Q1

G_1 ميكانيك

Two blocks, mass m_1 and m_2 are connected by a light spring on a horizontal frictionless table. Find the ratio of their accelerations a_1 and a_2 after they are pulled a part and then released.

Q2

Let the only forces acting on two bodies be their mutual interactions. If both bodies start from rest, show that the distance traveled by each are inversely proportional to the respective masses of the bodies.

Q3

A body of mass **m** is acted on by two forces F_1 and F_2 as shown in fig. If $m = 5.0$ kg, $F_1 = 3.0$ N, and $F_2 = 4.0$ N, find the vector acceleration of the body.

Q6

An electron travels in a straight line from the cathode of a vacuum tube to its anode, which is exactly 1.0 cm away. It starts with zero speed and reaches the anode with speed of 6.0×10^{6} m/s

a) Assume constant acceleration and compute the force on the electron. $m_e = 9.1 \times 10^{-31}$ kg.

b) compare it with the gravitational force on the electron.

Q9

A space traveler whose mass is 75 kg leavs the eart Compute his weight (a) on the earth (b) 400 miles above the earth (where $g = 8.1 \ m/s^2$) and (c) in inter-planetary space. what is his mass at each of these location.

Q11

Three blockes are connected on a horizontal frictionless table and pulled to the right with a force $T_3 = 60$ N. If $m_1 = 10$ kg, $m_2 = 20$ kg, and $m_3 = 30$ kg, find the tensions T_1 and T_2

A block of mass $m_1 = 3.0$ kg slugs on a smooth inclined plane of angle 30° is connected by a cord over a small frictionless pulley to a second block of mass $m_2 = 2$ kg slugs hanging vertically (a) what is the acceleration of each body? (b) what is the tension (توتر) in the cord (الكبل)?

Q 21

A lamp hangs vertically from a cord in a descending elevator. The elevator has a deceleration of $8.0\ ft/sec^2$ befor coming to a stop (a) If the tension in the cord is 20 lb, what is the mass of the lamp? (b) what is the tension in the cord when the elevator ascends with an acceleration of $8.0\ ft/sec^2$?

Q22

A plumb bob hanging from the ceiling of a railroad car acts as an accelerometer.

ⓐ Derive the general expression relating the horizontal acceleration a of the car to the angle θ made by the bob with the vertical.

ⓑ Find a when $\theta = 20°$. Find θ when $a = 5$ ft/s.

Q25

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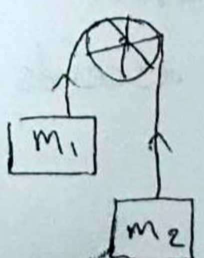
Let $m_1 = 0.50$ kg and $m_2 = 1.0$ kg. Find the acceleration of the two blocks and the tension in the string.



(ح) : د. / أول أمثلة على الفصل الخامس

ميكانيك

Ex (1)

A body of mass m move on X-axis with velocity $V = A\cos\omega t$ where A, ω constant find a) the net force affect the body at time t. b) The force exerted on the body when it is at distance X from the origin.

a) $F = ma$

$= m\frac{dv}{dt}$

$= m\frac{d}{dt}(A\cos\omega t)$

$F = mA(-)\omega \sin\omega t$

$F = -m\omega A \sin\omega t$

b) $V = \frac{dx}{dt} \Longrightarrow \int dx = \int v\,dt$

$X = \int A\cos\omega t\,dt$

$= \frac{A}{\omega}\sin\omega t$

$\frac{X\omega}{A} = \sin\omega t$

$F = -m\omega A\left(\frac{X\omega}{A}\right)$

$F = -m\omega^2 X$

$= -KX$ where $K = m\omega^2$

F is the force for a body move simple Harmonic motion

Ex (2)

a body is at rest X_0 from origin, a force $F = -\frac{k}{x^2}$ acted on it and make it move on a straight line along x-direction. Find its velocity as a function of the distance X.

