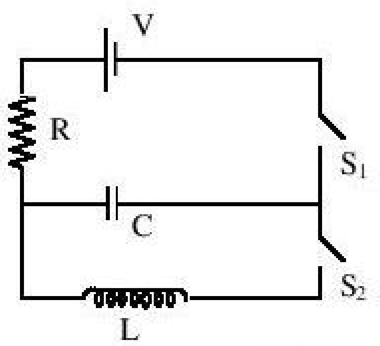
JEE (MAIN) - 2014

PHYSICS

61. In an LCR circuit as shown below both switches are open initially. Now switch S_1 is closed. S_2 kept open. (q is charge on the capacitor and $\tau = RC$ is capacitive time constant). Which of the following statement is correct?



(1) $At\, t = \tau, q = CV/2$

(2) $At\, t = 2\tau, q = CV\left(1-e^{-2}\right)$

(3) $At\, t = \frac{\tau}{2}, q = CV\left(1-e^{-1}\right)$

(4) Work done by the battery is half of the energy dissipated in the resistor.

62. A diode detector is used to detect an amplitude modulated wave of 60% modulation by using a condenser of capacity $250\,\text{pico}$ farad in parallel with a load resistance $100\,\text{kilo}$ ohm. Find the maximum modulated frequency which could be detected by it.

(1) $10.62\,\text{kHz}$

(2) $5.31\,\text{MHz}$

(3) $5.31\,\text{kHz}$

(4) $10.62\,\text{MHz}$

63. The supply voltage to a room is $120V$. The resistance of the lead wires is 6Ω. A $60W$ bulb is already switched on. What is the decrease of voltage across the bulb, when a $240W$ heater is switched on in parallel to the bulb?

(1) $2.9\,\text{Volt}$

(2) $13.3\,\text{Volt}$

(3) $10.04\,\text{Volt}$

(4) zero volt

Note: Here supply voltage is taken as rated voltage.

64. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_0 of the spring when it is in equilibrium is:

(1) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$

(2) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$

(3) $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$

(4) $\frac{Mg}{k}$

(Here k is spring constant)

65. Two charges, each equal to q, are kept at $x=-a$ and $x=a$ on the x-axis. A particle of mass m and charge $q_0=\frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement $(y \ll a)$ along the y-axis, the net force acting on the particle is proportional to:

(1) $-y$

(2) $\frac{1}{y}$

(3) $-\frac{1}{y}$

(4) y

66. A beam of unpolarised light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of $45°$ relative to that of A. The intensity of the emergent light is:

(A) $I_0/2$

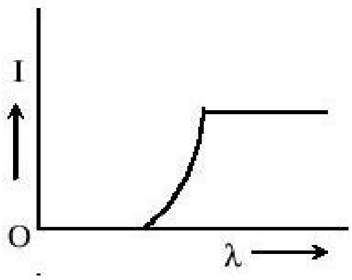
(B) $I_0/4$

(C) $I_0/8$

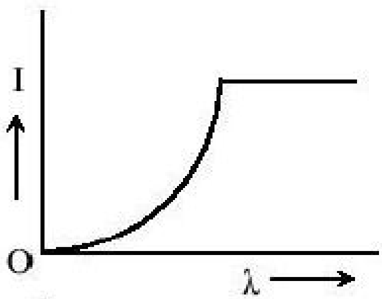
(D) I_0

67. The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows:

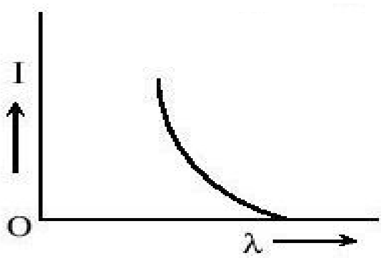
(A)



