ω to 150 Ω when its temperature is increased from 270C to 2270C. This implies that $\alpha = 2.5 \times 1 - 0^{-3} /^0\, C.$

Statement –2: $\alpha = 2.5 \times 1 - 0^{-3} /^0\, C.$ is valid only when the change in the temperature ΔT is small and $\Delta R = (R - R_0) << R_0.$.

1. **Statement –1 is false, Statement- 2 is true**
2. **Statement –1 is true, Statement- 2 is false**
3. **Statement –1 is true, Statement- 2 is true; Statement -2 is the correct explanation for Statement-1**
4. **Statement –1 is true, Statement- 2 is true; Statement -2 is not the correct explanation for Statement-1**

Answer: (1)

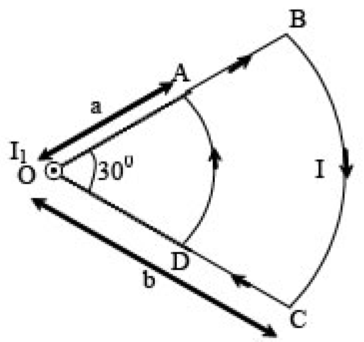
Q.27. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area 3A. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

1. **9 F**
2. **F**
3. **4 F**
4. **6 F**

Answer: (1)

Directions: Question numbers 58 and 59 are based on the following paragraph

A current loop ABCD is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius =a) of the loop are joined by two straight wires AB and CD. A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 300. Another straight thin wire with steady current I1 flowing out of the plane of the paper is kept at the origin.



Q.28. The magnitude of the magnetic field (B) due to the loop ABCD at the origin (O) is:

1. $\frac{\mu_0 I}{4\pi}\left[2(b-a)+\frac{\pi}{3}(a+b)\right]$
2. **Zero**
3. $\frac{\mu_0 I(b-a)}{24ab}$
4. $\frac{\mu_0 I}{4\pi}\left[\frac{b-a}{ab}\right]$

Answer: (3)

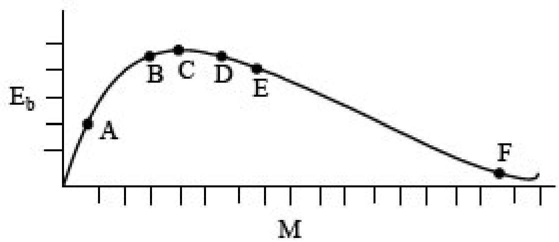
Q.29. Due to the presence of the current I1 at the origin :

1. **The magnitude of the net force on the loop is given by** $\frac{\mu_0 II_1}{24ab}(b-a)$
2. **The forces on AB and DC are zero**

3. The forces on AD and BC are zero
4. The magnitude of the net force on the loop is given by $\frac{I_1 I}{4\pi}\mu_0\left[2(b-a)+\frac{\pi}{3}(a+b)\right]$

Answer: (3)

Q.30. The above is a plot of binding energy per nucleon Eb, against the nuclear mass M; A, B, C, D, E, F correspond to different nuclei. Consider four reactions:



1. $A+B\rightarrow C+\varepsilon$
2. $C\rightarrow A+B+\varepsilon$
3. $D+E\rightarrow F+\varepsilon$ *and*
4. $F\rightarrow D+E+\varepsilon$

Where ε is the energy released? In which reactions is ε positive?

1. (ii) and (iii)
2. (i) and (iv)
3. (i) and (iii)
4. (ii) and (iv)

Answer: (2)