Department	Mechanical		Program		
Subject Name	Fundamental Dynamics		Subject Code MEC 301		
Semester	3rd	Credits	3	Teacher Incharge/Mentor	Prof. N. A. Sheikh

Unit I: FUNDAMENTAL DYNAMICS

Topic Name: Kinematics of Particles

LINKS TO THE RESOURCES:

1. http://www.nptelvideos.in/search?q=Kinematics+of+Particles
2. https://www.youtube.com/watch?v=Fv_aobbTvwo
3. https://www.youtube.com/watch?v=DsQ-cxWWcTg
4. https://www.youtube.com/watch?v=KkdCU65nK3g

BOOKS TO BE CONSULTED:

1. Elementary Physics I Kinematics, Dynamics and Thermodynamics
   by Prof. Satindar Bhagat

2. Classical Mechanics by Tom W.B. Kibble and Frank H. Berkshire
   by Tom W.B. Kibble and Frank H. Berkshire

3. Classical Mechanics by H.C. Rosu
   by H.C. Rosu

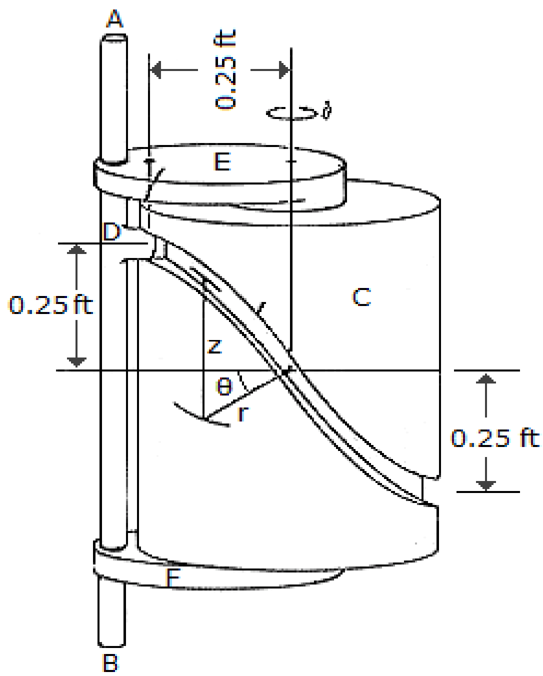
4. Meriam, J.L., Kraige, L.G., "Engineering Mechanics: Vol.2, Dynamics". S.I., Version, John Wiley & Sons Inc.,1996.
5. Hibbeler, R.C., "Dynamics", Prentice Hall, N.Jersy, USA, 2000.

NOTES DOWANLOADED FROM:

1. https://engineering.purdue.edu/ME562/bajaj562chpt2.pdf
2. http://www.iitg.ac.in/kd/Lecture%20Notes/ME101-Lecture26-KD.pdf
3. http://ocw.nthu.edu.tw/ocw_develop/upload/75/794/ch11.pdf
4. http://www.umt.fme.vutbr.cz/~ruja/vyuka/kinematics/LectureNotes.pdf
5. http://www.engr.mun.ca/~neil/3934/notes/notes.pdf
6. http://fsinet.fsid.cvut.cz/en/U2052/Kinematics.pdf

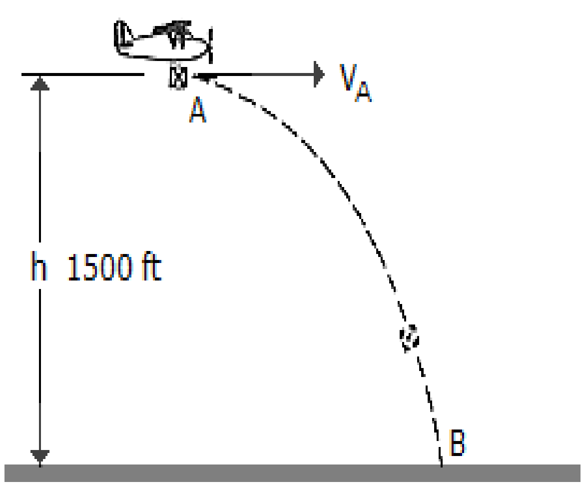
IMPORTANT QUESTIONS:

(1).



