Section A

Q1 Masses   are placed at the corners   respectively of a square   of diagonal . The distance of centre of mass from   will be   [MP PMT 1999]
   (a) $20 cm$ (b) $30 cm$ (c) $40 cm$ (d) $60 cm$

Q2 The coordinates of the positions of particles of mass 7,4" and 10" gm are ("1,5,"-3),("2," 5,7) and ("3,3,"-1)cm respectively. The position of the centre of mass of the system would be
   (a) $\left(-\frac{15}{7}, \frac{85}{17}, \frac{1}{7}\right) cm$
   (b) $\left(\frac{15}{7}, -\frac{85}{17}, \frac{1}{7}\right) cm$
   (c) $\left(\frac{15}{7}, \frac{85}{21}, -\frac{1}{7}\right) cm$
   (d) $\left(\frac{15}{7}, \frac{85}{21}, \frac{7}{3}\right) cm$

Q3 The wheel of a car is rotating at the rate of 1200 revolutions per minute. On pressing the accelerator for 10 sec it starts rotating at 4500 revolutions per minute. The angular acceleration of the wheel is
   (a) 30 radians/sec2   (b) 1880 degrees/sec2   (c) 40 radians/sec2   (d) 1980 degrees/sec2

Q4 A wheel is at rest. Its angular velocity increases uniformly and becomes 60 rad/sec after 5 sec. The total angular displacement is
   (a) $600 rad$ (b) $75 rad$ (c) $300 rad$ (d) $150 rad$

Q5 Moment of inertia of a uniform circular disc about a diameter is I. Its moment of inertia about an axis perpendicular to its plane and passing through a point on its rim will be
   (a)   5 I   (b)   6 I   (c)   3 I   (d)   4 I

Q6 Three point masses each of mass mare placed at the corners of an equilateral triangle of side a. Then the moment of inertia of this system about an axis passing along one side of the triangle is
   (a) ma^2 (b) $3ma^2$ (c) $\frac{3}{4}ma^2$ (d) $\frac{2}{3}ma^2$

Q7 The moment of inertia of a solid sphere of density ρ and radius R about its diameter is
   (a) $\frac{105}{176}R^5\rho$ (b) $\frac{105}{176}R^2\rho$ (c) $\frac{176}{105}R^5\rho$ (d) $\frac{176}{105}R^2\rho$

Q8 A horizontal heavy uniform bar of weight W is supported at its ends by two men. At the instant, one of the men lets go off his end of the rod, the other feels the force on his hand changed to
   (a) W   (b) $\frac{W}{2}$ (c) $\frac{3W}{4}$ (d) $\frac{W}{4}$

Q9 The gravitational force between two objects does not depend on
   (a)   Sum of the masses   (b)   Product of the masses
   (c)   Gravitational constant   (d)   Distance between the masses

Q10 The mass of the moon is about 1.2% of the mass of the earth. Compared to the gravitational force the earth exerts on the moon, the gravitational force the moon exerts on earth

(a) Is the same   (b) Is smaller   (c) Is greater   (d) Varies
with its phase

Q11 .The moon's radius is 1/4 that of the earth and its mass is 1/80 times that of the earth. If g represents the acceleration due to gravity on the surface of the earth, that on the surface of the moon is

(a) $\frac{g}{4}$ (b) $\frac{g}{5}$ (c) $\frac{g}{6}$ (d) $\frac{g}{8}$

Q12 At surface of earth weight of a person is 72 N then his weight at height R/2 from surface of earth is (R = radius of earth)
(a)   28N   (b)   16N   (c)   32N   (d)   72N

Q13 Weight of a body of mass m decreases by 1% when it is raised to height h above the earth's surface. If the body is taken to a depth h in a mine, change in its weight is
(a)   2% decrease   (b)   0.5% decrease (c)   1% increase   (d)   0.5% increase

Q14 The depth d at which the value of acceleration due to gravity becomes 1/n times the value at the surface, is [R = radius of the earth]
(a)   R/n   (b)   R((n-1)/n)   (c)   R/n^2   (d)   R(n/(n+1))