$$\vec{F} = m\vec{a}$$

$$F = m\frac{dv}{dt} = m\frac{dv}{dx}\frac{dx}{dt}$$ by multiply $\frac{dx}{dx}$

$$= m \cdot \frac{dv}{dx} \cdot v$$

$$-\frac{k}{x^2} = mv\frac{dv}{dx}$$

$$\int mv\,dv = -\frac{k}{x^2}\,dx$$

$$\frac{mv^2}{2} = -\frac{k\,x^{-1}}{-1} + C_1 \quad --- (1)$$

when $X = X_0$, $v = 0$

$$\frac{m(0)}{2} = \frac{k}{X_0} + C_1 \longrightarrow C_1 = \frac{-k}{X_0}$$

put the value of C_1 in eqn. (1)

$$\frac{mv^2}{2} = \frac{k}{X} - \frac{k}{X_0}$$

$$\frac{mv^2}{2} = k\left(\frac{1}{x} - \frac{1}{X_0}\right)$$

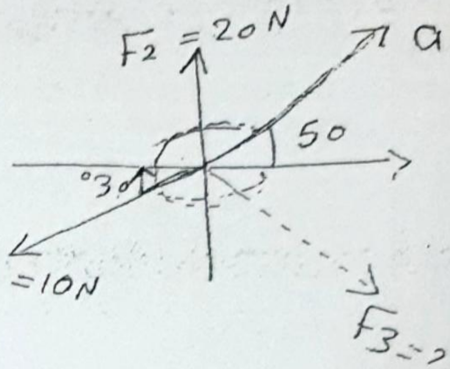
$$v^2 = \frac{2k}{m}\left(\frac{1}{x} - \frac{1}{X_0}\right)$$

$$v = \sqrt{\frac{2k}{m}\left(\frac{1}{x} - \frac{1}{X_0}\right)}$$

this's equation of velocity as a function of X

Ex:(3)

A 2.0kg tin is accelerated at $3.0\ m/s^2$ is shown in fig over frictionless horizontal surface. The acceleration is caused by 3 horizontal forces $F_1 = 10N$ with 30°, $F_2 = 20N$, $F_3 = ?$



we have

$$\sum \vec{F} = m\vec{a}$$

$$F_1 + F_2 + F_3 = ma$$

$$\therefore F_3 = ma - F_1 - F_2 \quad \text{---} (1)$$

we take the x component of this equation.

$$F_{3x} = ma_x - F_{1x} - F_{2x}$$

الحركة السينية صفر

$$F_{3x} = m(a\cos 50) - F_1(-\cos 30) - F_2(0)$$

$$= 2.0(3.0 \times 0.642) - (10(-0.866)) - 20(0)$$

$$= 3.85 + 8.66$$

$$= 12.5$$

كون اتجاه الزاوية بعكس محور السينات
توجد هذه الزاوية (-)
فتصبح (-)(-) جمع

$$F_{3y} = ma_y - F_{1y} - F_{2y}$$

$$= m(a\sin 50) - F_1(-\sin 30) - F_2 \sin 90$$

$$2(3 \times 0.766) + 10(0.5) - 20(1)$$

$$= 4.59 + 5 - 20 = -10.4$$

$$F_{3y} = -10.4$$

$$F_3 = F_{3x}\, i + F_{3y}\, j$$

$$F_3 = 12.5\, i - 10.4\, j$$

$$F = \sqrt{(12.5)^2 + (10.4)^2}$$

$$= \sqrt{156.2 + 108.3}$$

$$= \sqrt{264.5}$$

$$F = 16.2\ N \simeq 16\ N$$

$$\theta = \tan^{-1}\left(\frac{F_{3y}}{F_{3x}}\right)$$

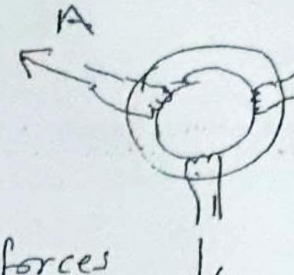
$$= \tan^{-1}\left(\frac{-10.4}{12.5}\right)$$

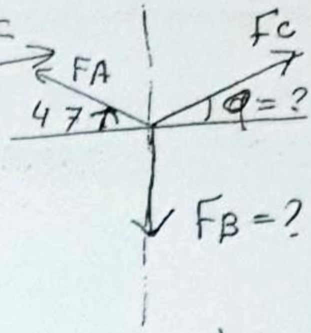
$$\theta = -39.7$$

$$\theta \simeq 40^{\circ}$$

Ex (4)

3 persons pull horizantally an automobile tire at the angles shown in Fig. The tire remains stationary in spite of the three pulls, one pull with force $F_A = 220N$, $F_C = 170N$ unknown direction what is F_B?