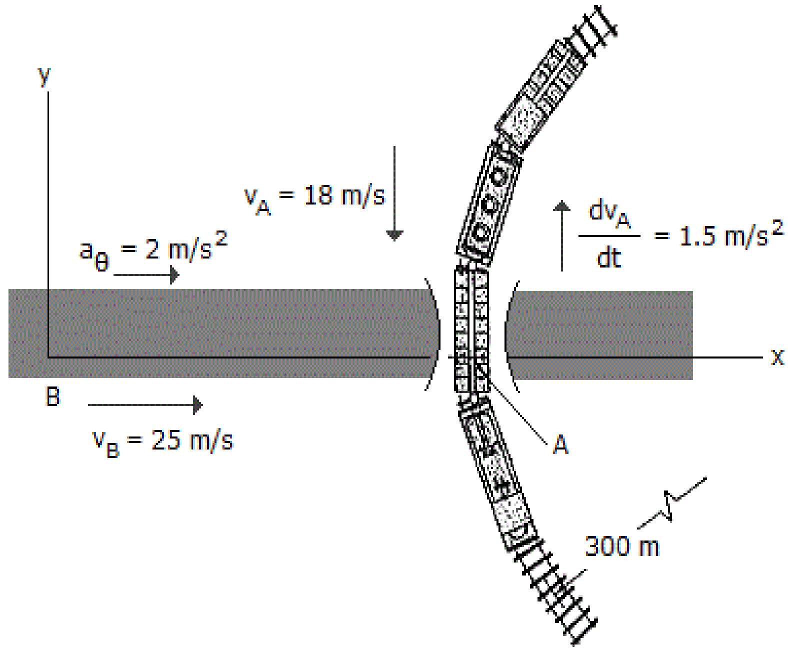
The cylindrical cam *C* is held fixed while the rod *AB* and bearings *E* and *F* rotate about the vertical axis of the cam at a constant rate of θ= 4 rad/s. If the rod is free to slide through the bearings, determine the magnitudes of the velocity and acceleration of the guide *D* on the rod as a function of θ. The guide follows the groove in the cam, and the groove is defined by the equations $r = 0.25$ft and $z = (0.25 \cos \theta)$ ft.

(2).



A package is dropped from the plane which is flying with a constant horizontal velocity of $v_A = 150$ft/s at a height h = 1500 ft. Determine the radius of curvature of the path of the package just after it is released from plane at A.

(3).



A passenger in the automobile B observes the motion of the train car. At the instant shown, the train has a speed of 18 m/s and is reducing its speed at a rate of 1.5 m/s^2. The automobile is accelerating at 2 m/s^2 and has a speed of 25 m/s. Determine the velocity and acceleration of A with respect to B. The train is moving along a curve of radius = 300 m.

Unit II: FUNDAMENTAL DYNAMICS

Topic Name: Kinetics of Particles

LINKS TO THE RESOURCES:

1. http://www.nptelvideos.in/search?q=Kinetics+of+Particles
2. https://www.youtube.com/watch?v=Ukc2krakJsA
3. https://www.youtube.com/watch?v=bSf7sf4Wwxs
4. https://www.youtube.com/watch?v=C_VATsExwcM

BOOKS TO BE CONSULTED:

1. Kinematics and Kinetics of Machinery
   by John A. Dent, Arthur C. Harper, Publisher: John Wiley & Sons 1921
   ISBN/ASIN: 1112323953, Number of pages: 410.