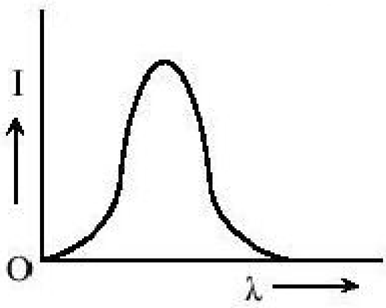
(B)



(C)



(D)



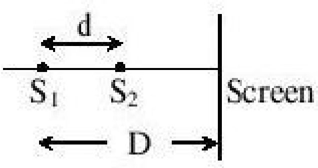
68. Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be:

(1) straight lines

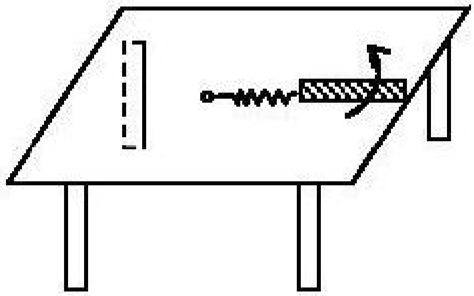
(2) semi-circles

(3) concentric circles

(4) points



69. A metallic rod of length 'ℓ' is tied to a string of length '2ℓ' and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is:



(1) $\frac{3B\omega\ell^2}{2}$

(2) $\frac{4B\omega\ell^2}{2}$

(3) $\frac{5B\omega\ell^2}{2}$

(4) $\frac{2B\omega\ell^2}{2}$

70. In a hydrogen like atom electron makes transition from an energy level with quantum number n to another with quantum number $(n-1)$. If $n \gg 1$, the frequency of radiation emitted is proportional to

(1) $\frac{1}{n^2}$

(2) $\frac{1}{n^{3/2}}$

(3) $\frac{1}{n^3}$

(4) $\frac{1}{n}$

71. Assume that a drop of liquid evaporates by decrease in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible? The surface tension is T, density of liquid is ρ and L is its latent heat of vaporization.

(1) $\sqrt{T/\rho L}$

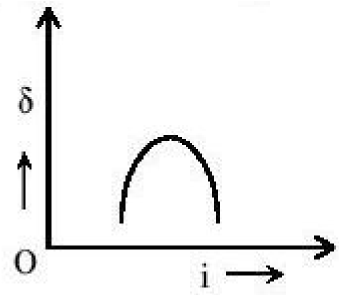
(2) $T/\rho L$

(3) $2T/\rho L$

(4) $\rho L/T$

72. The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by:

(1)



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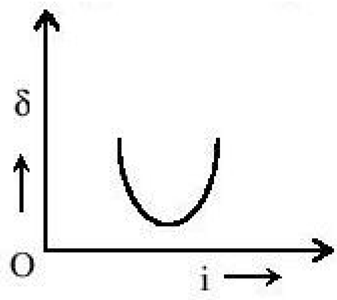

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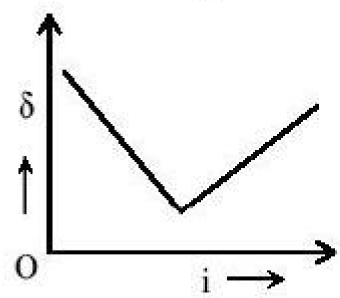

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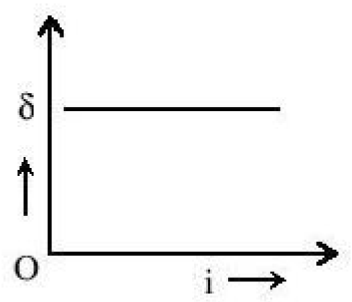


73. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If $M = mass, L = length, T = time$ and $A = electric\,current$, then:

(1) $[\varepsilon_0] = [M^{-1}L^{-3}T^{4}A^{2}]$

(2) $[\varepsilon_0] = [M^{-1}L^{2}T^{-1}A^{-2}]$

(3) $[\varepsilon_0] = [M^{-1}L^{-2}T^{-1}A]$

(4) $[\varepsilon_0] = [M^{-1}L^{-3}T^{2}A]$

74. The above p-v diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat extracted from the source in a single cycle is

(1) $\left(\frac{13}{2}\right)p_0v_0$

(2) $\left(\frac{11}{2}\right)p_0v_0$

(3) $4p_0v_0$

(4) p_0v_0

75. A sonometer wire of length 1.5m is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel if density and elasticity of steel are $7.7\times10^{3}\,\text{kg/m}^{3}$ and $2.2\times10^{11}\,\text{N/m}^{2}$ respectively?

