JEE–MAIN EXAMINATION – APRIL 2025
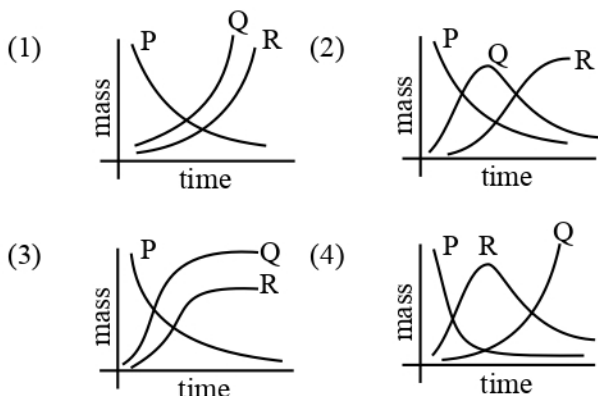
(HELD ON FRIDAY 04ᵗʰ APRIL 2025)   **TIME : 3:00 PM TO 6:00 PM**

PHYSICS

SECTION-A

26. A radioactive material P first decays into Q and then Q decays to non-radioactive material R. Which of the following figure represents time dependent mass of P, Q and R?

27. There are 'n' number of identical electric bulbs, each is designed to draw a power p independently from the mains supply. They are now joined in series across the main supply. The total power drawn by the combination is :

(1) np   (2) $\dfrac{p}{n^2}$

(3) $\dfrac{p}{n}$ (4) p

28. Consider a rectangular sheet of solid material of length $\ell = 9$ cm and width $d = 4$ cm. The coefficient of linear expansion is $\alpha = 3.1 \times 10^{-5}$ K^{-1} at room temperature and one atmospheric pressure. The mass of sheet m = 0.1 kg and the specific heat capacity $C_v = 900$ J kg^{-1}K^{-1}. If the amount of heat supplied to the material is 8.1×10^2 J then change in area of the rectangular sheet is :-

(1) 2.0×10^{-6} m^2 (2) 3.0×10^{-7} m^2
(3) 6.0×10^{-7} m^2 (4) 4.0×10^{-7} m^2

29. Given below are two statements :

Statement (I) : The dimensions of Planck's constant and angular momentum are same.

Statement (II) : In Bohr's model electron revolve around the nucleus only in those orbits for which angular momentum is integral multiple of Planck's constant.

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 correct

(2) **Statement I** is incorrect but **Statement II** is correct

(3) **Statement I** is correct but **Statement II** is incorrect

(4) Both **Statement I** and **Statement II** are incorrect

30. A cylindrical rod of length 1 m and radius 4 cm is mounted vertically. It is subjected to a shear force of 10^5 N at the top. Considering infinitesimally small displacement in the upper edge, the angular displacement θ of the rod axis from its original position would be : (shear moduli, $G = 10^{10}$ N/m^2)

(1) $1/160\pi$

(2) $1/4\pi$

(3) $1/40\pi$

(4) $1/2\pi$

31. From the combination of resistors with resistance values $R_1 = R_2 = R_3 = 5\ \Omega$ and $R_4 = 10\ \Omega$, which of the following combination is the best circuit to get an equivalent resistance of $6\ \Omega$?

(1)

R_1 R_2

R_3 R_4

(2)

R_1 R_2 R_4

R_3

(3)

R_1

R_2 R_3

R_4

(4)

