

Engineering Dynamics Homework 1

1.

A car starts from rest and reaches a speed of 75 ft/s after traveling 446 ft along a straight road. Determine its constant acceleration and the time of travel.

$$a_c = \underline{\hspace{2cm}} \text{ ft/s}^2$$
$$t = \underline{\hspace{2cm}} \text{ s}$$

2.

The position of a particle along a straight line is given by $s = (1.2t^3 - 9t^2 + 14.4t)$ ft, where t is in seconds. Determine the position of the particle when $t = 7$ s and the total distance it travels during the 7-s time interval. Hint: Plot the path to determine the total distance traveled.

$$s_{t=7} = \underline{\hspace{2cm}} \text{ ft}$$
$$d_7 = \underline{\hspace{2cm}} \text{ ft}$$

3.

A go-cart starts from rest and travels on a straight road with a constant acceleration of 6 ft/s² for 1 s, after which it maintains a constant speed for 2 s. Finally it decelerates at 10 ft/s² until it stops. Determine the total distance traveled and the average speed.

$$s_T = \underline{\hspace{2cm}} \text{ ft}$$
$$v_{avg} = \underline{\hspace{2cm}} \text{ ft/s}$$

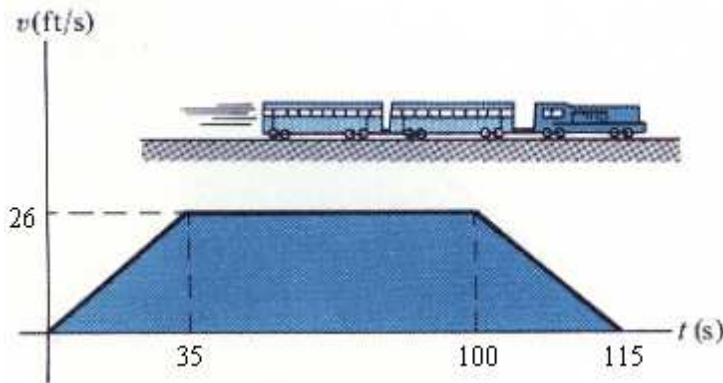
4.

The acceleration of a rocket traveling upwards is given by $a = 6 + 0.01s$ m/s² where s is in meters. Determine the rocket's velocity when $s = 4$ km and the time needed to reach this elevation. Initially, $v = 0$ and $s = 0$ when $t = 0$.

$$v_{s=4km} = \underline{\hspace{2cm}} \text{ m/s}$$
$$t = \underline{\hspace{2cm}} \text{ s}$$

5.

The v - t graph for the motion of a train as it moves from station A to station B is shown. Find the acceleration over each interval, then determine the average speed and the distance between the stations.



$$a_{t=(0,35)} = \underline{\hspace{2cm}} \text{ ft/s}^2$$

$$a_{t=(35,100)} = \underline{\hspace{2cm}} \text{ ft/s}^2$$

$$a_{t=(100,115)} = \underline{\hspace{2cm}} \text{ ft/s}^2$$

$$v_{avg} = \underline{\hspace{2cm}} \text{ ft/s}$$

$$s = \underline{\hspace{2cm}} \text{ ft}$$

6.

A particle moves along the path $\vec{r} = \{8t^2 \hat{i} + (t^3 + 7) \hat{j}\}$ m, where t is in seconds. Determine the magnitudes of the particle's velocity and acceleration when $t=5$ s. Also determine the equation $y=f(x)$ of the path.

$$v = \underline{\hspace{2cm}} \text{ m/s}$$

$$a = \underline{\hspace{2cm}} \text{ m/s}^2$$

$$y=f(x) = \underline{\hspace{2cm}}$$

7.

If the velocity of a particle is defined as $\bar{v}(t) = \{1.9t^2 \hat{i} + 12t^{1/2} \hat{j} + 3 \hat{k}\}$ m/s, determine the magnitude and coordinate direction angles α , β , γ (in degrees) of the particle's acceleration when $t=2$ s. Note: α is the angle the vector makes with the x -axis, β is the angle the vector makes with the y -axis, and γ is the angle the vector makes with the z -axis.

$a =$ _____ m/s²

$\alpha =$ _____ °

$\beta =$ _____ °

$\gamma =$ _____ °

8.

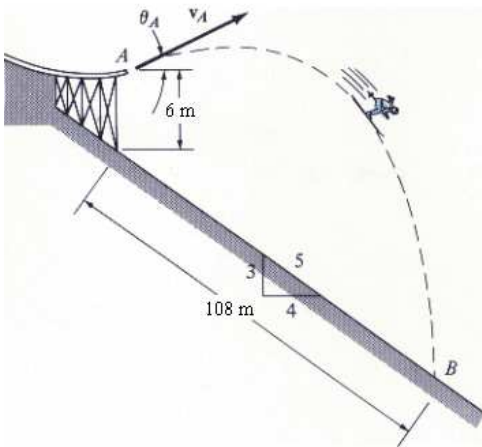
A particle moves in the x - y plane such that its position is defined by $\bar{r} = \sin^2 \theta \hat{i} + (\theta^2 + \cos \theta) \hat{j}$ where θ is in radians and r is in feet. If $\theta = 3t^2$ rad, where t is in seconds, determine the particle's velocity and acceleration when $t=4$ s.

$\bar{v} =$ _____ $\hat{i} +$ _____ \hat{j} ft/s

$\bar{a} =$ _____ $\hat{i} +$ _____ \hat{j} ft/s²

9.

It is observed that the skier leaves the ramp A at an angle $\theta_A = 25^\circ$ with the horizontal. If he strikes the ground at point B , determine his initial speed v_A and the time of flight t_{AB} .

