JEE Main January 2024

Question Paper With Text Solution

01 February | Shift-1

PHYSICS

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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31. Two identical capacitors have same capacitance C. One of them is charged to the potential V and other to the potential 2V. The negative ends of both are connected together. When the positive ends are also joined together, the decrease in energy of the combined system is:

(1) $\frac{3}{4}CV^2$ (2) $\frac{1}{4}CV^2$ (3) $2\,CV^2$ (4) $\frac{1}{2}CV^2$

Question ID:9561771075

Ans. Official Answer NTA (2)

Sol.

32. A parallel plate capacitor has a capacitance C = 200 pF. It is connected to 230 V ac supply with an angular frequency 300 rad/s. The rms value of conduction current in the circuit and displacement current in the capacitor respectively are:

(1) 14.3 μA and 143 μA (2) 13.8 μA and 13.8 μA

(3) 13.8 μA and 138 μA (4) 1.38 μA and 1.38 μA

Question ID:9561771079

Ans. Official Answer NTA (2)

Sol.

33. The dimensional formula of angular impulse is:

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

Question ID:9561771066

Ans. Official Answer NTA (3)

Sol.

34. If R is the radius of the earth and the acceleration due to gravity on the surface of earth is $g = \pi^2\ m/s^2$, then the length of the second's pendulum at a height h = 2R from the surface of earth will be:

(1) 1/9 m (2) 4/9 m (3) 8/9 m (4) 2/9 m

Question ID:9561771071

Ans. Official Answer NTA (1)

Sol.

35. With rise in temperature, the Young's modulus of elasticity:

(1) Decreases (2) Increases (3) Remains unchanged (4) Changes erratically

Question ID:9561771072

Ans. Official Answer NTA (1)

Sol.

36. The minimum energy required by a hydrogen atom in ground state to emit radiation in Balmer series is nearly:

(1) 1.9 eV (2) 1.5 eV (3) 13.6 eV (4) 12.1 eV

Question ID:9561771082

Ans. Official Answer NTA (4)

Sol.

37. A ball of mass 0.5 kg is attached to a string of length 50 cm. The ball is rotated on a horizontal circular path about its vertical axis. The maximum tension that the string can bear is 400 N. The maximum possible value of angular velocity of the ball in rad/s is:

(1) 20 (2) 40 (3) 1000 (4) 1600

Question ID:9561771069

Ans. Official Answer NTA (2)

Sol.

38. A galvanometer has a resistance of 50 Ω and it allows maximum current of 5 mA. It can be converted into voltmeter to measure upto 100 V by connecting in series a resistor of resistance:

(1) 20020 Ω (2) 19950 Ω (3) 19500 Ω (4) 5975 Ω

Question ID:9561771077

Ans. Official Answer NTA (2)

Sol.

39. In series LCR circuit, the capacitance is changed from C to 4C. To keep the resonance frequency unchanged, the new inductance should be:

(1) reduced by $\frac{3}{4}$ L (2) reduced by $\frac{1}{4}$ L (3) increased by 2L (4) increased by 4L

Question ID:9561771078

Ans. Official Answer NTA (1)

Sol.

40. The pressure and volume of an ideal gas are related as $PV^{\frac{3}{2}} = K$ (Constant). The work done when the gas is taken from state A(P_1, V_1, T_1) to state B (P_2, V_2, T_2) is:

(1) $2\left(\sqrt{P_1}V_1 - \sqrt{P_2}V_2\right)$ (2) $2\left(P_2V_2 - P_1V_1\right)$

(3) $2\left(P_1V_1 - P_2V_2\right)$ (4) $2\left(P_2\sqrt{V_2} - P_1\sqrt{V_1}\right)$

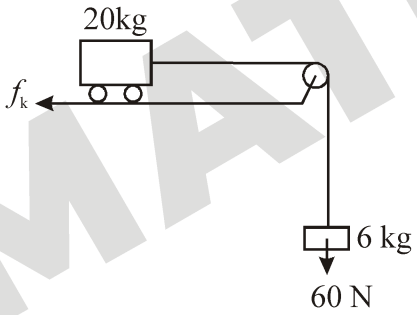
Question ID:9561771073

Ans. Official Answer NTA (3)

Sol.

