Kafrelsheikh University
Faculty of Engineering
Dept. Mech. Engineering
Year: Preparatory
Subject: Mechanics (I)_Dynamics

Semester: 2nd Semester
Final Examination
Date: May 26th, 2018
Time allowed: 3 hours
Full Mark: 70

(a) No. of questions: 8-No. of pages: 10. Only page no. [10/10] is blank.
(b) This is a close book exam. Only calculator is permitted
(c) Clear, systematic answers and solutions are required. In general, marks will not be assigned for answers and solutions that require unreasonable (in the opinion of the instructor) effort to decipher.
(d) Solve all questions.
(e) The exam will be marked out of 70. There are 12 marks bonus.

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1. Choose the correct answer. Justify your answer with calculations or explanations or both whenever possible. If answer requires justification, marks will not be given to the correct answer without justification. (10 Marks)

(a) A particle is moving in a circular path with non-uniform speed. Then, **(1 Mark)**

a. Its velocity is necessarily tangential to the path and acceleration is normal to the path.
b. Its velocity is necessarily tangential to the path, but the acceleration has normal and tangential compact.
c. Its velocity has normal and tangential compact.
d. Its acceleration is tangential

(b) A particle is moving in a straight line with varying speed. At the instant when the displacement is maximum, **(1 Mark)**

a. the speed must be 0
b. the speed must be maximum
c. the speed must be minimum

(c) If a particle is moving with a constant acceleration, its time versus displacement curve will be **(1 Mark)**

a. linear
b. parabolic
c. cubic
d. sinusoidal

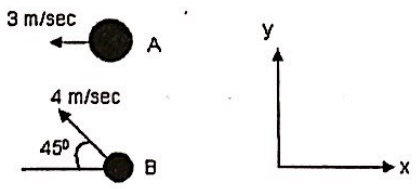
(d) The velocity of particle A relative to B is **(1 Mark)**

a. $\hat{i}$

b. $\left(3+\frac{4}{\sqrt{2}}\right)\hat{i}+\frac{4}{\sqrt{2}}\hat{j}$

c. $\left(3-\frac{4}{\sqrt{2}}\right)\hat{i}+\frac{4}{\sqrt{2}}\hat{j}$

d. none of these.



(e) The normal component of a particle moving on a curve i the particle is doubled, **(1 Mark)**

a. the normal component will become 40 m/sec².
b. the normal component will become 60 m/sec².
c. the normal component will become 80 m/sec².

(f) A particle moving in a straight line at a speed of 10 m/sec suddenly reverses its motion. At that instant, **(1 Mark)**

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a. its acceleration will be infinite
b. its acceleration will be 0
c. its acceleration will be finite
d. its acceleration will be negative

(g) Compared to earth a projectile's range on the moon will be **(1 Mark)**

a. same
b. more
c. less
d. same or less

(h) A projectile flies over the horizontal surface. The angle of projection is 45^0. The velocity of projection is 5 m/sec. After a time of 0.7 second, the gravity vanishes. Then, **(1 Mark)**

a. the particle will never reach ground.
b. the particle will eventually reach the ground.
c. the particle will stop at once.
d. the particle will fall vertically.

(i) At a particular instant, the magnitude of the velocity of a particle moving along a space curve is 10 m/sec. Its acceleration is 1 m/sec^2 and it makes 30^0 with the direction of the velocity. the radius of curvature of the space curve at the point where particle is at the moment. **(1 Mark)**

a. 20m.
b. 100m.
c. 115 m.
d. 200m.

(j) The maximum horizontal range of a projectile is *R*. The firing angle that should be used to hit a target located at a distance of *R* and at ground level is **(1 Mark)**

a. 15^0
b. 30^0
c. 45^0
d. 60^0

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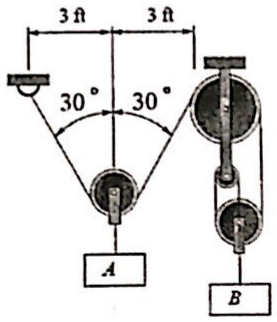
2. The acceleration of a particle is given by

$$\bar{a} = 3t\,i - 2t^2\,j + 5t^3\,k \quad m/sec^2$$

Particle starts with zero velocity at the origin. After 5 second find out particle's displacement, distance travelled, velocity and acceleration. **(7 Marks)**

Solution

3a) At the instant shown below block B is moving down with a velocity of 4.0 ft/s., determine the velocity of block A. **(5 Marks)**



Solution

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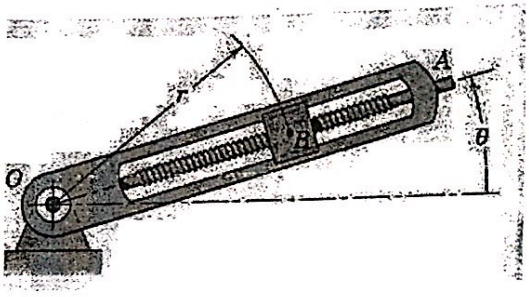
3b)A projectile is projected at an angle of 30^0 from horizontal with a velocity of 30 m/sec. At what times, the projectile will be at half the maximum attainable height? **(5 Marks)**

Solution

4. Rotation of the radically slotted arm is governed by $\theta = 0.2t + 0.02t^3$, where θ is in radians and t is in seconds. Simultaneously, the power screw in the arm engages the slider B and controls its distance from O according to $r = 0.2+0.04t^2$, where r is in meters and t is in seconds. Calculate the magnitudes of the velocity and acceleration of the slider for the instant when t=3s. **(10 Mark)**



