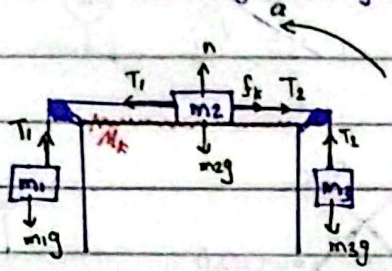
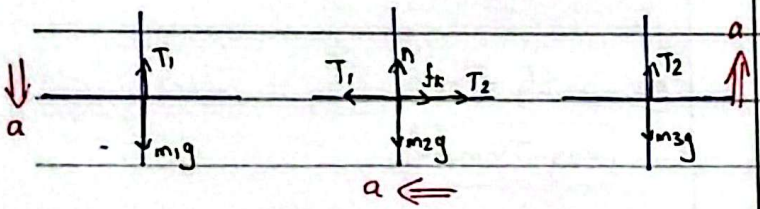
Subject: problems page 144+145 — Wednesday 19/11/2025 — Date — No.

Q64 $\mu_k = 0.35$, $m_1 = 4\,kg$, $m_2 = 1\,kg$, $m_3 = 2\,kg$



* لما يكون الخيوط مختلفة تكون (T) مختلفة ومش بتساوي

(a) Draw a free body diagram of each object.



(b) Determine the acceleration of each object, including its direction.

m_1 $\Sigma F_y = m_1 a$

$m_1g - T_1 = m_1 a$

m_2 $\Sigma F_y = 0 \Rightarrow n - m_2g = 0 \Rightarrow n = m_2g$

$\Sigma F_x = m_2 a$

$T_1 - T_2 - f_k = m_2 a$ $\quad f_k = \mu_k n = \mu_k m_2 g$

m_3 $\Sigma F_y = m_3 a$

$T_2 - m_3g = m_3 a$

$m_1g - T_1 = m_1 a$

$T_1 - T_2 - \mu_k m_2 g = m_2 a$

$T_2 - m_3g = m_3 a$

$m_1g - m_3g - \mu_k m_2 g = (m_1 + m_2 + m_3)\, a$

$$a = \frac{m_1g - m_3g - \mu_k m_2 g}{m_1 + m_2 + m_3}$$

نعوض القيم

$a = 2.31\ m/s^2$

(c) Determine the tensions in the two cords

$T_1 = m_1 g - m_1 a$

$T_1 = 29.96\ N$

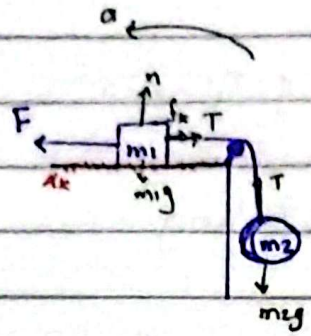
$T_2 = m_3 a + m_3 g$

$T_2 = 24.22\ N$

Subject Wednesday 19/11/2025 Date No

Ex

Calculate (a):



m_1 $\Sigma f_y = 0 \Rightarrow n - m_1 g = 0 \Rightarrow \boxed{n = m_1 g}$

$\Sigma f_x = m_1 a$

$\boxed{F - f_k - T = m_1 a}$

m_2 $\Sigma f_y = m_2 a$

$\boxed{T - m_2 g = m_2 a}$

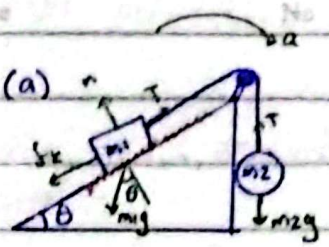
$F - f_k - T = m_1 a$

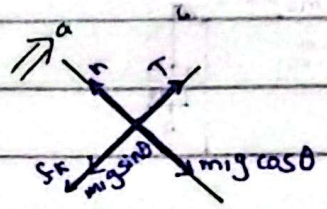
$T - m_2 g = m_2 a$

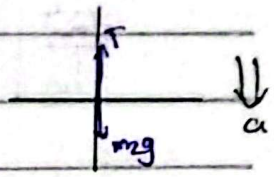
$F - f_k - m_2 g = (m_1 + m_2) a$

$$\boxed{a = \frac{F - f_k - m_2 g}{m_1 + m_2}}$$

Calculate (a)