41. Consider a block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04, the acceleration of the system in ms^{-2} is:

(Consider that the string is massless and unstretchable and the pulley is also massless and frictionless):



(1) 4 (2) 2 (3) 3 (4) 1.2

Question ID:9561771068

Ans. Official Answer NTA (2)

Sol.

42. The de Broglie wavelengths of a proton and an α particle are λ and 2λ respectively. The ratio of the velocities of proton and α particle will be:

(1) 8:1 (2) 1:8 (3) 4:1 (4) 1:2

Question ID:9561771081

Ans. Official Answer NTA (1)

Sol.

43. Two moles a monoatomic gas is mixed with six moles of a diatomic gas. The molar specific heat of the mixture at constant volume is:

(1) 7/4 R (2) 5/2 R (3) 9/4 R (4) 3/2 R

Question ID:9561771074

Ans. Official Answer NTA (3)

Sol.

44. A particle moving in a circle of radius R with uniform speed takes time T to complete one revolution. If this particle is projected with the same speed at an angle θ to the horizontal, the maximum height attained by it is equal to 4 R. The angle of projection θ is then given by:

(1) $\cos^{-1}\left[\frac{\pi R}{2gT^2}\right]^{\frac{1}{2}}$ (2) $\sin^{-1}\left[\frac{\pi^2 R}{2gT^2}\right]^{\frac{1}{2}}$ (3) $\sin^{-1}\left[\frac{2gT^2}{\pi^2 R}\right]^{\frac{1}{2}}$ (4) $\cos^{-1}\left[\frac{2gT^2}{\pi^2 R}\right]^{\frac{1}{2}}$

Question ID:9561771067

Ans. Official Answer NTA (3)

Sol.

45. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as

r = (0.35 ± 0.05) cm

R = (100 ± 10) ohm

l = (15 ± 0.2) cm

The percentage error in resistivity of the material of the wire is:

(1) 39.9% (2) 35.6% (3)37.3% (4) 25.6%

Question ID:9561771085

Ans. Official Answer NTA (1)

Sol.

46. 10 divisions on the main scale of a Vernier calliper coincide with 11 divisions on the Vernier scale. If each division on the main scale is of 5 units, the least count of the instrument is:

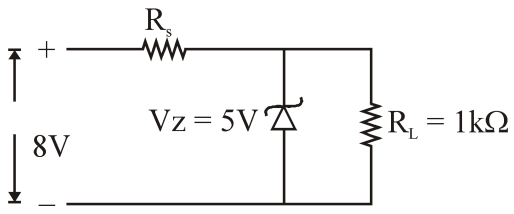
(1) 1/2 (2) 10/11 (3) 5/11 (4) 50/11

Question ID:9561771084

Ans. Official Answer NTA (3)

Sol.

47. In the given circuit if the power rating of Zener diode is 10 mW, the value of series resistance R_s to regulate the input unregulated supply is:



(1) 5 kΩ (2) 1 kΩ (3) 10 kΩ (4) 10 Ω

Question ID:9561771083

Ans. Official Answer NTA (2)

Matrix Answer (Bonus)

Sol.

48. A monochromatic light of wavelength 6000 Å is incident on the single slit of width 0.01 mm. If the diffraction pattern is formed at the focus of the convex lens of focal length 20 cm, the linear width of the central maximum is:

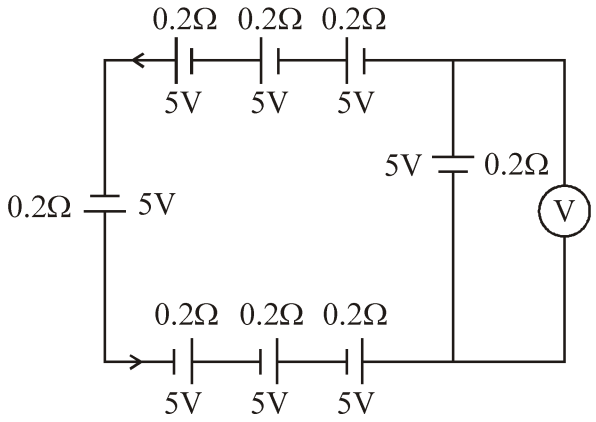
(1) 60 mm (2) 24 mm (3) 120 mm (4) 12 mm

Question ID:9561771080

Ans. Official Answer NTA (2)

Sol.