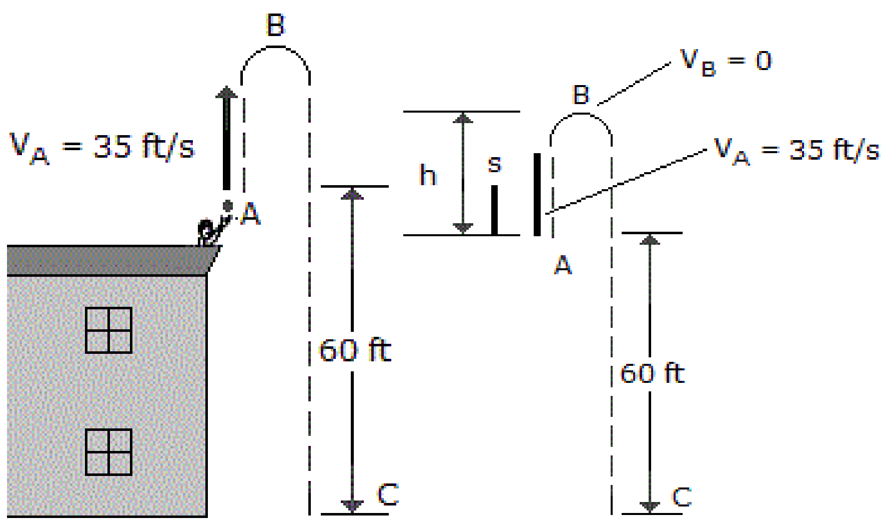
2. Meriam, J.L., Kraige, L.G., “Engineering Mechanics: Vol.2, Dynamics”. S.I., Version, John Wiley & Sons Inc., 1996.
3. Hibbeler, R.C., “Dynamics”, Prentice Hall, N.Jersy, USA, 2000.

NOTES DOWANLOADED FROM:

1. http://ocw.nthu.edu.tw/ocw_develop/upload/75/808/ch12.pdf
2. http://www.iitg.ac.in/kd/Lecture%20Notes/ME101-Lecture28-KD.pdf
3. http://www.iitg.ac.in/kd/Lecture%20Notes/ME101-Lecture26-KD.pdf
4. http://www.iitg.ac.in/kd/Lecture%20Notes/ME101-Lecture30-KD.pdf
5. http://www.uclm.org/profesorado/ajbarbero/FF_English/Newton%B4s%20Laws.pdf
6. https://personal.egr.uri.edu/datseris/fall2016/mce263/CLASS%20NOTES-NEWTON.pdf
7. http://pioneer.netserv.chula.ac.th/~anopdana/212/32workenergy.pdf
8.

IMPORTANT QUESTIONS:

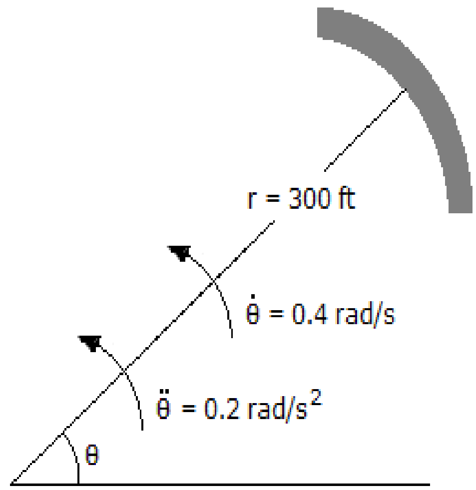
(1).



A ball thrown vertically upward from the top of a building with an initial velocity of v_A = 35ft/s. Determine (a) how high above the top of the building the ball will go before it stops at B, (b) the time t_{AB} it takes to reach its maximum height, and (c) the total time t_{AC} needed for it to reach the ground at C from the instant it is released.

(2). A particle is moving along a straight line through a fluid medium such that its speed is measured as v = (2t) m/s, where t is in seconds. If it is released from rest at s = 0, determine its positions and acceleration when t = 3s.

(3)



A car is traveling along the circular curve of radius r = 300 ft. At the instant shown, its angular rate of rotation is θ= 0.4 rad/s, which is increasing at the rate of $\ddot{\theta}$ = 0.2 rad/s^2. Determine the magnitude of the velocity of the car at this instant.

Unit III: FUNDAMENTAL DYNAMICS

Topic Name: Plane Kinematics of Rigid Bodies

LINKS TO THE RESOURCES:

1. http://www.nptelvideos.in/search?q=Plane+Kinematics+of+Rigid+Bodies
2. https://www.youtube.com/watch?v=rN8wJCTV18o
3. https://www.youtube.com/watch?v=4Xm-3gJZ8GA
4. https://www.youtube.com/watch?v=h_Er0QDN7aI
5. http://nptel.ac.in/courses/112103108/26

BOOKS TO BE CONSULTED:

1. Engineering Mechanics Paperback – 2011
   by Goyal M.C (Author).
2. A Concise Introduction to Mechanics of Rigid Bodies: Multidisciplinary Engineering
   by L. Huang.
3. Meriam, J.L., Kraige, L.G., “Engineering Mechanics: Vol.2, Dynamics”. S.I., Version, John Wiley & Sons Inc., 1996.
4. Hibbeler, R.C., “Dynamics”, Prentice Hall, N.Jersy, USA, 2000.

