GP1-L05

Problem 1

A particle of mass m moves along an x-axis, being propelled by a variable force directed along that axis. Its position is given by $x = 3 + 4t + 5t^2 - 2t^3$, with x in meters and t in seconds.
Derive the equation of velociy, $v(t)$ and acceleration, $a(t)$. **t** is the only variable for the equations. (02小題)

(a) $v(t)$=__________

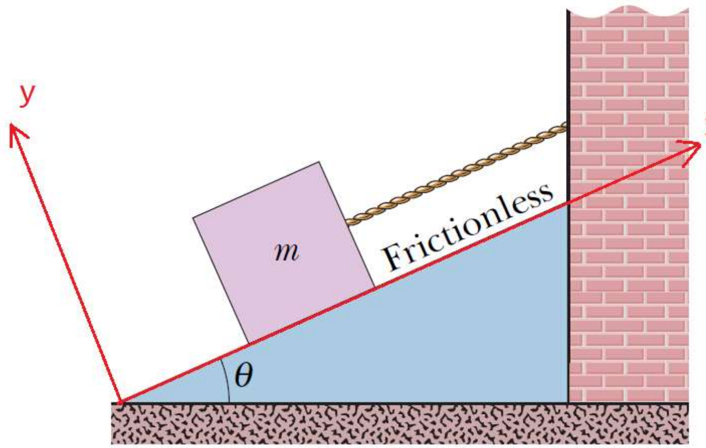
01: **ANS:=<u>4+10*t-6*t**2</u>**

(b) $a(t)$=__________

02: **ANS:=<u>10-12*t</u>**

Problem 2

In the figure, let the mass of the block be **m** and the angle be **theta**. Find (a) the tension in the cord and (b) the normal force acting on the block. (c) If the cord is cut, find the magnitude of the resulting acceleration of the block. The variables are **[m, theta, g]**. (03小題)



(a) The tension in the cord, T=_____

03: **ANS:=m*g*sin(theta)**

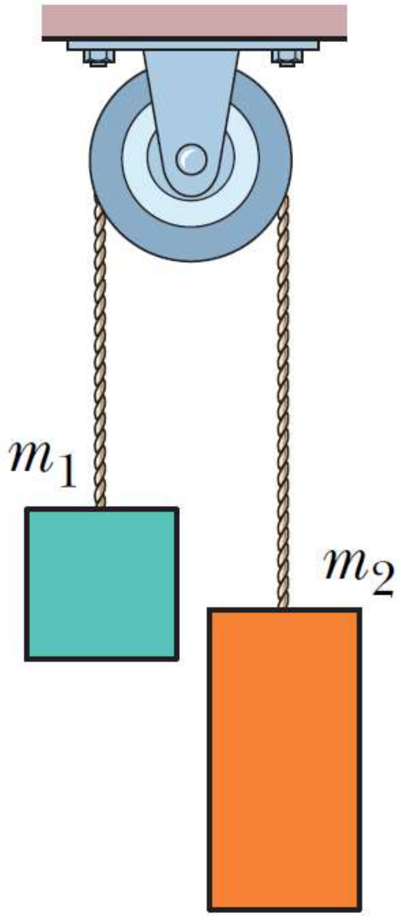
(b) the normal force acting on the block, N=______

04: **ANS:=m*g*cos(theta)**

05: **ANS:=-g*sin(theta)**

Problem 3

Figure shows two blocks connected by a cord (of negligible mass) that passes over a frictionless pulley (also of negligible mass). The arrangement is known as Atwood's machine. One block has mass m_1 and the other has mass m_2. m_2 is heavier than m_1. What are (a) the magnitude of the blocks' acceleration and (b) the tension in the cord? The variables are **[m_1, m_2, g]**. (02小題)