Q15 If earth stands still what will be its effect on man's weight
a) Increases   (b) Decreases   (c)   Remains same (d)   None of these

Q16 Infinite bodies, each of mass 3kg are situated at distances 1m, 2m, 4m, 8m....... respectively on x-axis. The resultant intensity of gravitational field at the origin will be
(a)   G   (b)   2G   (c)   3G   (d)   4G

Q17 The distance of a planet from the sun is 5 times the distance between the earth and the sun. The Time period of the planet is
(a) $5^{3/2} years$ (b) $5^{2/3} years$ (c) $5^{1/3} years$(d) $5^{1/2} years$

Q18 .Two satellites A and B go round a planet P in circular orbits having radii 4R and R respectively. If the speed of the satellite A is 3V, the speed of the satellite B will be
(a)   12 V   (b)   6 V   (c)   3/2 V   (d)   3/2 V

Q19 A satellite is launched into a circular orbit of radius 'R' around earth while a second satellite is launched into an orbit of radius 1.02 R. The percentage difference in the time periods of the two satellites is
(a)   0.7   (b)   1.0   (c)   1.5   (d)   3

Q20 .A and B are two wires. The radius of A is twice that of B. they are stretched by the same load. Then the stress on B is
(a)   Equal to that on A   (b)   Four times that on A
(c)   Two times that on A   (d)   Half that on A

Q21 In the above question, when is the shearing stress maximum
(a) $(\theta = 0^o$ (b)$\theta = 30^o$ (c) $\theta = 45^o$ (d) $\theta = 90^o$

Q22 A wire is stretched to double its length. The strain is
(a) 2   (b)   1   (c)   Zero   (d)   0.5

Q23 The diameter of a brass rod is 4 mm and Young's modulus of brass is $9 \times 10^{10} \, N/m^2$. The force required to stretch by 0.1% of its length is

(a)360 πN   (b) 36 N   (c) $144 \, \pi \times 10^3 \, N$ (d) $36 \pi \times 10^5 \, N$

Section B

Q24 State the condition for translational equilibrium of a body?
Q25 How is angular momentum related to linear momentum?
Q26 What are the factors on which moment of inertia of a body depends?

Q27 Which component of a force does not contribute towards torque?

Q28 To maintain a rotor at a uniform angular speed of 200 rad , an engine needs to transmit a torque of 180 Nm. What is the power required by the engine?

Q29 Why is gravitational potential energy always negative?

Q30 The gravitational force between two blocks is F what would happen if a mass of both the blocks as well as distance between them is doubled?

Q31 Where will a body weigh more at Delhi or at Shimla? Why?

Q32 .On which fundamental law of physics is keplers second law is based?

Q33 Distance between two bodies is increased to three times its original value. What is the effect on the gravitational force between them?

Q34 Which is greater the attraction of the earth for 1 kg of aluminum or aluminum or attraction of 1kg of aluminum for the earth?

Q35 The stretching of a coil spring is determined by its shear modulus. Why?

Q36 What are ductile and brittle materials?

Q37 Compute the fractional change in volume of a glass slab, when subjected to a hydraulic pressure of 10 atm.

Q38 State Hooke's law?

Section C

Q39 A planet revolves around on massive star in a highly elliptical orbit is its angular momentum constant over the entire orbit. Give reason?

Q40 Prove that the centre of mass of two particles divides the line joining the particles in the inverse ratio of their masses?

Q41 Show that for an isolated system the centre of mass moves with uniform velocity along a straight line path?

Q42 The angle θ covered by a body in rotational motion is give by the equation $\theta = 6t + 5t\,2 + 2t\,3$. Determine the value of instantaneous angular velocity and angular acceleration at time t = 2S.

Q43 A bullet of mass 10 g and speed 500 m/s is fired into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weighs 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. Find the angular speed of the door just after the bullet embeds into it.

Q44 What is kepler's law of periods? Show it mathematically?

Q45 With two characteristics of gravitational force?

Q46 If radius of earth is 6400km, what will be the weight of 1 quintal body if taken to the height of 1600 km above the sea level?