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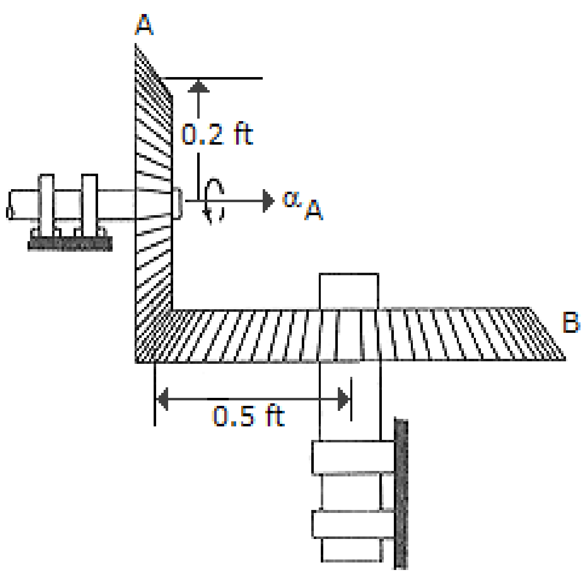
1. http://www.iitg.ac.in/kd/Lecture%20Notes/ME101-Lecture31-KD.pdf
2. http://ocw.nthu.edu.tw/ocw/upload/75/854/ch15.pdf
3. http://textofvideo.nptel.iitm.ac.in/112103108/lec26.pdf
4. http://optomecha.yonsei.ac.kr/admin/data/bbs/lecture/1205030716554_1.pdf
5. http://pioneer.netserv.chula.ac.th/~pphongsa/mech1/dynamics/ch4.pdf
6. http://pioneer.netserv.chula.ac.th/~anopdana/263/51rotation.pdf
7. http://web.mit.edu/8.01t/www/materials/modules/chapter20.pdf
8. http://courses.washington.edu/engr100/me230/week6.pdf
9. https://www.uclm.es/profesorado/ajbarbero/FF_English/Mechanics%20of%20Rigid%20Body%20Ia.%20Physics08.pdf
10. http://www.wiley.com/legacy/college/meriam/1118083458/asp_maple/maple_intro.pdf

IMPORTANT QUESTIONS:

(1).



Gear A is in mesh with gear B as shown. If A starts from rest and has a constant angular acceleration of $\alpha_A = 2$ rad/s^2, determine the tome needed for B to attain an angular velocity of $\omega_B = 50$ rad/s.

(2).

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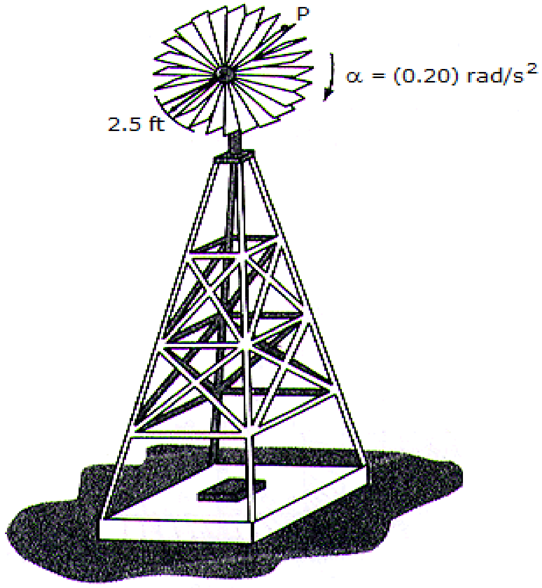
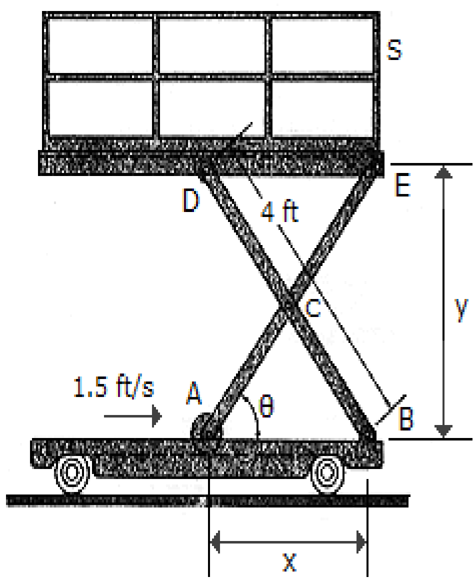