R_1

R_2

R_3

R_4
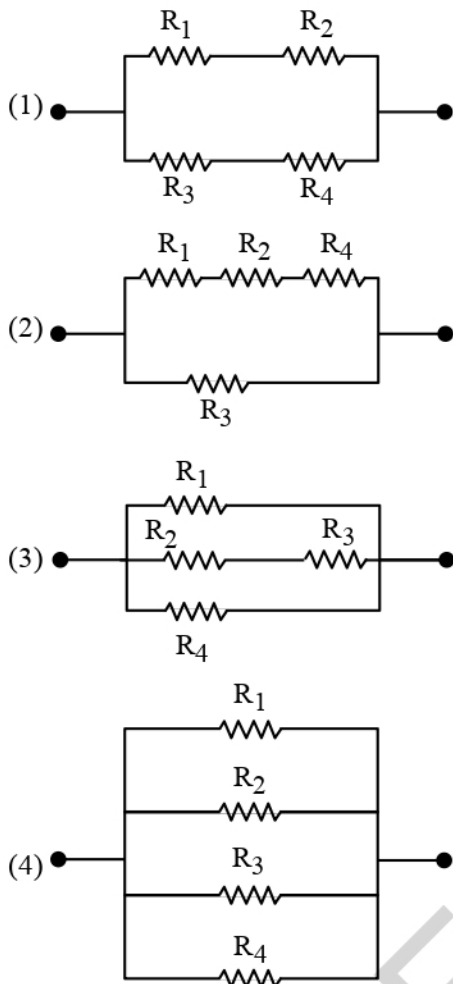
32. A metallic ring is uniformly charged as shown in figure. AC and BD are two mutually perpendicular diameters. Electric field due to arc AB to 'O' is 'E' is magnitude. What would be the magnitude of electric field at 'O' due to arc ABC ?
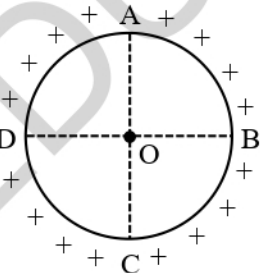
(1) 2E (2) $\sqrt{2}\,E$
(3) E/2 (4) Zero

33. There are two vessels filled with an ideal gas where volume of one is double the volume of other. The large vessel contains the gas at 8 kPa at 1000 K while the smaller vessel contains the gas at 7 kPa at 500 K. If the vessels are connected to each other by a thin tube allowing the gas to flow and the temperature of both vessels is maintained at 600 K, at steady state the pressure in the vessels will be (in kPa).

(1) 4.4 (2) 6
(3) 24 (4) 18

34. An object is kept at rest at a distance of 3R above the earth's surface where R is earth's radius. The minimum speed with which it must be projected so that it does not return to earth is :

(Assume M = mass of earth, G = Universal gravitational constant)

(1) $\sqrt{\dfrac{GM}{2R}}$ (2) $\sqrt{\dfrac{GM}{R}}$

(3) $\sqrt{\dfrac{3GM}{R}}$ (4) $\sqrt{\dfrac{2GM}{R}}$

35. Three parallel plate capacitors C_1, C_2 and C_3 each of capacitance 5 μF are connected as shown in figure. The effective capacitance between points A and B, when the space between the parallel plates of C_1 capacitor is filled with a dielectric medium having dielectric constant of 4, is :

A —— C_1 C_2 —— B

C_3
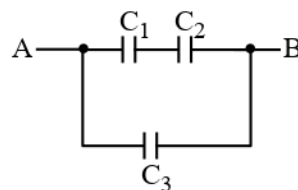
(1) 22.5 μF (2) 7.5 μF
(3) 9 μF (4) 30 μF

36. The displacement x versus time graph is shown below.
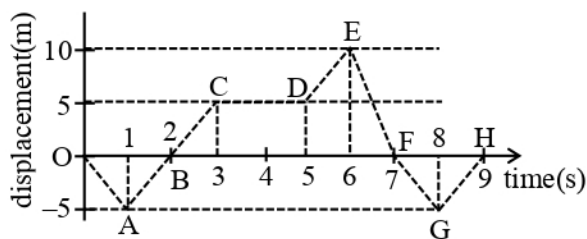
(A) The average velocity during 0 to 3 s is 10 m/s

(B) The average velocity during 3 to 5 s is 0 m/s

(C) The instantaneous velocity at t = 2 s is 5 m/s

(D) The average velocity during 5 to 7 s and instantaneous velocity at t = 6.5 s are equal

(E) The average velocity from t = 0 to t = 9 s is zero

Choose the **correct** answer from the options given below:

(1) (A), (D), (E) only

(2) (B), (C), (D) only

(3) (B), (D), (E) only

(4) (B), (C), (E) only

37. A wheel is rolling on a plane surface. The speed of a particle on the highest point of the rim is 8 m/s. The speed of the particle on the rim of the wheel at the same level as the centre of wheel, will be :

(1) $4\sqrt{2}\ \text{m}/\text{s}$

(2) 8 m/s

(3) 4 m/s

(4) $8\sqrt{2}\ \text{m}/\text{s}$

38. For the determination of refractive index of glass slab, a travelling microscope is used whose main scale contains 300 equal divisions equals to 15 cm. The vernier scale attached to the microscope has 25 divisions equals to 24 divisions of main scale. The least count (LC) of the travelling microscope is (in cm) :