(1) $178.2\,\text{Hz}$

(2) $200.5\,\text{Hz}$

(3) $700\,\text{Hz}$

(4) $188.5\,\text{Hz}$

76. This question has statement I and statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1: Higher the range, greater is the resistance of ammeter.

Statement- II: To increase the range of ammeter, additional shunt needs to be used across it.

(1) Statement -1 is true. Statement - II is true. Statement - II is not the correct explanation of Statement-I.

(2) Statement -1 is true, statement - II is false.

(3) Statement -1 is false. Statement - II is true

(4) Statement -1 is true. Statement - II is true. Statement - II is the correct explanation of statement-1.

77. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of $2R$?

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

(2) $\frac{GmM}{2R}$

(3) $\frac{GmM}{3R}$

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

78. A projectile is given an initial velocity of $\left(\hat{i}+2\hat{j}\right)\text{m/s}$, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If $g=10\,\text{m/s}^{2}$, the equation of its trajectory is:

(1) $y=2x-5x^{2}$

(2) $4y = 2x - 5x^2$

(3) $4y = 2x - 25x^2$

(4) $y = x - 5x^2$

$x = t$

$y = 2t - 5t^2$

Equation of trajectory is $y = 2x - 5x^2$

79. Two capacitors C_1 and C_2 are charged to $120\,\text{V}$ and $200\,\text{V}$ respectively. It is found that by connecting them together the potential on each one can be made zero. Then:

(1) $3C_1 = 5C_2$

(2) $3C_1 = 5C_2 = 0$

(3) $9C_1 = 4C_2$

(4) $5C_1 = 3C_2$

80. A hoop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip?

(1) $\frac{r\omega_0}{3}$

(2) $\frac{r\omega_0}{2}$

(3) $r\omega_0$

(4) $\frac{r\omega_0}{4}$

81. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and cylinder have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency:

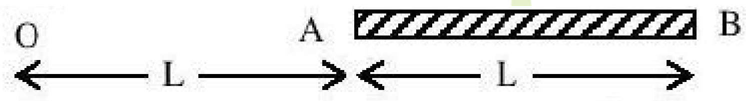
(1) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$

(2) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$

(3) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

(4) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$

82. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at a distance L from the end A is:



(1) $\frac{3Q}{4\pi\varepsilon_0 L}$

(2) $\frac{Q}{4\pi\varepsilon_0 L\, In2}$

(3) $\frac{Q\, In2}{4\pi\varepsilon_0 L}$

(4) $\frac{Q}{8\pi\varepsilon_0 L}$

83. A circular loop of radius 0.3cm lies parallel to a much bigger circular loop of radius 20cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15cm. If a current of $2.0\,A$ flows through the smaller loop, then the flux linked with bigger loop is

(1) 6×10^{-11} *weber*

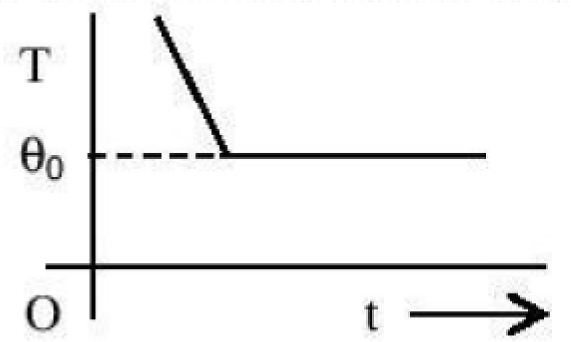
(2) 3.3×10^{-11} *weber*

(3) 6.6×10^{-9} *weber*

(4) 9.1×10^{-11} *weber*

84. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0 the graph between the temperature T of die metal and time t will be closest to:

(1)



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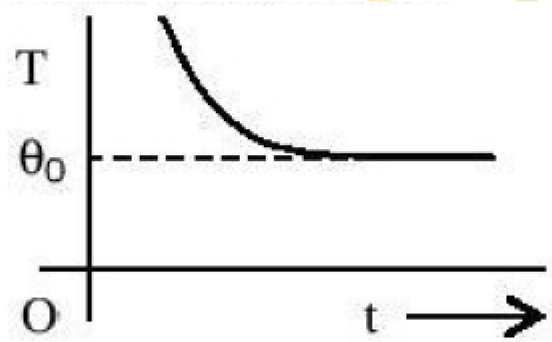

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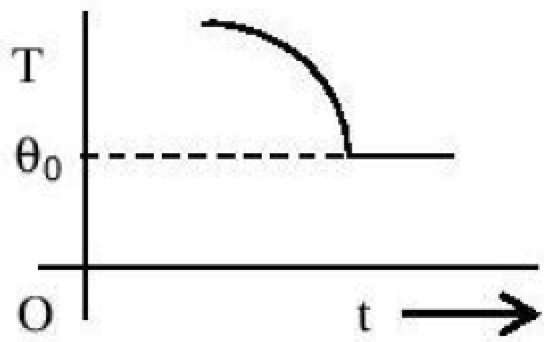

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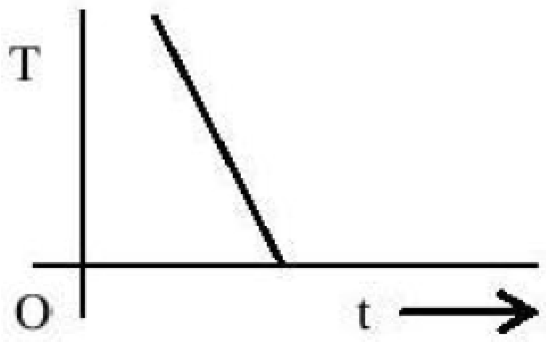
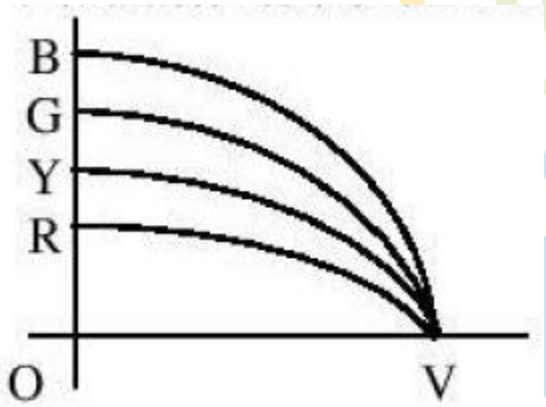


85. The I - V characteristic of an *LED* is

(1)



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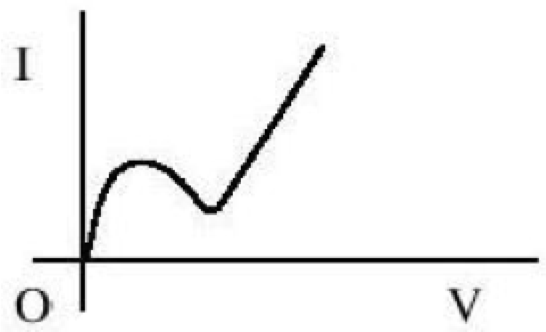

