Date 15th Oct 2023

NS1001 APPLIED PHYSICS

ASSIGNMENT #3

1(a) $F = ma$

$m = \frac{2.21}{9.81} = 0.225\,kg$

$\Delta S = \frac{1}{2}(\Delta v)\Delta t$

$\Delta S = \frac{1}{2}(+18)(0.17) = +1.53\,m$

(b) $a = \frac{\Delta v}{\Delta t} = \frac{18}{0.17} = 106\,ms^{-2}$

F_1: Force of pitcher on ball, F_2: Weight

$F_1 + F_2 = ma$

$F_{1x} + F_{2x} = ma_x$ $\quad\quad$ $F_{1y} + F_{2y} = ma_y$

$F_{1x} = ma_x$ $\quad\quad$ $F_{1y} - 2.21 = 0$

$F_{1x} = (0.225)(106)$ $\quad\quad$ $F_{1y} = 2.21$

$F_{1x} = 23.9\,N$

$F_1 = \sqrt{23.9^2 + 2.21^2}$

$F_1 = 24.0\,N$

$\theta = \tan^{-1}\left(\frac{2.21}{23.9}\right) = 5.29°$

Pitcher exerts force of 24.0N forward at 5.29° anticlockwise from the positive x-axis.

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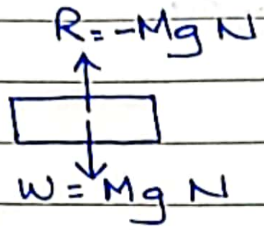
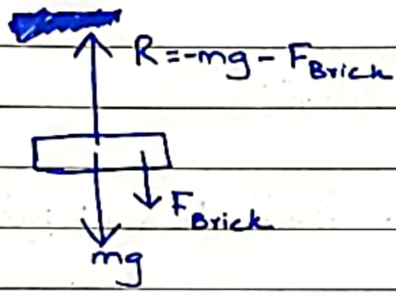
(a) Brick free-body diagram:



(b)



(c) Force: Normal force of cushion on brick
Reaction: Force of brick on cushion

Force: Gravity force of Earth on Brick
Reaction: Gravity force of Brick on Earth

Force: Normal force of ground on cushion
Reaction: ~~Not~~ Force of cushion on ground

Force: Gravity force of Earth on cushion
Reaction: Gravity force of cushion on Earth.

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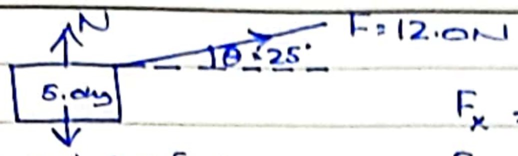
3)



$W = 49.05N$

$F_x = 12\cos 25$ $\quad F_y = 12\sin 25$

$F_x = 10.88\,N$ $\quad F_y = 5.07\,N$

a) $F_x = ma_x$

$10.88 = (5)a_x$

$a_x = 2.18ms^{-2}$

$F_y = ma_y$

$\cancel{-49.05 + 5.07 = (5)a_y}$

$\cancel{a_y = -8.80ms^{-2}}$

$F_N + F\sin\theta - mg = 0$

$F_N = 43.9N$

Block remains on floor as $F_N < W$

$a = 2.18m/s^2$

b) $F_N = 0$

$F\sin\theta = mg$

$F = \frac{(5)(9.81)}{\sin 25} = 116N$

c) $ma = F\cos\theta$

$a = \frac{F\cos\theta}{m}$

$a = \frac{116\cos 25}{5.00} = 21.0ms^{-2}$

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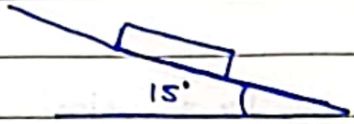
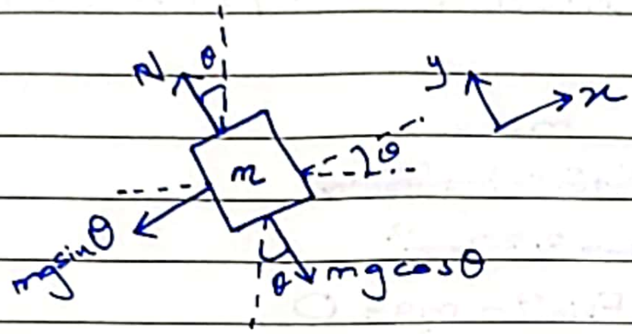
4) 

a) 

b) $\theta = 15°$

$a = g\sin\theta$

$a = -9.81 \sin 15 = -2.54 ms^{-2}$

c) $u = 0 ms^{-1}$

$2as = v^2 - u^2$

$v^2 = 2as + u^2$

$v^2 = (2)(2.54)(2)$ → using $|a|$

$v = 3.19 ms$

6 a) $m = \frac{18}{0.6} = 30 cm/s^2$ ← Acceleration

$F_y = m a_y$

$F_{Bar} - (64)(9.81) = (64)(0.3)$

$F_{Bar} = 627.84 + 19.2$

$F_{Bar} = 647 N$

b) Same as (a) because same acceleration due to same slope

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c) $a_y = 0\,ms^{-2}$ at $t = 1.1s$

$F_y = ma_y$

$F_{Bar} - (64)(9.81) = 0$

$F_{Bar} = 627$ N upwards.

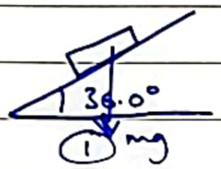
d) $a_y = \dfrac{0-24}{1.7-1.3} = -60$

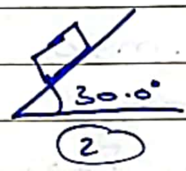
$F_y = ma_y$

$F_{Bar} - (64)(9.81) = (64.0)(-0.6)$

$F_{Bar} = 589$ N up.