m_1

$\Sigma f_x = m_1 a$

$\boxed{T - f_k - m_1 g \sin\theta = m_1 a}$

m_2 $\Sigma f_y = m_2 a$

$\boxed{m_2 g - T = m_2 a}$

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

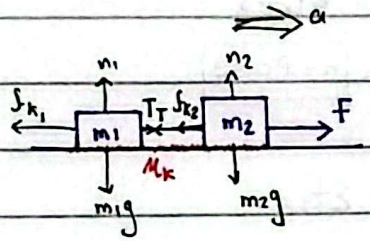
$m_2 g - T = m_2 a$

$m_2 g - f_k - m_1 g \sin\theta = (m_1 + m_2) a$

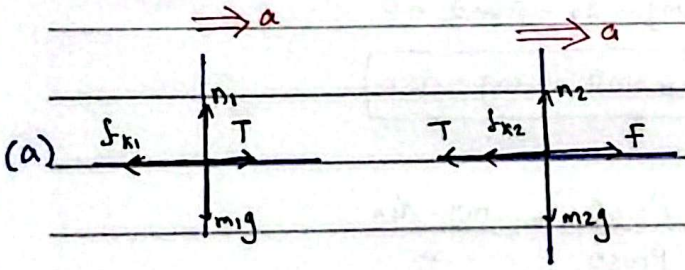
$$\boxed{a = \frac{m_2 g - f_k - m_1 g \sin\theta}{(m_1 + m_2)}}$$

Subject: problems page: 145 — Wednesday 19/11/2025 — Date — No.

Q65 Two blocks connected by a rope of negligible mass are being dragged by a horizontal force, Suppose: $f = 68\,N$, $m_1 = 12$ $m_2 = 18\,kg$, and the coefficient of kinetic friction between each block and the surface is 0.1 (a) Draw a free-body Diagram for each bbck.



(a)



(b) the acceleration of the system.

m_1 $\sum f_y = 0 \Rightarrow n_1 - m_1 g = 0 \Rightarrow \boxed{n_1 = m_1 g}$

$\sum f_x = m_1 a$

$\boxed{T - f_{k1} = m_1 a}$

$f_{k_1} = \mu_k n_1$

$= \mu_k m_1 g$

$\boxed{f_{k_1} = 11.76}$

m_2 $\sum f_y = 0 \Rightarrow n_2 - m_2 g = 0 \Rightarrow \boxed{n_2 = m_2 g}$

$\sum f_x = m_2 a$

$\boxed{F - f_{k_2} - T = m_2 a}$

$f_{k_2} = \mu_k n_2$

$= \mu_k m_2 g$

$\boxed{f_{k_2} = 17.64}$

$T - f_{k_1} = m_1 a$

$F - f_{k_2} - T = m_2 a$

$F - f_{k_1} - f_{k_2} = (m_1 + m_2) a$

$$\boxed{a = \frac{F - f_{k_1} - f_{k_2}}{m_1 + m_2}}$$

نعوض القيم

$\boxed{a = 1.29\ m/s^2}$

(c) the tension T in the rope

$T - f_{k_1} = m_1 a$

$T = m_1 a + f_{k_1}$

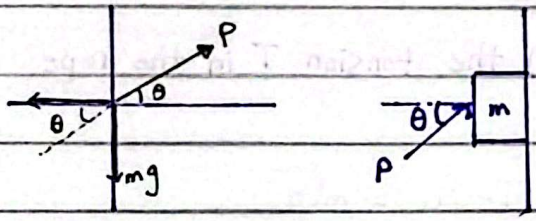
$= (12)(1.29) + 11.76$

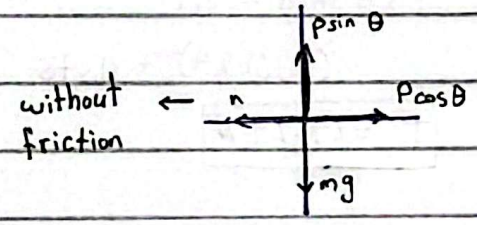
$\boxed{T = 27.24\ N}$

Subject: Wednesday 19/11/2025 Date: No.

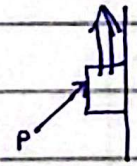
Problems page 195

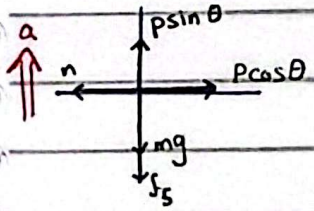
Q56 A block of mass $m = 3\,kg$ is pushed up against a wall by a force P that makes an angle of $\theta = 50$ with the horizontal as shown in Figure. The coefficient of static friction between the block and the wall is $\mu_s = 0.25$ (a) Determine the possible values for the magnitude of $\vec{P}$ that allow the block to remain stationary