Q47 State two essential requisites of geostationary satellite?

Q48 An astronaut inside a small space ship orbiting around the earth cannot detect gravity. If the space station orbiting around the earth has a large size, can he hope to detect gravity?

Q49 A comet orbits the Sun in a highly elliptical orbit. Does the comet have a constant (a) linear speed, (b) angular speed, (c) angular momentum, (d) kinetic energy, (e) potential energy, (f) total energy throughout its orbit? Neglect any mass loss of the comet when it comes very close to the Sun.

Q50 Compute the bulk modulus of water from the following data: Initial volume = 100.0 litre, Pressure increase = 100.0 atm (1 atm =1.013 x 105 Pa), Final volume = 100.5 litre. Compare the bulk modulus of water with that of air (at constant temperature). Explain in simple terms why the ratio is so large.

Q51 A rigid bar of mass 15 kg is supported symmetrically by three wires each 2.0 m long. Those at each end are of copper and the middle one is of iron. Determine the ratio of their diameters if each is to have the same tension.

Q52 What is poison's ratio

Section D

Q53 A circular ring of diameter 40cm and mass 1kg is rotating about an axis normal to its plane and passing through the centre with a frequency of 10 rotations per second. Calculate the angular momentum about its axis of rotation?

Q54 A metre stick is balanced on a knife edge at its centre. When two coins, each of mass 5 g are put one on top of the other at the 12.0 cm mark, the stick is found to be balanced at 45.0 cm. What is the mass of the metre stick?

Q55 Which physical quantities are represented by the (i) Rate of change of angular momentum (ii) Product of I and w

Q56 Four particles of mass 1kg, 2kg, 3kg and 4kg are placed at the four vertices A, B, C and D of square of side 1m. Find the position of centre of mass of the particle.

Q57 (a) Why is moment of inertia called rotational inertia? (b) Calculate M.I of a uniform circular disc of mass 500gm and radius 10cm about (i) Diameter (ii) axis tangent to the disc and parallel to diameter (c) Axis passing trough centre and perpendicular to its plane?

Q58 A satellite is revolving is a circular path close to a planet of density P. find an expression for its period of revolution?

Q59 Obtain on expression showing variation of acceleration due to gravity with height?

Q60 Suppose there existed a planet that went around the sun twice as fast as the earth. What would be its orbital size as compared to that of the earth?

Q61 Assuming the earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the earth if it weighed 250 N on the surface?

Q62 A star 2.5 times the mass of the sun and collapsed to a size of 12 km rotates with a speed of 1.2 rev. per second. (Extremely compact stars of this kind are known as neutron stars. Certain stellar objects called pulsars belong to this category). Will an object placed on its equator remain stuck to its surface due to gravity? (mass of sun = 2 X 1030 kg)

Q63 Define strain, define different type of strain

Section E

Q64 (a) A cat is able to land on its feet after a fall. Why? (b) If angular momentum moment of inertia is decreased, will its rotational be also conserved? Explain.

Q65 Derive an expression for the torque acting on a body.

Q66 State and prove law of conservation of angular momentum

Q67 Obtain an expression for angular momentum in polar form

Q68 Derive an expression for the relation between torque and angular acceleration

Q69 Define Gravitational potential energy Hence deduces an expression for gravitational potential energy of a body placed at a point sear the surface of earth?

Q70 Two stars each of one solar mass (=2 X 1030 kg) are approaching each other for a head on collision. When they are a distance 109 km, their speeds are negligible. What is the speed with which they collide? The radius of each star is 104 km. Assume the stars to remain undistorted until they collide. (Use the known value of G).

Q71 Two heavy spheres each of mass 100 kg and radius 0.10 m are placed 1.0 m apart on a horizontal table. What is the gravitational force and potential at the mid point of the line joining the centers of the spheres? Is an object placed at that point in equilibrium? If so, is the equilibrium stable or unstable?

Q72 What is the density of water at a depth where pressure is 80.0 atm, given that its density at the surface is 1.03 x 103 kg/m-3

Q73 What is stress. Define different types of stress