$F_{net} = ma$

because the three forces do not accelerate the tire $a = 0$ so the three force in equilibrium توازن

$\sum F = ma$

$F_A + F_B + F_C = m(0) = 0$

$F_B = -F_A - F_C$ --- (*)

$F_{By} = -F_{Ay} - F_{cy}$

$-F_B = -F_A \sin 47 - F_c \sin\varphi$

$-F_B = -220(\sin(180-47) - 170 \sin\phi$

$-F_B = -220 \sin 133 - 170 \sin\varphi$ --- (1)

the x componant of F.

$F_{Bx} = -F_{Ax} - F_{cx}$

$$F_B (\cos(-90)) = -F_A \cos 133 - F_C \cos\phi$$

$$0 = -220 \cos 133 - 170 \cos\phi \quad \text{---(6)}$$

$$\cos\phi = \frac{-220 \cos 133}{170}$$

$$\phi = \cos^{-1}\left(-\frac{220 \cos 133}{170}\right)$$

$$\phi = \cos^{-1}(0.882)$$

$$\phi = 28.115^\circ$$

put this value in eqn. (1)

$$-F_B = -220\ 133 - 170 \sin(28.115)$$

$$= -160.89 - 170 \times 0.47$$

$$= -16.89 - 80.09$$

$$-F_B = -240.9$$

$$F_B \simeq 241\ N$$

(6.)

(2). A passenger of mass 72.2 kg what does the scale read a) when the elevator cable is decreasing with constant velocity.

b) when a scending with $a = 3.2\ m/s^2$.

c) when the cable of elevator break.

You are standing on bathroom scale in an elevator in which of these situation must the scale read the same as when the elevator is at rest.

a) moving up with increasing speed.

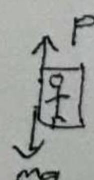
b) moving up at constant speed.

c) in free fall (after elevator cable cut.

A 80-kg woman stands on scale in an elevator when it starts to move the scale read 700 N.

a) is the elevator moving upward or downward.

b) if its velocity not constant. if so, what is the elevator acceleration what is



a) $P - mg = ma$

$700 - 80 \times 9.8 = 80\,a$

$700 - 784 = 80\,a$

$a = -1.05$ so the elevator move down

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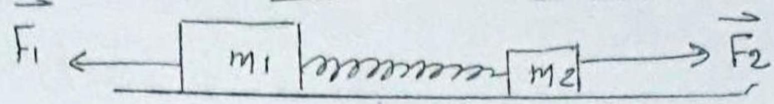
P: 104

أجوبة
مسائل الفصل
الخامس

Q1)



$\vec{F_1} = m_1 \vec{a}_1$ $\qquad \frac{a_1}{a_2} = ?$

$\vec{F_2} = m_2 \vec{a}_2$

$\vec{F_1} = \vec{F_2}$ $\qquad \therefore \; m_1 a_1 = m_2 a_2$

$$\frac{a_1}{a_2} = \frac{m_2}{m_1}$$

Q.2)

$\vec{F_1} = m_1 a_1$ --- (1)

$\vec{F_2} = m_2 a_2$ --- (2)

$x_1 = V_0 t + \frac{1}{2} a t^2$

$x_1 = 0 + \frac{1}{2} a_1 t^2$

$a_1 = \frac{2x_1}{t^2}$

the same thing $\qquad a_2 = \frac{2x_2}{t^2}$

$F_1 = m_1 \left(\frac{2x_1}{t^2}\right)$ $\qquad$ عوض a_1 في معادلة (1)

subsitute a_2 in equation (2)

$F_2 = m_2 \left(\frac{2x_2}{t^2}\right)$

divide F_1 by F_2 we get

$$\frac{F_1}{F_2} = \frac{m_1\left(\frac{2X_1}{t^2}\right)}{m_2\left(\frac{2X_2}{t^2}\right)}$$

$$1 = \frac{m_1}{m_2} \cdot \frac{X_1}{X_2} \qquad F_1 = F_2$$

$$m_1 X_1 = m_2 X_2$$

$$X_1 = \frac{m_2 X_2}{m_1}$$

this mean that the distance traveled by the mass m_1 is inversly proporti to the mass m_1

المسافة المقطوعة من قبل الجسم m_1 تتناسب عكسيا مع الكتلة m_1

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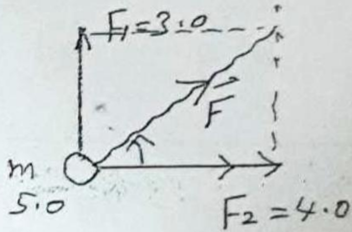
23) $F = \sqrt{(4)^2 + (3)^2} = 5\ nt$