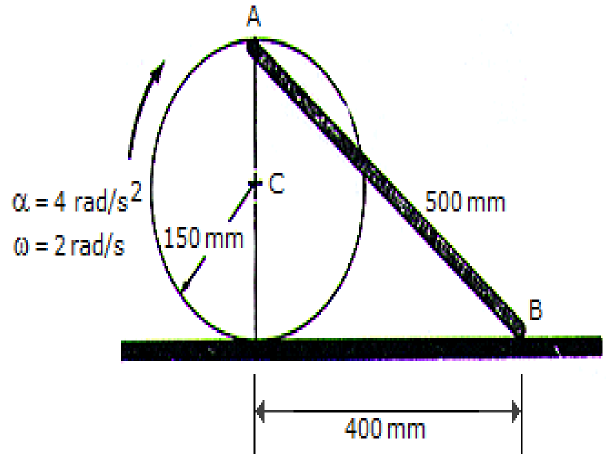
During a gust of wind, the blades of the windmill are given an angular acceleration of α = (0.2θ) rad/s^2, where θ is measured in radians. If initially the blades have an angular velocity of 5 rad/s, determine the speed of point located at the tip of one of the blades just after the blade has turned two revolutions.

(3).



The scaffold S is raised hydraulically by moving the roller at A towards the pin at B. If A is approaching B with a speed of 1.5ft/s, determine the speed at which the platform is rising as a function of θ. Each link is pin-connected at its midpoint and end points and has a length of 4 ft.

(4).



The disk rolls without slipping such that it has an angular acceleration of α = 4 rad/s^2 and angular velocity of ω = 2 rad/s at the instant shown. Determine the accelerations of points *A* and *B* on the link and the link's angular acceleration at this instant. Assume point *A* lies on the periphery of the disk, 150 mm from *C*.

SOLUTIONS:

Refer: http://www.indiabix.com/engineering-mechanics/kinematics-of-a-partic

T-SHEETS:

(Refer Prof. N. A. Sheikh)

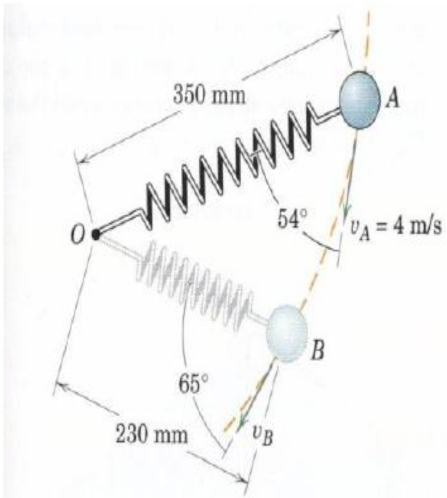


Fig. (Q1.)