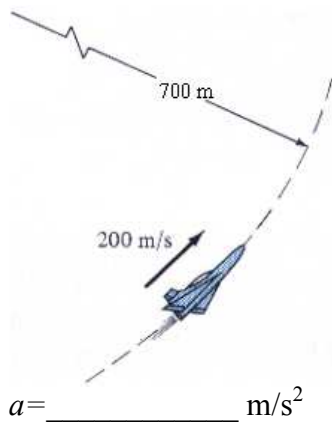


$v_A =$ _____ m/s

$t_{AB} =$ _____ s

10.

A jet plane flies along the vertical curve having a radius of 700 m. If its speed is uniformly increased from 160 m/s to 250 m/s in 4 s, determine the magnitude of its acceleration at the instant the plane's speed is 200 m/s.



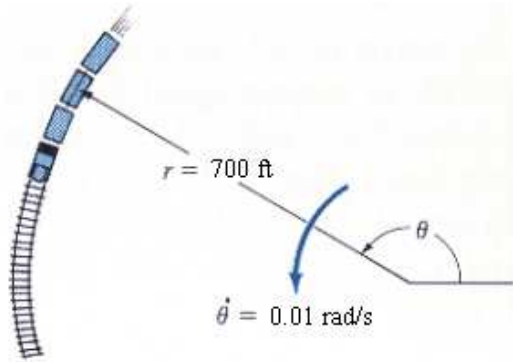
11.

A particle is moving along a circular path having a radius of 0.3 m. Its angular position as a function of time is given by $\theta = (5t^2)$ rad, where t is in seconds. Determine the magnitude of the particle's acceleration when $\theta = 40^\circ$. The particle starts from rest when $\theta = 0^\circ$.

$|a| = \underline{\hspace{2cm}} \text{ m/s}^2$

12.

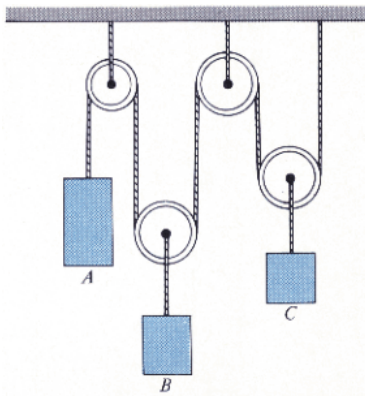
A train is traveling along the circular curve of radius $r=700$ ft. At the instant shown, its angular rate of rotation is $\dot{\theta}=0.01$ rad/s, which is decreasing at the rate $\ddot{\theta}=-0.0017$ rad/s². Determine the magnitudes of the train's velocity and acceleration at this instant.



$|v| =$ _____ ft/s
 $|a| =$ _____ ft/s²

13.

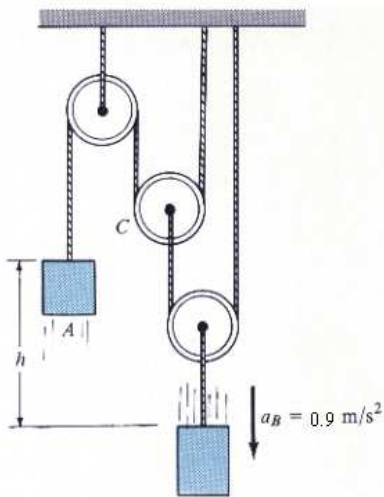
The pulley system supports three blocks as shown. If A is moving downward with a speed of 4 ft/s while C is moving up at 4 ft/s, determine the speed of block B .



$v_B =$ _____ ft/s

14.

Block B (the block to the right in the diagram) is moving downward with a constant acceleration $a_B = 0.9 \text{ m/s}^2$. If both blocks start from rest and are at the same elevation, $h = 0$, when $t = 0$, determine (a) the velocities of blocks A and B when $t = 3 \text{ s}$, and (b) the elevation h between the blocks when $t = 3 \text{ s}$.



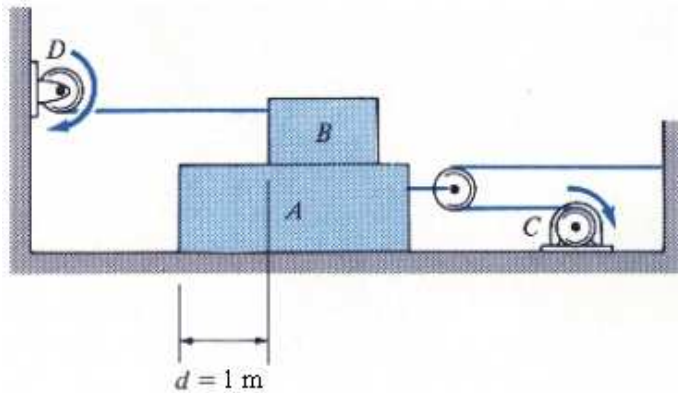
$v_A =$ _____ m/s

$v_B =$ _____ m/s

$h =$ _____ m

15.

The motor at C pulls in the cable with an acceleration $a_C = (8t^2) \text{ m/s}^2$ where t is in seconds. The motor at D draws in its cable at $a_D = 7 \text{ m/s}^2$. If both motors start at the same instant from rest when $d = 1 \text{ m}$, determine (a) the time needed for $d = 0$ and (b) the relative velocity of block B with respect to block A when this occurs.



$t_{d=0} = \underline{\hspace{2cm}}$ s

$V_{B/A} = \underline{\hspace{2cm}}$ m/s to the right/left (select one)