(a) acceleration, a=_____

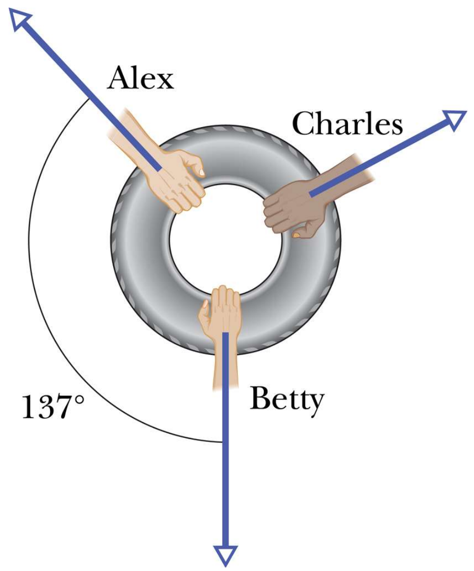
06: **ANS:=(m_2-m_1)/(m_1+m_2)*g**

(b) tension, T=______

07: **ANS:=(2*m_1*m_2)/(m_1+m_2)*g**

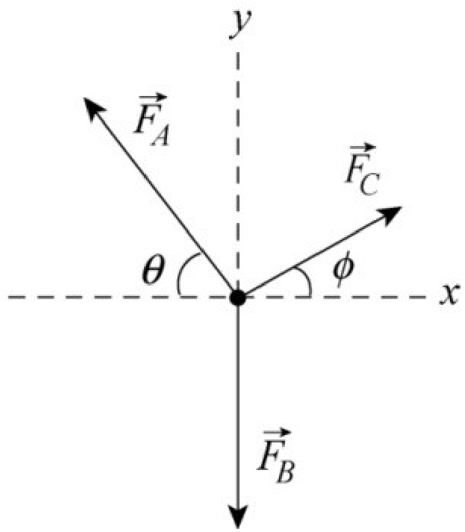
Problem 4

In a two-dimensional tug-of-war, Alex, Betty, and Charles pull horizontally on an automobile tire at the angles shown in the overhead view of the figure. The tire remains stationary in spite of the three pulls. Alex pulls with force $\vec{F}_A$ of magnitude 230N, and Charles pulls with force $\vec{F}_C$ of magnitude 170N . Note that the direction of $\vec{F}_C$ is not given. What is the magnitude of Betty's force $\vec{F}_B$?



the magnitude of $\vec{F}_B$=______N

08: **ANS:=234**



$$F_C \cos\phi - F_A \cos\theta = 0$$

$$F_A \sin\theta + F_C \sin\phi - F_B = 0$$

$$\cos\phi = \frac{F_A \cos\theta}{F_C} = \frac{(230N)\cos 47^0}{170N} = 0.923$$

$$\phi = \cos^{-1} 0.923 = 22.7^0$$

$$F_B = F_A \sin\theta + F_C \sin\phi = (230N)\sin 47^0 + (170N)\sin 22.7^0 = 234N$$

Problem 5

A $2.0kg$ particle moves along an x axis, being propelled by a variable force directed along that axis. Its position is given by $x = 3m + (4m/s)t + ct^2 - (2m/s^2)t^3$, with x in meters and t in seconds. The factor c is a constant. At $t = 3s$, the force on the particle has a magnitude of $36N$ and is in the negative direction of the axis. What is c?