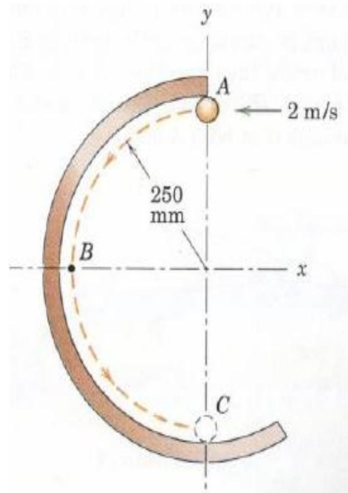


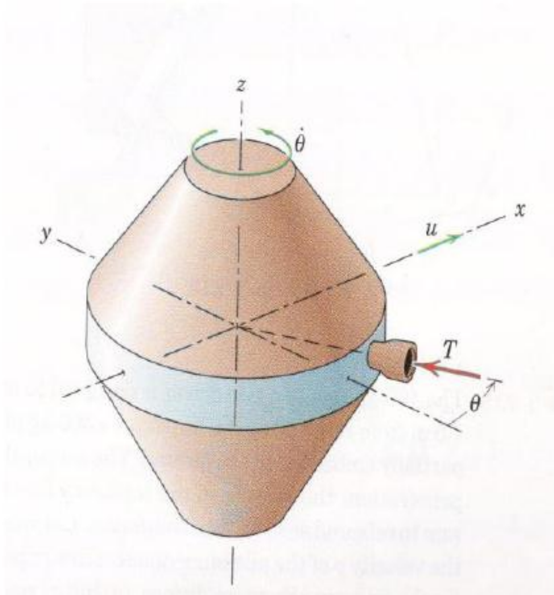
Fig. (Q2.)

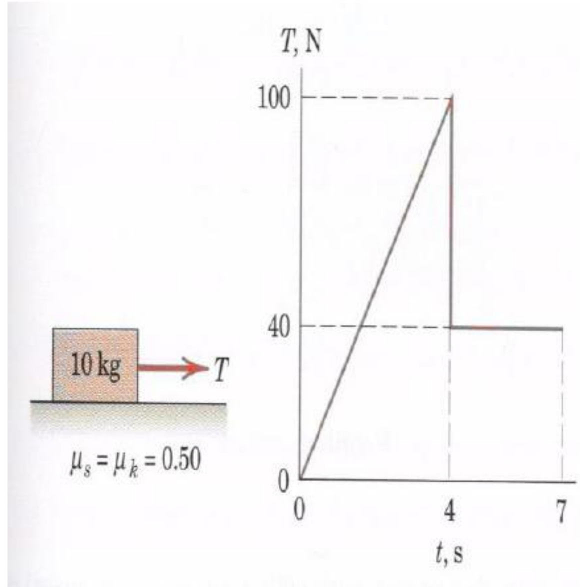
Q1.

A particle of mass m movies with negligible friction on a horizontal surface and is connected to a light spring fastened at "O". At position A the particle has the velocity v_a=4m/s. Determine the velocity v_b of the particle as it passes position B.

Q2.

A small 110-g particle is projected with a horizontal velocity of 2m/s in to the top A of the smooth circular guide fixed in the vertical plane. Calculate the time rate of change $\dot{H}_B$ of angular momentum about point B when the particle passes the bottom of the guide at C.





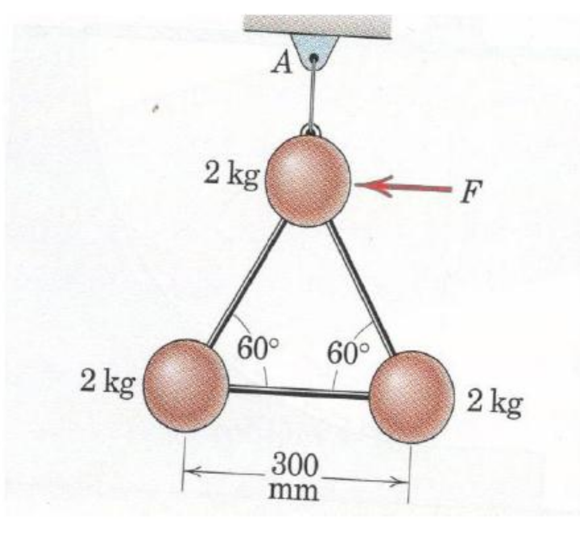
Q3. Q4.

Q3.

A space craft with a mass of 260kg is moving with a velocity u=30,000km/h in the fixed x-direction remote from any attracting celestial body. The space craft is spin stabilised and rotates about the z-axis at the constant rate = /10rad/s. During a quarter of a revolution from =0 to = /2, a jet is activated which produces a thrust T=600N of constant magnitude. Determine the y-component of the velocity of the space-craft when = /2. Neglect the small change in mass due to the loss of exhaust gas through the control nozzle and treat the space craft as a particle.