(6)





1 $-F_R + mg\sin\theta = 0$; $R - mg\cos\theta = 0$

$F_R = \mu R$

$+\mu_s R = mg\sin\theta$ $\qquad R = mg\cos\theta$

$+\mu(\cancel{mg}\cos\theta) = \cancel{mg}\sin\theta$

$\mu = \tan\theta$

$\mu_s = \tan 36.0°$ — 1

$\mu_k = \tan 30.0°$ — 2

$\mu_s = 0.727$ $\qquad \mu_k = 0.577$

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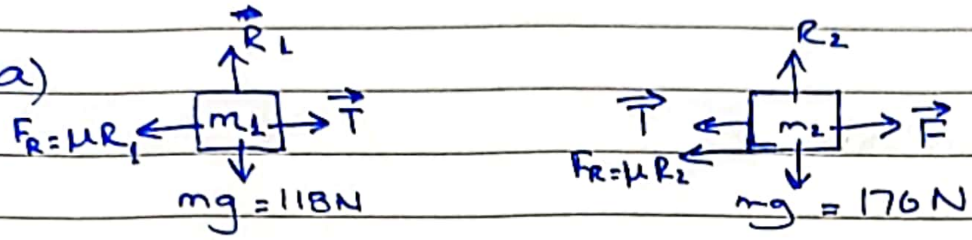
7)

(a)



b) $F_x = T - F_{R_1} = m_1 a$] m_1 $\quad$ $F_x = F - T - F_{R_2} = ma$] m_2

$F_y = R_1 - m_1 g = 0$ $\quad$ $F_y = R_2 - m_2 g = 0$

Sub T from m1 into m2

$F - m_1 a - F_{R1} - F_{R2} = m_2 a$

$m_2 a + m_1 a = F - F_{R1} - F_{R2}$

$a(m_1 + m_2) = F - F_{R1} - F_{R2}$

$a = \dfrac{(68.0N - 11.8 - 17.6)}{12.0 + 18.0} = 1.29\,ms^{-2}$

c) $T = m_1 a + F_{R1}$

$T = (12)(1.29) + 11.8 = 27.2\ N$

8) a) $\dfrac{\cancel{m}v^2}{R} = \cancel{m}g \cdot \tan(x)$

$\tan(x) = \dfrac{v^2}{Rg}$

$v_{max} = \sqrt{Rg\tan(\theta + \tan^{-1}(\mu_s))}$

$v_{max} = \sqrt{\dfrac{Rg\tan(\theta + \tan^{-1}\mu_s)}{1 - \mu_s\tan\theta}}$

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

$17 = \sqrt{150g\tan(\theta)}$

$\theta = 11.1°$

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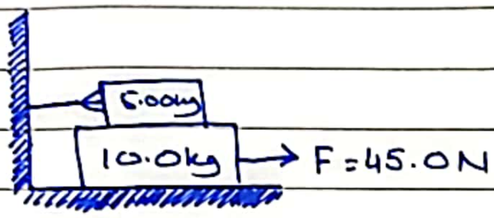
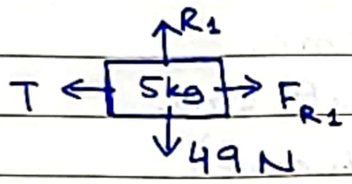
b) Not banked so $\theta = 0°$

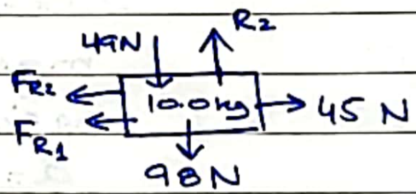
$$v = \sqrt{Rg\mu_s}$$

$$\mu_s = \frac{(17^2)}{(150)(9.81)} = 0.196$$

9)







b) F_y: $R_1 = m_1 g$

$R_1 = (5)(9.8)$

$R_1 = 49.0N$

F_x: $F_{R1} = T$

$\cancel{F_x}$: $\mu R_1 = T$

$T = (0.20)(49)$

$T = 9.80N$

m_1

P

F_y : $R_2 - R_1 - 98 = 0$

F_x: $45 - F_{R1} - F_{R2} = 10a$

$F_{R2} = \mu R_2 = \mu(m_1 + 98)$

$F_{R2} = (0.20)(49 + 98) = 29.4$

$45 - 9.8 - 29.4 = 10a$

$a = 0.58 ms^{-2}$

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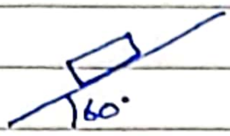
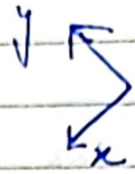


$\mu_k = 0.3$
$u = 0 \, ms^{-1}$
$s = 1.00 \, m$, $t = 0.483$



$s = ut + \frac{1}{2}at^2$
$1 = (\frac{1}{2})(a)(0.483)^2$

$a = 8.57 \, ms^{-2}$

$\Sigma F_y = ma_y$
$R - mg\cos\theta = 0$
$R = mg\cos\theta$

$\Sigma F_x = ma_x$
$mg\sin\theta - F_k = ma$
$mg\sin\theta - \mu_k mg\cos\theta = ma$
$a = g(\sin\theta - \mu_k\cos\theta)$
$a = (9.81)(\sin 60 - 0.3\cos 60)$
$a = 7.02 \, ms^{-2}$

Situation is impossible because these forces cannot produce this acceleration.