Solution

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5A) During a hammer thrower's practice swings, the 7-kg head *A* of the hammer revolves at a constant speed *v* in a horizontal circle as shown. If $\rho = 1$ m and $\theta = 60°$, determine **(5 Marks)**

(*a*) the tension in wire *BC*, **(2 Marks)**

(*b*) the speed of the hammer's head. **(3 Marks)**

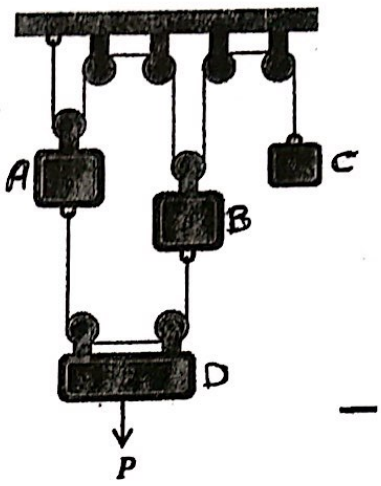
Solution

5B) The masses of blocks *A*, *B*, *C* and *D* are 9 kg, 9 kg, 6 kg and 7 kg, respectively. Knowing that a downward force, ***P***, of magnitude 120 N is applied to block *D*, and acceleration of block A equals 1 m/s². **By using Newton's second law determine: (15 Marks)**

a) acceleration of each other blocks, **(12 Marks)**

b) tension in cord *ABC* and *ADB*. **(4 Marks)**

N.B. Neglect the weights of the pulleys and the effect of friction.



Solution

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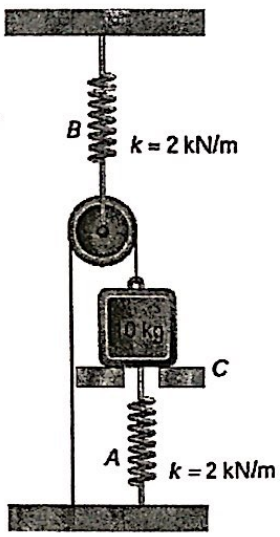
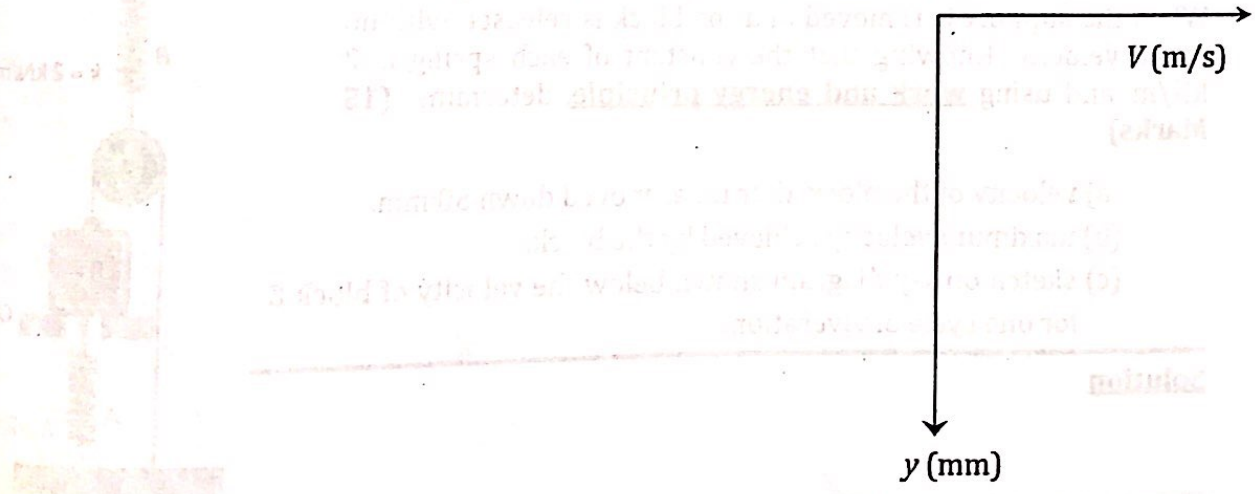
6. A 10-kg block is attached to spring A and connected to spring B by a cord and pulley. The block is held in the position shown with spring A is unstretched and spring B is stretched by 10 mm. When the support is removed and the block is released with no initial velocity. Knowing that the constant of each spring is 2 kN/m, and using **work and energy principle**, determine: **(15 Marks)**



(a) velocity of the block after it has moved down 50 mm.
(b) maximum velocity achieved by the block.
(c) sketch on v-y diagram shown below the velocity of block C for one cycle of viveration.

Solution



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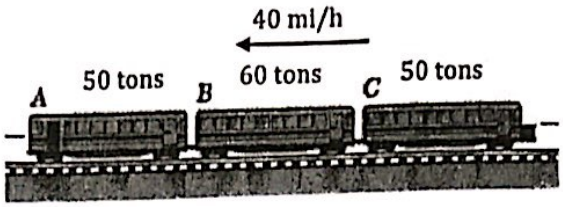
7. The subway train shown is traveling at a speed of 40 mi/h when the brakes are fully applied on the wheels of car A, causing it to slide on the track, but are not applied on the wheels of cars B and C. Knowing that the coefficient of kinetic friction is 0.35 between the wheels and the track, determine: **(10 Marks)**



(a) the time required to bring the train to a stop, **(5 Marks)**

(b) the force in each coupling. **(5 Marks)**

Solution