Q4.

The 10kg block is resting on the horizontal surface when the force T is applied to it for 7-seconds. The variation of T with time is shown. Calculate the maximum velocity reached by the block and the total time during which the block is in motion. The coefficients of static and kinetic friction are both 0.5.



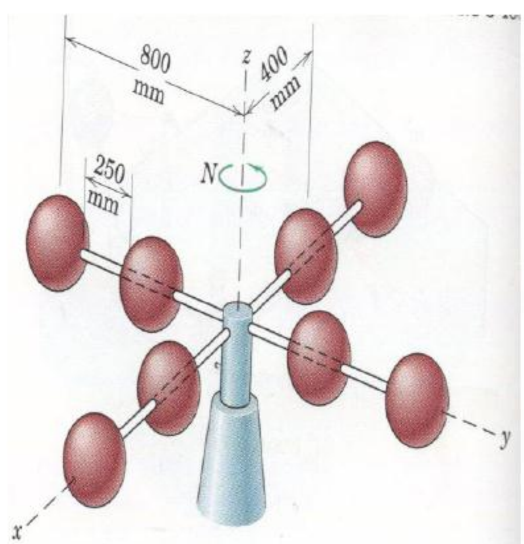


Fig.(Q5.) Fig.(Q6.)

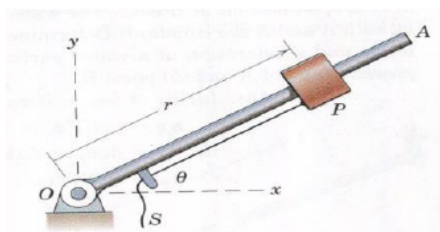
Q5.

The three identical 2-kg spheres are welded to the connecting rods of negligible mass and are hanging by a cord from point A. The spheres are initially at rest when a horizontal force F=16N is applied to the upper sphere. Calculate the initial acceleration of the mass center of the spheres, the rate at which the angular velocity is increasing and the initial acceleration " " of the top sphere.

Q6.

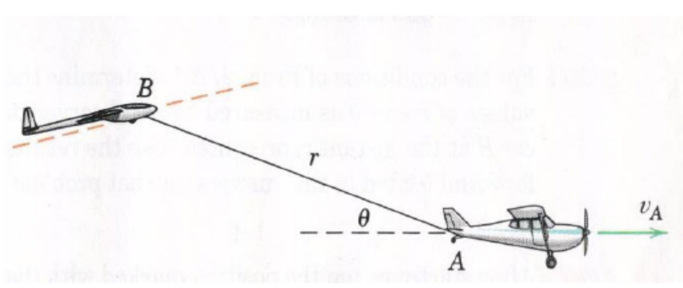
The system of 8-symmetrically located spheres, each of mass 2-kg, is rotating freely about the vertical z-axis at the rate N=120rev./min. The outer spheres are welded to the ends of the rods of negligible mass. The inner spheres are initially latched in the positions shown but are able to slide outward along the rods when the latches are released. Determine the new angular rate after release and after the spheres have moved 250mm and come to rest against the outer spheres. Also calculate the loss in kinetic energy and account for the loss. The spheres may be treated as particles.

Q7.



The slider P can be moved inward by means of the string S as the bar OA rotates about the pivot O. The angular position of the bar is given by $\theta = 0.4 + 0.12t + 0.06t^3$ where θ is in radians and t is in seconds. The position of the slider is given by $r - 0.8 - 0.1t - 0.05t^2$, where r is in meters and t is in seconds. Determine and sketch the velocity and acceleration of the slider at time $t = 2s$. Find the angles α and β which $\vec{v}$ and $\vec{a}$ make with the positive x-axis.

Q8.



Airplane **A** is flying horizontally with a constant speed of 200km/h and is towing the glider **B**, which is gaining the altitude. If the tow cable has a length r=60m and θ is increasing at the constant rate of 5degrees per second, determine the magnitudes of the velocity **v** and acceleration **a** of the glider for the instant when $\theta = 15^0$