

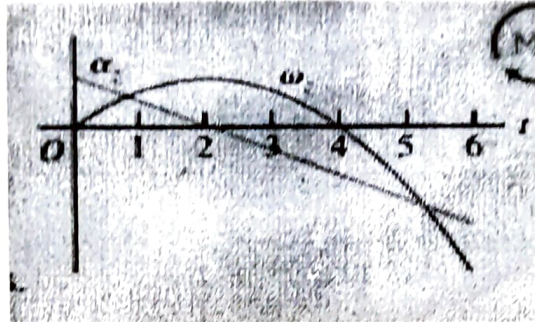
SECTION-A

Scientific calculators are allowed

Answer all the questions, each question carries 1 mark

(20×1=20 Marks)

1) The figure shows the graph of angular velocity and angular acceleration Vs time of rotating body, during which time intervals is the rotation speeding up



a) $0 < t < 1 \text{ s}$ b) $0 < t < 2 \text{ s}$ c) $1 < t < 2 \text{ s}$ d) $1 < t < 4 \text{ s}$

2) Two hollow cylinders have the same mass and radii but they have different lengths. One is made of low density wood and other of high density lead. Which cylinder has the greatest moment of inertia around its axis of symmetry.

a) the wood cylinder b) the lead cylinder c) two moments of inertia are equal d) none

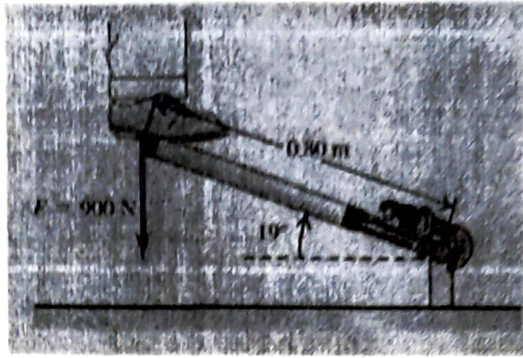
3) An airplane propeller is rotating at 1800 rpm. Compute the propeller's angular velocity in rad/s

a) 60π b) 120π c) 180π d) 30π

4) To maintain a rotor at a uniform angular speed of 50 rad s^{-1} , an engine needs to transmit a torque of 200 Nm. What is the power required by the engine in kW ?

a) 15 b) 20 c) 18 d) 10

5) Find the magnitude and direction of the torque the plumber applies about the center of the fitting as shown in the figure



- a) 680 N-m b) -680 N-m c) 234.4 N-m d) -234.4 N-m

6) You apply equal torques to two different cylinders, one of which has a moment of inertia twice as large as the other cylinder. Each cylinder is initially at rest. After one complete rotation, which cylinder has the greater kinetic energy?

- a) the cylinder with the larger moment of inertia
b) the cylinder with the smaller moment of inertia
c) both cylinders have the same kinetic energy.
d) None of the above

7) The angle θ covered by a body in rotational motion is given by the equation $\theta = 2t + 3t^2 + 4t^3$. Determine the value of instantaneous angular acceleration at time $t = 2s$

- A) 24 rad/s² b) 62 rad/s² c) 24 rad/s² d) 54 rad/s²

8) When a torque acting on a system is zero, then which of the following should not change?
(a) Linear velocity
(b) Angular momentum
(c) Angular displacement
(d) Force acting on the body

9) A particle oscillating under a force is called linear harmonic oscillator if such force is directly proportional to

- a) x^2 b) x c) x^3 d) x^0

10) What fraction of the total energy is Kinetic Energy when the displacement is one half of a amplitude of a particle executing SHM ?

- (a) 1/2 (b) 3/2 (c) 3/4 (d) 1/4

11) a body in a spring mass system oscillates back and forth . For the values of the body's velocity, $v = 0$ and acceleration, $a < 0$, state whether its displacement x is

- a) positive b) negative c) zero d) none

12)for a spring mass system oscillating under SHM , the potential and kinetic energies are equal at a displacement $x =$

- a) $A/2$ b) A c) 0 d) $0.707 A$

13)which force term in case of simple pendulum acts like a restoring force

- a) Tension (T) b) $mg\cos(\theta)$ c) $T - mg\cos(\theta)$ d) $mg\sin(\theta)$

14)The phenomenon of increase in amplitude when the driving force frequency is close to the natural frequency of the oscillator is called

- a)Damping oscillations b) free oscillations c)resonance d) All

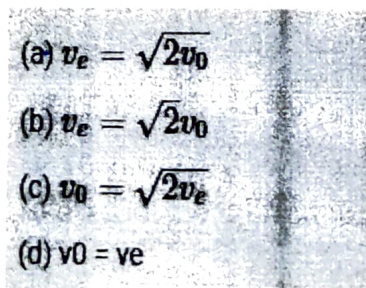
15)The force of attraction due to a hollow spherical shell of uniform density on a point mass which is situated inside it is

- a) $2Gm_1m_2/r$ b) zero c) Gm_1m_2/r^2 d) $2 Gm_1m_2/r^2$

16)The gravitational potential due to the gravitational force of the earth is defined as

- a) Gravitational force per unit distance
b) Gravitational force per unit mass
c) Gravitational potential energy per unit distance
d) Gravitational potential energy per unit mass

17) What is the relation between the escape velocity and orbital velocity of a satellite, if the satellite is close to the earth's surface?



(a) $v_e = \sqrt{2}v_0$
(b) $v_e = \sqrt{2}v_0$
(c) $v_0 = \sqrt{2}v_e$
(d) $v_0 = v_e$

18) The mass of the body on planet mars is 40kg, what is the weight on the earth.(acceleration due to gravity on mars is 3.7 m/s^2)

- a) 392 N b) 0 N c) 148 N d) 65.3 N

19) In case of geostationary satellites, at what height from the surface of earth we need to keep the satellite in circular orbit of equatorial plane.

- a) 6400 km b) 36000 km c) 12800 km d) 19200 km

20) Two spherical balls each of mass 1 kg are placed 1 cm apart. Find the gravitational force of attraction between them.

- a) $6.67 \times 10^{-7} \text{ N}$ b) $6.67 \times 10^{-11} \text{ N}$ c) $6.67 \times 10^7 \text{ N}$ d) $6.67 \times 10^{11} \text{ N}$

SECTION-B

Answer any 2 questions from the following

Each question carries 5 marks

(2x5 = 10 Marks)

1a). Define vector product. Explain the properties of a vector product with two examples.

b) Find the vector product of two vectors $\mathbf{a} = 3\mathbf{i} - 4\mathbf{j} + 5\mathbf{k}$ and $\mathbf{b} = -2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$

2a) Obtain an expression for the time period of oscillation of spring mass system

b) For the damped oscillator, the mass of the block is 200g, spring constant $K = 90 \text{ N/m}$ and damping constant b is 40 g/s. Calculate the time taken for its amplitude of vibrations to drop to half of its initial value.

3a) Define escape speed and obtain an expression for it.

b) Three spherical balls of masses 1kg, 2kg and 3 kg are placed at the corners of an equilateral triangle of side 1m. Find the magnitude of gravitational force exerted by the 2 kg and 3 kg masses on the 1 kg mass.

4a) Derive an expression for the kinetic energy and potential energy of a simple harmonic oscillator

b) Assume that Earth and Mars move in circular orbits around the sun, with the martian orbit being 1.52 times the orbital radius of the earth. What is the length of the Martian year in days.