$$v = \frac{dx}{dt} = (4m/s) + 2ct - (6m/s^2)t^2$$

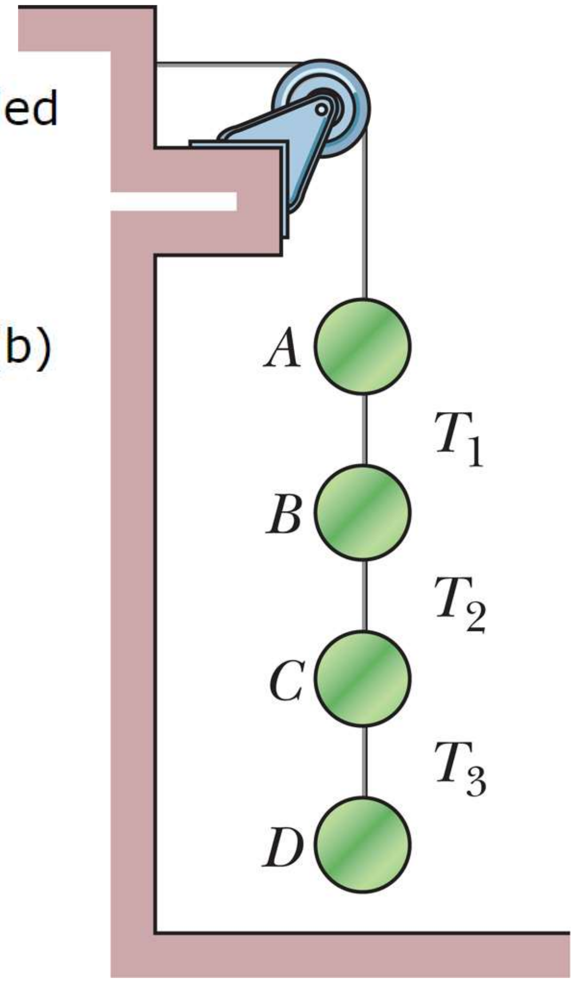
$$c = 9$$

$$a = \frac{dv}{dt} = 2c - (12m/s^3)t$$

$$F = -36N = ma = (2kg)[2c - (12m/s^3)(3s)]$$

Problem 6

The Figure shows an arrangement in which four disks are suspended by cords. The longer, top cord loops over a frictionless pulley and pulls with a force of magnitude 98 N on the wall to which it is attached. The tensions in the shorter cords are $T_1 = 58.8N$, $T_2 = 49N$, and $T_3 = 9.8N$. What are the masses of (a) disk A, (b) disk B, (c) disk C, and (d) disk D.?



$$T_3 = 9.8N$$

$$\underline{\underline{m_D = 1kg}}$$

$$T_2 - T_3 = m_C g$$

$$49N - 9.8N = m_C g$$

$$\underline{\underline{m_C = 4kg}}$$

$$T_1 - T_2 = m_B g$$

$$58.8N - 49N = m_B g$$

$$\underline{\underline{m_B = 1kg}}$$

$$98N - T_1 = m_A g$$

$$98N - 58.8N = m_A g$$

$$m_A = 4kg$$

Problem 7

A $500kg$ rocket sled can be accelerated at a constant rate from rest to $1600km/h$ in $1.8s$. What is the magnitude of the required net force?

$$1600km/h = (\frac{1600km}{h})(\frac{1000m}{1km})(\frac{1h}{60min})(\frac{1min}{60sec}) = 444m/s$$

$$v = v_0 + at$$

$$444m/s = 0 + a(1.8s)$$

$$a = \frac{444m/s}{1.8s} = 246.6m/s^2$$

$$F = ma = (500kg)(246.6m/s^2) = 1.2 \times 10^5 N$$

Problem 8

Sunjamming. A "sun yacht" is a spacecraft with a large sail that is pushed by sunlight. Although such a push is tiny in everyday circumstances, it can be large enough to send the spacecraft outward from the Sun on a cost-free but slow trip. Suppose that the spacecraft has a mass of $900kg$ and receives a push of $20N$. (a) What is the magnitude of the resulting acceleration? If the craft starts from rest, (b) how far will it travel in 1 day and (c) how fast will it then be moving?

(a)acceleration a=__

15: **ANS:=0.022**

(b)distance travelled

16: **ANS:=8.3E7**

(c)its velocity in (b),

17: **ANS:=1.9E3**

$$(a) a = \frac{F}{m} = \frac{20N}{900kg} = 0.022m/s^2$$

$$(b) 1d = (\frac{24h}{1d})(\frac{60min}{1h})(\frac{60sec}{1min}) = 86400s$$

$$s = \frac{1}{2}at^2 = \frac{1}{2}(0.022m/s^2)(86400s)^2 = 8.3 \times 10^7 m$$

$$(c) v = at = (0.022m/s^2)(86400s = 1.9 \times 10^3 m/s)$$

Problem 9

An elevator cab and its load have a combined mass of $1600kg$. Find the tension in the supporting cable when the cab, originally moving downward at $12m/s$, is brought to rest with constant acceleration in a distance of 42 m.