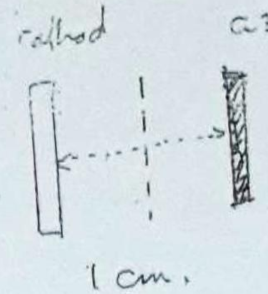


$\vec{F} = m\vec{a}$

$5 = 5a \qquad a = 1\,m s^{-2}$

$\tan\theta = \frac{3}{4} \qquad \theta = 37$ from F_2 to F_1

5) (6)



a) $v^2 = v_o^2 + 2aX$

$v_o = 0$ start from rest

$v^2 = 2aX$

$a = \frac{v^2}{2X} = \frac{(6.0 \times 10^6 \ m/sec)^2}{2 \times 1.0 \times 10^{-2}}$

$a = 18 \times 10^{14} \ m/sec^2$

$\vec{F} = m\vec{a} = 9.1 \times 10^{-31} \ kg \times 18 \times 10^{14}$

$F = 163.8 \times 10^{-17}$ Neut

$F = 1.638 \times 10^{-15}$ Neut

This is the force on the electron due to its acceleration (electrical Force)

b) the force due to the gravity.

$\vec{F} = mg = 9.1 \times 10^{-31} \times 9.8 = 89.1 \times 10^{-31}$ Neut

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Q-9 $m = 75 \ kg$

a) this weigh on the earth $W = mg$

$W = 75 \times 9.8 = 740$ Neut

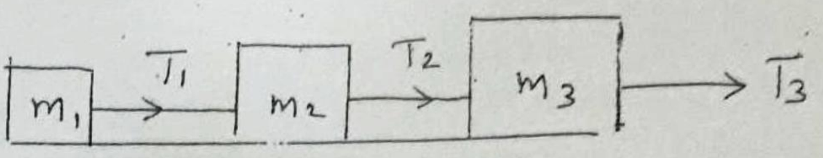
b) if $g = 8.1$ then $W = 75 \times 8.1$

$= 607.5$ Neut

$\simeq 610$ Neut.

c) $W = 0$

Q 11



$T_1 = m_1 a$

$T_2 = (m_1 + m_2) a$

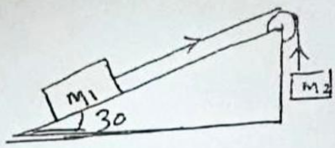
$T_3 = (m_1 + m_2 + m_3) a$

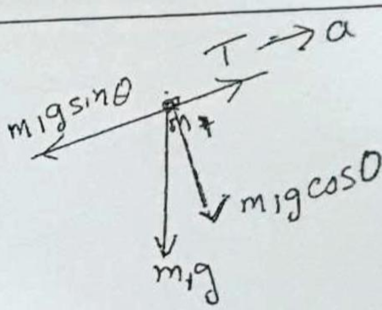
$60 = (10 + 20 + 30) a$ $\quad a = 1\ m s^{-2}$

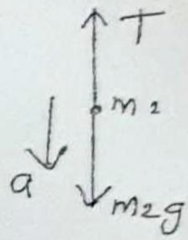
$T_2 = (10 + 20) \cdot 1 \longrightarrow T_2 = 30$ neut

$T_1 = 10 \cdot 1 = 10$ neut.

Q 15)







$\Sigma F x = m a$

$g \simeq 10\ m/sec^2$

$T - m_1 g \sin\theta = m_1 a$

$T = m_1 a + m_1 g \sin\theta$

$= m_1 (a + g \sin\theta)$

$= 3 (a + 10 \times \sin 30)$

$T = 3 (a + 5)$

$T = 3a + 15$ --- (1)

For the mas m_2

$T - m_2 g = - m_2 a$

$m_2 g - T = m_2 a$

$2 \times 10 - T = 2a$

subsitute T from equation 1 in equation (2)

