

# FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Saturday 06<sup>th</sup> April, 2024)

TIME : 3 : 00 PM to 6 : 00 PM

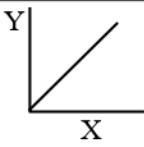
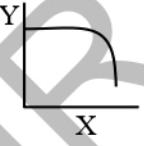
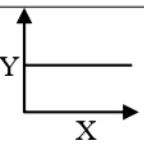
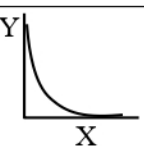
## PHYSICS

### SECTION-A

31. The longest wavelength associated with Paschen series is : (Given  $R_H = 1.097 \times 10^7$  SI unit)
- (1)  $1.094 \times 10^{-6}$  m      (2)  $2.973 \times 10^{-6}$  m  
(3)  $3.646 \times 10^{-6}$  m      (4)  $1.876 \times 10^{-6}$  m
32. A total of 48 J heat is given to one mole of helium kept in a cylinder. The temperature of helium increases by  $2^\circ\text{C}$ . The work done by the gas is : (Given,  $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ .)
- (1) 72.9 J      (2) 24.9 J  
(3) 48 J      (4) 23.1 J
33. In finding out refractive index of glass slab the following observations were made through travelling microscope 50 vernier scale division = 49 MSD; 20 divisions on main scale in each cm
- For mark on paper  
MSR = 8.45 cm, VC = 26
- For mark on paper seen through slab  
MSR = 7.12 cm, VC = 41
- For powder particle on the top surface of the glass slab  
MSR = 4.05 cm, VC = 1
- (MSR = Main Scale Reading, VC = Vernier Coincidence)
- Refractive index of the glass slab is:
- (1) 1.42      (2) 1.52  
(3) 1.24      (4) 1.35
34. In the given electromagnetic wave  $E_y = 600 \sin(\omega t - kx) \text{ Vm}^{-1}$ , intensity of the associated light beam is (in  $\text{W/m}^2$ ); (Given  $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )
- (1) 486      (2) 243  
(3) 729      (4) 972
35. Assuming the earth to be a sphere of uniform mass density, a body weighed 300 N on the surface of earth. How much it would weigh at  $R/4$  depth under surface of earth ?
- (1) 75 N      (2) 375 N  
(3) 300 N      (4) 225 N
36. The acceptor level of a p-type semiconductor is 6eV. The maximum wavelength of light which can create a hole would be : Given  $hc = 1242 \text{ eV nm}$ .
- (1) 407 nm      (2) 414 nm  
(3) 207 nm      (4) 103.5 nm
37. A car of 800 kg is taking turn on a banked road of radius 300 m and angle of banking  $30^\circ$ . If coefficient of static friction is 0.2 then the maximum speed with which car can negotiate the turn safely : ( $g = 10 \text{ m/s}^2$ ,  $\sqrt{3} = 1.73$ )
- (1) 70.4 m/s      (2) 51.4 m/s  
(3) 264 m/s      (4) 102.8 m/s
38. Two identical conducting spheres P and S with charge Q on each, repel each other with a force 16N. A third identical uncharged conducting sphere R is successively brought in contact with the two spheres. The new force of repulsion between P and S is :
- (1) 4 N      (2) 6 N  
(3) 1 N      (4) 12 N
39. In a coil, the current changes from  $-2 \text{ A}$  to  $+2 \text{ A}$  in 0.2 s and induces an emf of 0.1 V. The self-inductance of the coil is :
- (1) 5 mH      (2) 1 mH  
(3) 2.5 mH      (4) 4 mH

40. For the thin convex lens, the radii of curvature are at 15 cm and 30 cm respectively. The focal length the lens is 20 cm. The refractive index of the material is :
- (1) 1.2 (2) 1.4  
(3) 1.5 (4) 1.8
41. Energy of 10 non rigid diatomic molecules at temperature T is :
- (1)  $\frac{7}{2} RT$  (2)  $70 K_B T$   
(3)  $35 RT$  (4)  $35 K_B T$
42. A body of weight 200 N is suspended form a tree branch thought a chain of mass 10 kg. The branch pulls the chain by a force equal to (if  $g = 10 \text{ m/s}^2$ ):
- (1) 150 N (2) 300 N  
(3) 200 N (4) 100 N
43. When UV light of wavelength 300 nm is incident on the metal surface having work function 2.13 eV, electron emission takes place. The stopping potential is : (Given  $hc = 1240 \text{ eV nm}$ )
- (1) 4 V (2) 4.1 V  
(3) 2 V (4) 1.5 V
44. The number of electrons flowing per second in the filament of a 110 W bulb operating at 220 V is : (Given  $e = 1.6 \times 10^{-19} \text{ C}$ )
- (1)  $31.25 \times 10^{17}$  (2)  $6.25 \times 10^{18}$   
(3)  $6.25 \times 10^{17}$  (4)  $1.25 \times 10^{19}$
45. When kinetic energy of a body becomes 36 times of its original value, the percentage increase in the momentum of the body will be :
- (1) 500% (2) 600%  
(3) 6% (4) 60%
46. Pressure inside a soap bubble is greater than the pressure outside by an amount : (given : R = Radius of bubble, S = Surface tension of bubble)
- (1)  $\frac{4S}{R}$  (2)  $\frac{4R}{S}$   
(3)  $\frac{S}{R}$  (4)  $\frac{2S}{R}$