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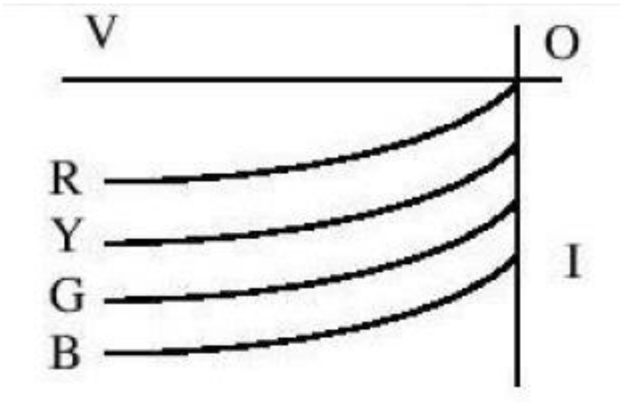

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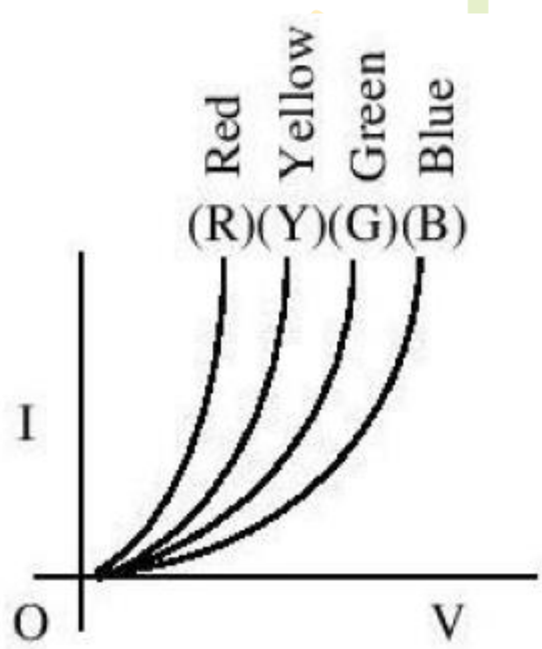

86. This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.

Statement - I: A point particle of mass m moving with speed v collides with stationary point particle of mass M. If the maximum energy loss possible is given as $f\left(\frac{1}{2}mv^2\right)$ then $f\left(\frac{m}{M+m}\right)$.

Statement - II: Maximum energy loss occurs when the particles get stuck together as a result of the collision.

(1) Statement -1 is true. Statement - II is true. Statement - II is not a correct explanation of Statement -1.

(2) Statement - I is true. Statement - II is false.

(3) Statement -I is false. Statement - II is true

(4) Statement - I is true. Statement - II is true. Statement - II is a correct explanation of Statement - I.

87. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude is $5s$. In another $10s$ it will decrease to α times its original magnitude, where α equals.

(1) 0.81

(2) 0.729

(3) 0.6

(4) 0.7

88. Diameter of plano-convex lens is 6cm and thickness at the centre is 3mm. If s peed of light in material of lens is 2×10^8 m/s, the focal length of the lens is:

(1) 20cm

(2) 30cm

(3) 10cm

(4) 15cm

89. The magnetic field in a travelling electromagnetic wave has a peak value of $20nT$. The peak value of electric field strength is:

(1) 6V/m

(2) 9V/m

(3) 12V/m

(4) 3V/m

90. Two short bar magnets of length $1\,\text{cm}$ each have magnetic moments $1.20\,\text{Am}^2$ and $1.00\,\text{Am}^2$ respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of $20.0\,\text{cm}$. The value of the resultant horizontal magnetic induction at the mid - point O of the line joining their centres is close to (Horizontal component of earth's magnetic induction is $3.6\times10^{-5}\,\text{wb/m}^2$)

(1) $2.56\times10^{-4}\,\text{Wb/m}^2$

(2) $3.50\times10^{-4}\,\text{Wb/m}^2$

(3) $5.80\times10^{-4}\,\text{Wb/m}^2$

(4) $3.6\times10^{-5}\,\text{Wb/m}^2$