$20 - (3a + 15) = 2a$

$20 - 3a - 15 = 2a$

$5 = 5a$

$a = 1\ m/sec^2$

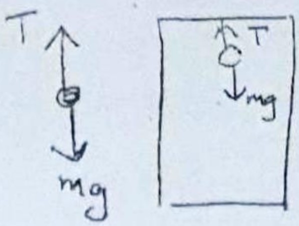
$\therefore T = 3(1 + 5)$

$= 18$ nt

21) The elevator descending نازل المصعد
بتباطؤ deceleration of $8.0\,m/se^2$

a) $T = 20\,lb$

$m = ?$



$\sum F_y = ma$

$T - mg = (-)\times(-)\,ma$ $\quad$ $a\,(-)\downarrow$

if the elevator descend $a(-)$ and if it deceleration $a(-)$

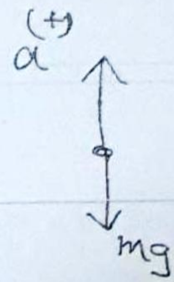
$\therefore a = (-)\times(-) = (+)$

$T = ma + mg$

$T = m(a+g)$

$m = \dfrac{T}{a+g} = \dfrac{20}{8+10} = \dfrac{20}{18} = 1.1\ Kg$

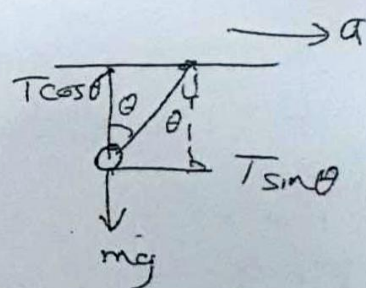
b) when the elevator ascend with accelerat increase what is $T = ?$
المصعد يصعد بتعجيل متزايد



$T - mg = ma$

$T = m(a+g)$

$T = 1.1(8+10) = 19.8$ Neut.



22) $T\cos\theta = mg$

$T\sin\theta = ma$

$\dfrac{a}{g} = \tan\theta \longrightarrow a = g\tan\theta$

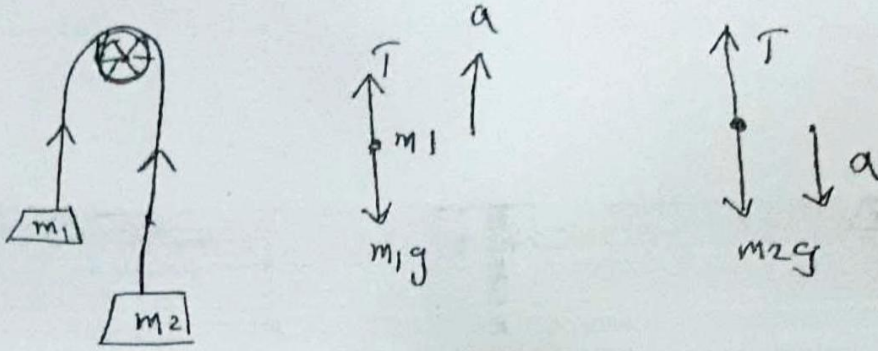
if $\theta = 20$ $\quad g\tan\theta \Rightarrow \tan 20 \times 9.8 = a$

$a = 357\ m s^{-2}$

b) $a = 357\ m s^{-2}$

c) $357 = g\tan\theta$ $\qquad \tan^{-1}\theta = \dfrac{357}{980}$

(1.25)



For m_1

$$T - m_1 g = m_1 a$$

$$T = m_1 (a + g) \text{ --- } (1)$$

For m_2

$$T - m_2 g = -m_2 a$$

$$m_2 g - T = m_2 a \text{ --- } (2) \quad \text{sub (1) in (2)}$$

$$m_2 g - m_1 (a+g) = m_2 a$$

$$m_2 g - m_1 a - m_1 g = m_2 a$$

$$m_2 g - m_1 g = (m_2 + m_1) a$$

$$(m_2 - m_1) g = (m_2 + m_1) a$$

$$a = \frac{(m_2 - m_1)}{m_2 + m_1} \cdot g$$

if $m_1 = 0.5\,kg$, $m_2 = 1.0\,kg$

find $a = ?$ $T = ?$

$$a = \frac{1 - 0.5}{1.5} \cdot 9.8 = 3.3\,ms^{-2}$$

$$T = m_1 \left[\left(\frac{m_2 - m_1}{m_2 + m_1} \right) \cdot g + g \right]$$

$$= m_1 \left[\frac{(m_2 - m_1) g + (m_2 + m_1) g}{\ldots} \right] = \left[m_1 m_2 g - m_1^2 g + m_2 m_1 g + m_1^2 g \right.$$

$$= \frac{2m_1m_2g}{m_1+m_2}$$

$$= \frac{2 \times 0.5 \times 1 \times g}{1.5} = \frac{1.0}{1.5} g = 0.066g$$

$T = 0.066g$.