$$T - mg = ma$$

$$T = m(g + a)$$

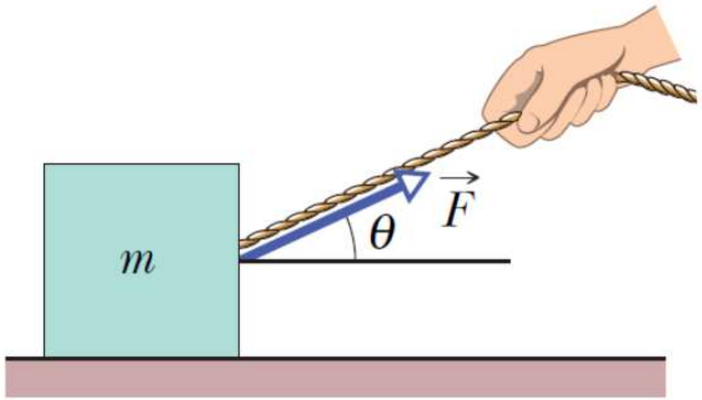
$$v^2 = v_0^2 + 2ay$$

$$a = -\frac{v_0^2}{2y} = -\frac{(-12m/s)^2}{2(-42m)} = 1.71m/s^2$$

$$T = m(g + a) = (1600kg)(9.8m/s^2 + 1.71m/s^2) = 1.8 \times 10^4 N$$

Problem 10

In the figure, a block of mass m = 5.00 kg is pulled along a horizontal frictionless floor by a cord that exerts a force of magnitude F = 12.0 N at an angle $\theta = 25.0^{\circ}$. (a)What is the magnitude of the block's acceleration? (b) The force magnitude F is slowly increased. What is its value just before the block is lifted (completely) off the floor? (c) What is the magnitude of the block's acceleration just before it is lifted (completely) off the floor?



(a)acceleration, a=_

19: **ANS:=2.18**

(b)the minimum for

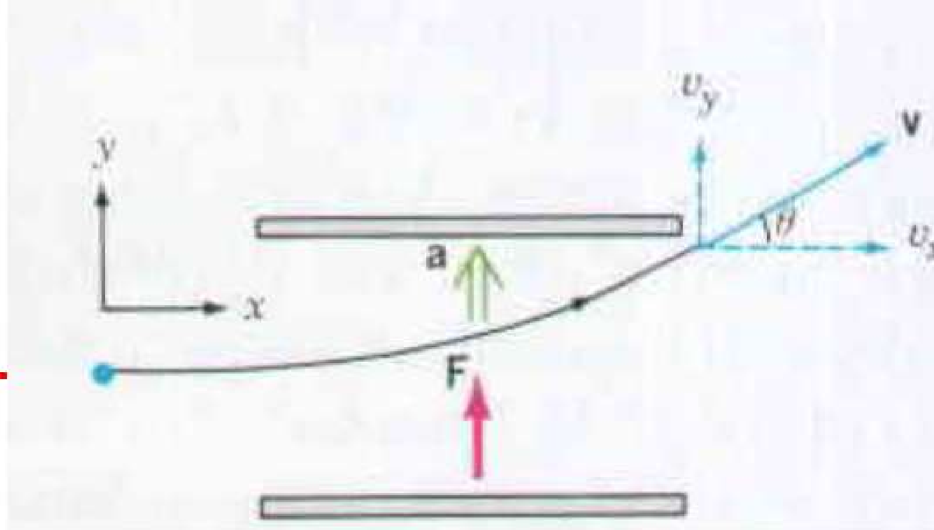
20: **ANS:=116**

(c)acceleration just

21: **ANS:=21**

Problem 11

An electron of mass 9.1×10^{31} kg has an initial velocity $\vec{v}_0 = 10^6\hat{i}$ m/s. It enters a region in which it experiences a force $\vec{F} = 8 \times 1O^{-17}\hat{j}$ N for a period of 10^{-8} s. What is its velocity as it emerges from the region? (see figure) (02小題)



(a)the magnitude of its velocity=_____ m/s

22: **ANS:=<u>8.8E5</u>**

(b)the angle between v

23: **ANS:=<u>41.3</u>**