Case 1 : $P \rightarrow max$





$\Sigma f_x = 0 \Rightarrow \boxed{n = P\cos\theta}$

$\Sigma F_y = 0$

$P\sin\theta - mg - f_s = 0$

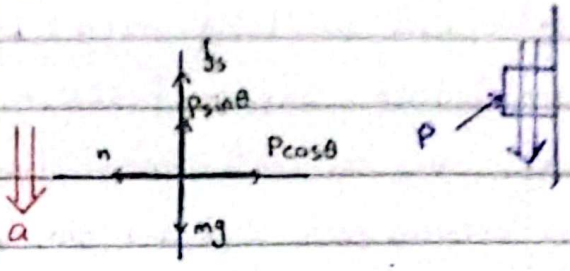
$\boxed{P\sin\theta = mg + f_s}$

$\frac{P\sin\theta}{P\cos\theta} = \frac{mg + f_s}{n}$ ($f_s = \mu_s n$) $\Rightarrow$ [illegible]

$\tan\theta = \frac{mg}{n} + \frac{\mu_s n}{n} \Rightarrow \tan\theta - \mu_s = \frac{mg}{n}$

$\boxed{n = \frac{mg}{\tan\theta - \mu_s}} \rightarrow \boxed{n = 31.2} \rightarrow P = \frac{n}{\cos\theta} \rightarrow \boxed{P = 48.5}$

Case 2 : $P \rightarrow min$



$\Sigma f_x = 0$

$\boxed{n = P\cos\theta}$

$\Sigma f_y = 0$

$mg - f_s - P\sin\theta = 0$

$\boxed{P\sin\theta = mg - \mu_s n}$

$\frac{P\sin\theta}{P\cos\theta} = \frac{mg - \mu_s n}{n}$

$\tan\theta = \frac{mg}{n} - \mu_s \Rightarrow \mu_s + \tan\theta = \frac{mg}{n}$

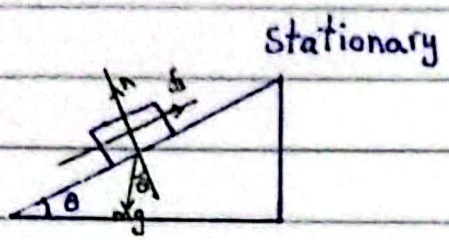
$\boxed{n = \frac{mg}{\mu_s + \tan\theta}}$

$\boxed{n = 20.4}$

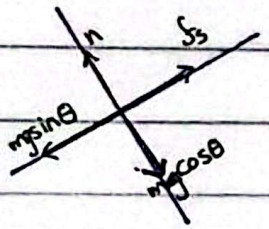
$P = \frac{n}{\cos\theta}$ $\boxed{P = 31.7}$

NOTEBOOK

Ex)



* Calculate the coefficent of static friction.



$\Sigma F_x = 0$

$$mg \sin\theta = \mu_s n$$

$\Sigma F_y = 0$

$$mg\cos\theta = n$$

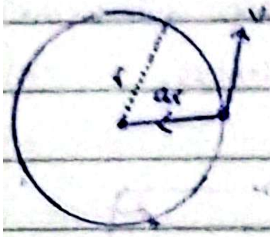
$$\frac{mg\sin\theta}{mg\cos\theta} = \frac{\mu_s n}{n}$$

$$\mu_s = \tan\theta$$

Monday 24/11/2025

Chapter (6) :

Circular Motion application on Newton's 2nd Law.



$$a_r = \frac{v^2}{r}$$

Centripital Force : $\leftarrow F_r = m a_r$

$$\boxed{F_r = -\frac{mv^2}{r}\hat{r}}$$

(−) ⇒ toward center

($\hat{r}$) ⇒ direction of radius.

* دائماً الجسم بينطلق بإتجاه المماس اذا تم قطع الحبل *

* الي بحافظ على الجسم إنه يضل في حركة دائرية قوة الشد [Tension]

* القوة الي بتخلي الجسم يضل في مساره الدائري

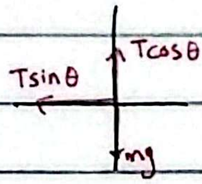
- الحبل [قوة الشد (T)]
- السيارة [قوة الاحتكاك السكوني (f_s)]

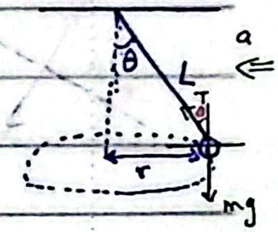
* طريقة الحل : ① بندور على القوة الي بتكون بإتجاه المركز . ② ΣF