(1) 0.001

(2) 0.002

(3) 0.0005

(4) 0.0025

39. A block of mass 25 kg is pulled along a horizontal surface by a force at an angle 45° with the horizontal. The friction coefficient between the block and the surface is 0.25. The block travels at a uniform velocity. The work done by the applies force during a displacement of 5 m of the block is:

(1) 970 J

(2) 735 J

(3) 245 J

(4) 490 J

40. Two polarisers P_1 and P_2 are placed in such a way that the intensity of the transmitted light will be zero. A third polariser P_3 is inserted in between P_1 and P_2, at the particular angle between P_2 and P_3. The transmitted intensity of the light passing the through all three polarisers is maximum. The angle between the polarisers P_2 and P_3 is :

(1) $\dfrac{\pi}{4}$

(2) $\dfrac{\pi}{6}$

(3) $\dfrac{\pi}{8}$

(4) $\dfrac{\pi}{3}$

41. Consider a n-type semiconductor in which n_e and n_h are number of electrons and holes, respectively.

(A) Holes are minority carriers

(B) The dopant is a pentavalent atom

(C) $n_e n_h \neq n_i^2$

(where n_i is number of electrons or holes in semiconductor when it is intrinsic form)

(D) $n_e n_h \geq n_i^2$

(E) The holes are not generated due to the donors

Choose the **correct** answer from the options given below :

(1) (A), (C), (D) only

(2) (A), (C), (E) only

(3) (A), (B), (E) only

(4) (A), (B), (C) only

42. Match **List-I** with **List-II**.

List-I	List-II
(A) Isobaric	(I) $\Delta Q = \Delta W$
(B) Isochoric	(II) $\Delta Q = \Delta U$
(C) Adiabatic	(III) ΔQ = zero
(D) Isothermal	(IV) $\Delta Q = \Delta U + P\Delta V$

ΔQ = Heat supplied

ΔW = Work done by the system

ΔU = Change in internal energy

P = Pressure of the system

ΔV = Change in volume of the system

Choose the **correct** answer from the options given below :

(1) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(2) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
(3) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(4) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

43. Displacement of a wave is expressed as

$x(t) = 5\cos\left(628t + \dfrac{\pi}{2}\right)$ m . The wavelength of the wave when its velocity is 300 m/s is :

(1) 5 m
(2) 3 m
(3) 0.5 m
(4) 0.33 m

44. A finite size object is placed normal to the principal axis at a distance of 30 cm from a convex mirror of focal length 30 cm. A plane mirror is now placed in such a way that the image produced by both the mirrors coincide with each other. The distance between the two mirrors is :

(1) 45 cm
(2) 7.5 cm
(3) 22.5 cm
(4) 15 cm

45. In an electromagnetic system, a quantity defined as the ratio of electric dipole moment and magnetic dipole moment has dimension of $[M^P L^Q T^R A^S]$. The value of P and Q are :

(1) – 1, 0
(2) – 1, 1
(3) 1, – 1
(4) 0, – 1

SECTION-B

46. A particle of charge 1.6 µC and mass 16 µg is present in a strong magnetic field of 6.28 T. The particle is then fired perpendicular to magnetic field. The time required for the particle to return to original location for the first time is _____ s.
($\pi = 3.14$)

47. A solid sphere with uniform density and radius R is rotating initially with constant angular velocity (ω_1) about its diameter. After some time during the rotation its starts loosing mass at a uniform rate, with no change in its shape. The angular velocity of the sphere when its radius become R/2 is $x\omega_1$. The value of x is _____.

48. If an optical medium possesses a relative permeability of $\dfrac{10}{\pi}$ and relative permittivity of $\dfrac{1}{0.0885}$, then the velocity of light is greater in vacuum than that in this medium by _____ times.
($\mu_0 = 4\pi \times 10^{-7}$ H/m, $\epsilon_0 = 8.85 \times 10^{-12}$ F/m, $c = 3 \times 10^8$ m/s)

49. In a Young's double slit experiment, two slits are located 1.5 mm apart. The distance of screen from slits is 2 m and the wavelength of the source is 400 nm. If the 20 maxima of the double slit pattern are contained within the centre maximum of the single slit diffraction pattern, then the width of each slit is $x \times 10^{-3}$ cm, where x-value is _____.

50. An inductor of self inductance 1 H connected in series with a resistor of 100 π ohm and an ac supply of 100 π volt, 50 Hz. Maximum current flowing in the circuit is _____ A.

4