49. The reading in the ideal voltmeter (V) Shown in the given circuit diagram is:



(1) 0 V (2) 10 V (3) 5 V (4) 3 V

Question ID:9561771076

Ans. Official Answer NTA (1)

Sol.

50. A simple pendulum of length 1 m has a wooden bob of mass 1 kg. It is struck by a bullet of mass 10^{-2} kg moving with a speed of 2×10^2 ms^{-1}. The bullet gets embedded into the bob. The height to which the bob rises before swinging back is. (use $g = 10\ m/s^2$)

(1) 0.20 m (2) 0.35 m (3) 0.40 m (4) 0.30 m

Question ID:9561771070

Ans. Official Answer NTA (1)

Sol.

51. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle θ with each other. When suspended in water the angle remains the same. If density of the material of the sphere is 1.5 g/cc, the dielectric constnat of water will be _____(Take density of water = 1 g/cc)

Question ID: 9561771090

Ans. Official Answer NTA (3)

Sol.

52. The radius of a nucleus of mass number 64 is 4.8 fermi. Then the mass number of another nucleus having radius of 4 fermi is $\frac{1000}{x}$, where x is.

Question ID: 9561771095

Ans. Official Answer NTA (27)

Sol.

53. A tunning fork reasonates with a sonometer wire of length 1 m strethched with a tension of 6 N. When the tension in the wire is changed 56 N, the same tuning fork produces 12 beats per second with it. The frequency of the tuning form is ____Hz.

Question ID: 9561771089

Ans. Official Answer NTA (6)

Sol.

54. A regular polygon of 6 sides is formed by bending a wire of length 4π meter. If an electric current of $4\pi\sqrt{3}$ A is flowing through the sides of the polygon, the magnetic field at the centre of the polygon would be $x \times 10^{-7}$ T.

The value of x is.

Question ID: 9561771092

Ans. Official Answer NTA (72)

Sol.

55. A plane is in level flight at constant speed and each of its two wings has an area of 40 m^2. If the speed of the air is 180 km/h over the lower wing surface and 252 km/h over the upper wing surface, the mass of the plane ____kg. (Take air density to be 1 kg m^{-3} and g = 10 ms^{-2})

Question ID: 9561771088.

Ans. Official Answer NTA (9600)

Sol.

56. A rectangular loop of sides 12 cm and 5 cm, with its sides parallel to the x-axis and y-axis respectively, moves with a velocity of 5 cm/ s in the positive x axis direction, in a space containing a variable magnetic field in the positive z direction. The field has a gradient of 10^{-3} T/cm along the negative x direction and it is decreasing with time at the rate of 10^{-3} T/s. If the resistance of the loop is 6 mΩ, the power dissipated by the loop as heat is _____ × 10^{-9} W.

Question ID: 9561771093

Ans. Official Answer NTA (216)

Sol.

57. A particle is moving in one dimension (along x -axis) under the action of a variable force. It's initial position was 16 cm right of origin. The variation of its position (x) with time (t) is given as $x = -3t^3 + + 18t^2 + 16t$, where x is in m and t is in s. The velocity of the particle when its acceleration becomes zero is _____m/s.

Question ID: 9561771086

Ans. Official Answer NTA (52)

Sol.

58. The current in a conductor is expressed as $I = 3t^2 + 4t^3$, where I is in in Ampere and t is in second. The amount of electric charge that flows through a section of the conductor during t = 1s to t = 2s is ____C.

Question ID: 9561771091

Ans. Official Answer NTA (22)

Sol.

59. The distance between object and its 3 times magnified virtual image as produced by a convex lens is 20 cm. The focal length of the lens used is _____cm.

Question ID: 9561771094

Ans. Official Answer NTA (15)

Sol.

60. The identical spheres each of mass 2M are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 4 m each. Taking point of intersection of these two sides as origin, the magnituded of position vector of the centre of mass of system is $\frac{4\sqrt{2}}{x}$, where the value of x is.

Question ID: 9561771087

Ans. Official Answer NTA (3)

Matrix Answer NTA (2)

Sol.