Page 152

Ex: 6.1

A small ball of mass m is suspended from a string of length L. The ball revolves with constant speed v in a horizontal circle of radius r as shown in Figure [Because the string sweeps out the surface of a cone, the system is known as a conical pendulum]. Find an expression for v in terms of the geometry in Figure





$$\Sigma F_x = ma$$

$$T\sin\theta = \frac{mv^2}{r} \Rightarrow v = \sqrt{\frac{Tr\sin\theta}{m}}$$

$$\Sigma F_y = 0 \Rightarrow T\cos\theta - mg = 0$$

$$T\cos\theta = mg$$

$$\boxed{T = \frac{mg}{\cos\theta}}$$

$$v = \sqrt{\frac{\frac{mg}{\cos\theta} r\sin\theta}{m}}$$

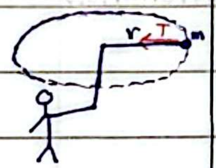
$$\boxed{v = \sqrt{rg\tan\theta}}$$

لو ابتدا الجسم انطلق من القوة أي بشغله [illegible]
ابعد الطريق بمقداره أكثر منها

Subject Monday 24/11/2025 Date No.

page: 152 Ex: 6.2

A puck of mass 0.5 kg (m) is attached to the end of a cord 1.5 m (r) long. The puck moves in a horizontal circle as shown in Figure. If the cord can withstand a maximum tension of 50 N (T_{max}), what is the maximum speed at which the puck can move before the cord breaks? Assume the string remains horizontal during the motion.



$$\Sigma F_x = ma$$

$$T = \frac{mv^2}{r}$$

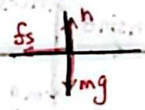
$$v = \sqrt{\frac{Tr}{m}} \qquad v_{max} \ @ \ T_{max}$$

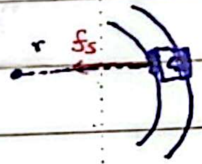
$$v_{max} = \sqrt{\frac{T_{max}\, r}{m}} = \sqrt{\frac{50(1.5)}{0.5}}$$

$$\boxed{v_{max} = 12.24 \ m/s}$$

page: 153 Ex: 6.3

A 1500 kg car moving on a flat, horizontal road negotiates a curve as shown in figure. If the radius of the curve is 35 m (r) and the coefficient of static friction between the tires and dry pavement is 0.523 (μ_s), find the maximum speed the car can have and still make the turn successfully.





$$\Sigma F = ma$$

$$f_s = \frac{m v^2}{r}$$

$$v = \sqrt{\frac{r f_s}{m}} \rightarrow \quad \Sigma F_y = 0$$

$$n - mg = 0 \Rightarrow n = mg$$

$$f_s = \mu_s n$$

$$\boxed{f_s = \mu_s mg}$$

$$v = \sqrt{\frac{r \mu_s m g}{m}}$$

$$v = \sqrt{r \mu_s g}$$

$$v = \sqrt{(35)(0.523)(9.8)}$$

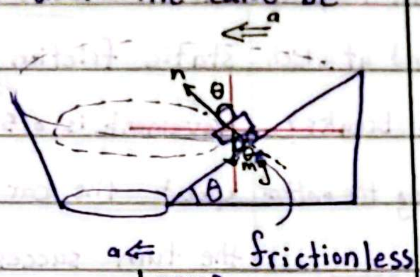
$$\boxed{v_{max} = 13.1 \ m/s}$$

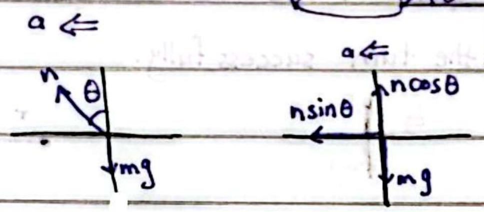
* (f_s) لأن السيارة لا تنزلق باتجاه r او خارج الدائرة بنستخدم الاحتكاك السكوني.
* (f_k) الاحتكاك الحركي بكون في إتجاه حركة الجسم.

بما انها خارج اطار حركة السيارة ، يعني القوة لكي يحافظ على حركتها بشكل دائري [illegible] مسار السيارة [illegible] f_s [illegible]

page: 154
Ex. 6.4

A civil engineer wishes to rede.......
Suppose the designated speed for the road is to be 13.4 m/s (30 mi/h) and the radius of the curve is 35 m. At what angle should the curve be banked ?





$$\Sigma F_y = 0 \Rightarrow n\cos\theta - mg = 0 \Rightarrow n\cos\theta = mg$$

$$\boxed{n = \frac{mg}{\cos\theta}}$$

$$\Sigma F_x = ma$$

$$n\sin\theta = \frac{mv^2}{r}$$

$$v = \sqrt{\frac{nr\sin\theta}{m}} = \sqrt{\frac{\frac{mg}{\cos\theta} r\sin\theta}{m}}$$

$$v = \sqrt{gr\tan\theta}$$

*المطلوب θ ??

$$\tan\theta = \frac{v^2}{rg} \Rightarrow \theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$$

$$\theta = \tan^{-1}\left(\frac{(13.4)^2}{35(9.8)}\right)$$

$$\boxed{\theta = 27.6^\circ}$$