

IIT JAM 2024 NAT Model Questions

Subject - Physics (PH)

Q.1 A satellite is revolving around the Earth in a closed orbit. The height of the satellite above Earth's surface at perigee and apogee are 2500 km and 4500 km, respectively. Consider the radius of the Earth to be 6500 km. The eccentricity of the satellite's orbit is ____ (Round off to 1 decimal place).

Q.2 Three masses $m_1 = 1$, $m_2 = 2$ and $m_3 = 3$ are located on the x -axis such that their centre of mass is at $x = 1$. Another mass $m_4 = 4$ is placed at x_0 and the new centre of mass is at $x = 3$. The value of x_0 is _____.

Q.3 A normal human eye can distinguish two objects separated by 0.35 m when viewed from a distance of 1.0 km. The angular resolution of the eye is _____ seconds (Round off to the nearest integer).

Q.4 A rod with a proper length of 3 m moves along x -axis, making an angle of 30° with respect to the x -axis. If its speed is $c/2$ m/s, where c is the speed of light, the change in length due to Lorentz contraction is ____ m (Round off to 2 decimal places). [Use $c = 3 \times 10^8$ m/s]

Q.5 Consider a unit circle C in the xy plane with centre at the origin. The line integral of the vector field, $F(x, y, z) = -2y\hat{x} - 3z\hat{y} + x\hat{z}$, taken anticlockwise over C is _____ π .

Q.6 A vehicle of mass 600 kg with an engine operating at constant power P accelerates from rest on a straight horizontal road. The vehicle covers a distance of 600 m in 1 minute. Neglecting all losses, the magnitude of P is _____ kW. (Round off to 2 decimal places)

Q.7 The angular momentum of a particle relative to origin varies with time (t) as $L = (4\hat{x} + \alpha t^2\hat{y})$ kg m²/s, where $\alpha = 1$ kg m²/s³. The angle between L and the torque acting on the particle becomes 45° after a time of _____ s.

Q.8 Two transverse waves $y_1 = 5 \cos(kx - \omega t)$ cm, and $y_2 = 5 \cos(kx + \omega t)$ cm, travel on a string along x -axis. If the speed of a point at $x = 0$ is zero at $t = 0$ s, 0.25 s and 0.5 s, then the minimum frequency of the waves is _____ Hz.

Q.9 A body at a temperature T is brought into contact with a reservoir at temperature $2T$. Thermal equilibrium is established at constant pressure. The heat capacity of the body at constant pressure is C_p . The total change in entropy of the body and the reservoir in units of C_p is _____. (Round off to 2 decimal places)

Q.10 One mole of an ideal monatomic gas at pressure P , volume V and temperature T is expanded isothermally to volume $4V$. Thereafter, the gas is heated isochorically (at constant volume) till its pressure becomes P . If R is the universal gas constant, the total heat transfer in the process, in units of RT is _____. (Round off to 2 decimal places)

Q.11 The radioactive nuclei ^{40}K decay to ^{40}Ar with a half-life of 1.25×10^9 years. The $^{40}\text{K}/^{40}\text{Ar}$ isotopic ratio for a particular rock is found to be 50. The age of the rock is $m \times 10^7$ years. The value of m is _____. (Round off to 2 decimal place)

Q.12 A body of mass 1 kg is moving under a central force in an elliptic orbit with semi major axis 1000 m and semi minor axis 100 m. The orbital angular momentum of the body is $100 \text{ kg m}^2 \text{ s}^{-1}$. The time period of motion of the body is _____ hours. (Specify your answer in hours up to two digits after the decimal point.)

Q.13 The moon moves around the earth in a circular orbit with a period of 27 days. The radius of the earth (R) is 6.4×10^6 m and the acceleration due to gravity on the earth surface is 9.8 ms^{-2} . If D is the distance of the moon from the centre of the earth, the value of D/R will be _____. (Specify your answer up to one digit after the decimal point.)

Q.14 A syringe is used to exert 1.5 atmospheric pressure to release water horizontally. The speed of water immediately after ejection is _____. (take 1 atmospheric pressure = 10^5 Pascal, density of water = 10^3 kg m^{-3}) (Specify your answer in ms^{-1} as an integer.)

Q.15 Consider a slit of width $18 \mu\text{m}$ which is being illuminated simultaneously with light of orange colour (wavelength 600 nm) and of blue colour (wavelength 450 nm). The diffraction pattern is observed on a screen kept at a distance in front of the slit. The smallest angle at which only the orange colour is observed is θ_1 , and the smallest angle at which only the blue colour is observed is θ_2 . The angular difference $\theta_2 - \theta_1$ (in degrees) is _____. (Specify your answers up to two digits after the decimal point.)

ANSWER KEY

Question No.	Question Type (QT)	Subject Name (SN)	Key/Range (KY)	Mark (MK)
1	NAT	PH	0.1 to 0.1	1
2	NAT	PH	6 to 6	1
3	NAT	PH	71 to 73	1
4	NAT	PH	-0.31 to -0.29 or 0.29 to 0.31	1

5	NAT	PH	2 to 2	1
6	NAT	PH	1.11 to 1.13	2
7	NAT	PH	1.9 to 2.1	2
8	NAT	PH	2 to 2	2
9	NAT	PH	0.19 to 0.20	2
10	NAT	PH	5.88 to 5.94	2
11	NAT	PH	3.55 to 3.65	2
12	NAT	PH	1.70 to 1.80	2
13	NAT	PH	59.0 to 60.0	2
14	NAT	PH	10 to 10	2
15	NAT	PH	0.45 to 0.55	2

CollegeDekho