47. Match List-I with List-II

List-I (Y vs X)		List-II (Shape of Graph)	
(A)	Y = magnetic susceptibility X = magnetising field	(I)	
(B)	Y = magnetic field X = distance from centre of a current carrying wire for $x < a$ (where $a$ =radius of wire)	(II)	
(C)	Y = magnetic field X = distance from centre of a current carrying wire for $x > a$ (where $a$ = radius of wire)	(III)	
(D)	Y = magnetic field inside solenoid X = distance from center	(IV)	

Choose the correct answer from the options given below :

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

48. In a vernier calliper, when both jaws touch each other, zero of the vernier scale shifts towards left and its 4<sup>th</sup> division coincides exactly with a certain division on main scale. If 50 vernier scale divisions equal to 49 main scale divisions and zero error in the instrument is 0.04 mm then how many main scale divisions are there in 1 cm ?
- (1) 40 (2) 5  
(3) 20 (4) 10

49. Given below are two statements :

**Statement (I) :** Dimensions of specific heat is  $[L^2 T^{-2} K^{-1}]$

**Statement (II) :** Dimensions of gas constant is  $[M L^2 T^{-1} K^{-1}]$

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

50. A body projected vertically upwards with a certain speed from the top of a tower reaches the ground in  $t_1$ . If it is projected vertically downwards from the same point with the same speed, it reaches the ground in  $t_2$ . Time required to reach the ground, if it is dropped from the top of the tower, is :

- (1)  $\sqrt{t_1 t_2}$
- (2)  $\sqrt{t_1 - t_2}$
- (3)  $\sqrt{\frac{t_1}{t_2}}$
- (4)  $\sqrt{t_1 + t_2}$

### SECTION-B

51. In Franck-Hertz experiment, the first dip in the current-voltage graph for hydrogen is observed at 10.2 V. The wavelength of light emitted by hydrogen atom when excited to the first excitation level is \_\_\_\_\_ nm.

(Given  $hc = 1245 \text{ eV nm}$ ,  $e = 1.6 \times 10^{-19} \text{ C}$ ).

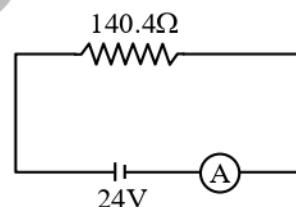
52. For a given series LCR circuit it is found that maximum current is drawn when value of variable capacitance is 2.5 nF. If resistance of  $200\Omega$  and 100 mH inductor is being used in the given circuit. The frequency of ac source is \_\_\_\_\_  $\times 10^3 \text{ Hz}$ .  
(given  $\pi^2 = 10$ )

53. A particle moves in a straight line so that its displacement  $x$  at any time  $t$  is given by  $x^2 = 1 + t^2$ . Its acceleration at any time  $t$  is  $x^{-n}$  where  $n =$  \_\_\_\_\_.

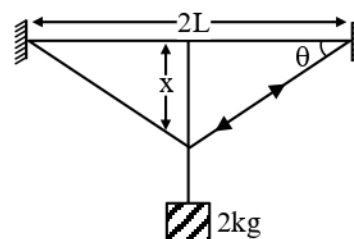
54. Three balls of masses 2kg, 4kg and 6kg respectively are arranged at centre of the edges of an equilateral triangle of side 2 m. The moment of inertia of the system about an axis through the centroid and perpendicular to the plane of triangle, will be \_\_\_\_\_  $\text{kg m}^2$ .

55. A coil having 100 turns, area of  $5 \times 10^{-3} \text{ m}^2$ , carrying current of 1 mA is placed in uniform magnetic field of 0.20 T such a way that plane of coil is perpendicular to the magnetic field. The work done in turning the coil through  $90^\circ$  is \_\_\_\_\_  $\mu\text{J}$ .

56. In the given figure an ammeter A consists of a  $240\Omega$  coil connected in parallel to a  $10\Omega$  shunt. The reading of the ammeter is \_\_\_\_\_ mA.



57. A wire of cross sectional area  $A$ , modulus of elasticity  $2 \times 10^{11} \text{ Nm}^{-2}$  and length 2 m is stretched between two vertical rigid supports. When a mass of 2 kg is suspended at the middle it sags lower from its original position making angle  $\theta = \frac{1}{100}$  radian on the points of support. The value of  $A$  is \_\_\_\_\_  $\times 10^{-4} \text{ m}^2$  (consider  $x \ll L$ ).  
(given :  $g = 10 \text{ m/s}^2$ )



58. Two coherent monochromatic light beams of intensities  $I$  and  $4I$  are superimposed. The difference between maximum and minimum possible intensities in the resulting beam is  $x I$ . The value of  $x$  is \_\_\_\_\_.

59. Two open organ pipes of length 60 cm and 90 cm resonate at 6<sup>th</sup> and 5<sup>th</sup> harmonics respectively. The difference of frequencies for the given modes is \_\_\_\_\_ Hz.

(Velocity of sound in air = 333 m/s)

60. A capacitor of  $10 \mu\text{F}$  capacitance whose plates are separated by 10 mm through air and each plate has area  $4 \text{ cm}^2$  is now filled equally with two dielectric media of  $K_1 = 2$ ,  $K_2 = 3$  respectively as shown in figure. If new force between the plates is 8 N. The supply voltage is \_\_\_\_\_ V.

