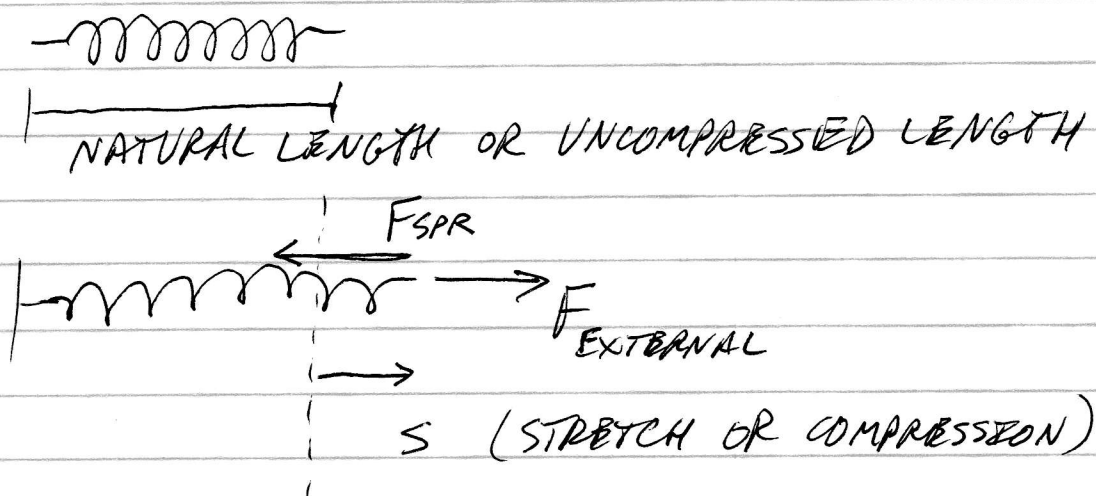
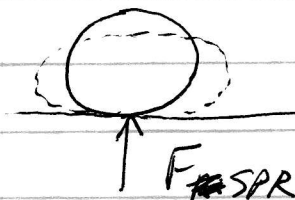
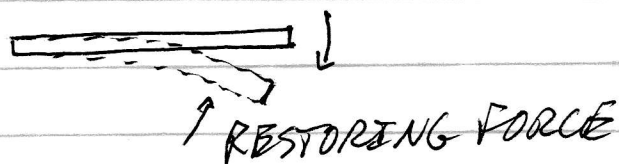


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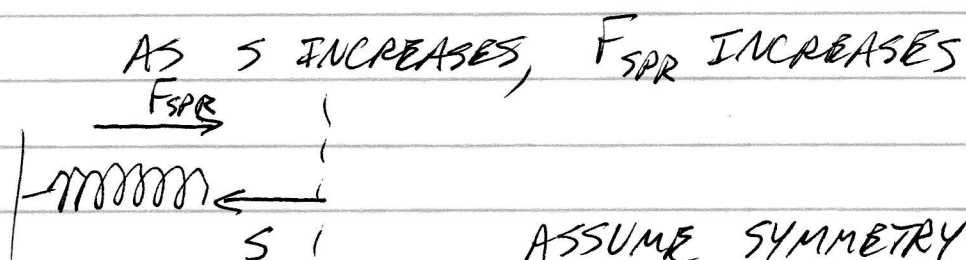
SPRING OR ELASTIC FORCE

F_{SPR}



F_{SPR} DEPENDS ON: • s

• SPRING PHYSICAL DETAILS



ASSUME SYMMETRY

WE'LL ASSUME WE DON'T EXCEED PHYSICAL
LIMITS OF SPRING

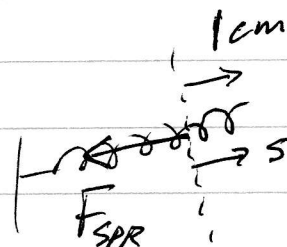
A GOOD MODEL FOR A SPRING LINEAR OR HOOKE'S LAW

$$F_{SPR} = k \cdot s$$

$\nwarrow$ STRETCH
 DIRECTED OPPOSITE OF s
 $\uparrow$ SPRING CONSTANT
 (DETAILS OF SPRING)
 UNITS: $\frac{N}{m}$ $\frac{lb}{ft}$ $\frac{N}{cm}$ $\frac{lb}{in}$
 S.I. U.S.

EXAMPLE: $k = 200 \frac{N}{m}$

$s = 1 \text{ cm} = 0.01 \text{ m}$



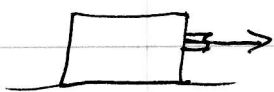
$$F_{SPR} = (200 \frac{N}{m})(0.01 \text{ m}) = 2 \text{ N} \text{ IN A DIRECTION OPPOSITE } s$$

FORCES DUE TO ROPES OR CHAINS

THESE TRANSFER FORCE FROM ONE OF ITS ENDS TO THE OTHER



F_T



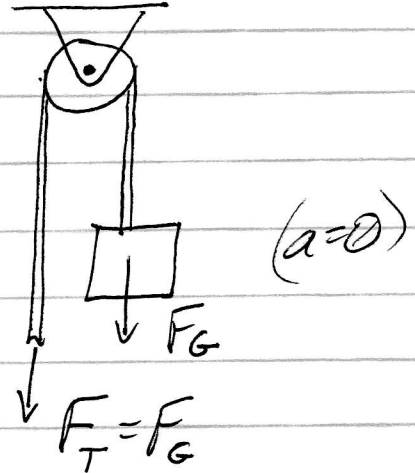
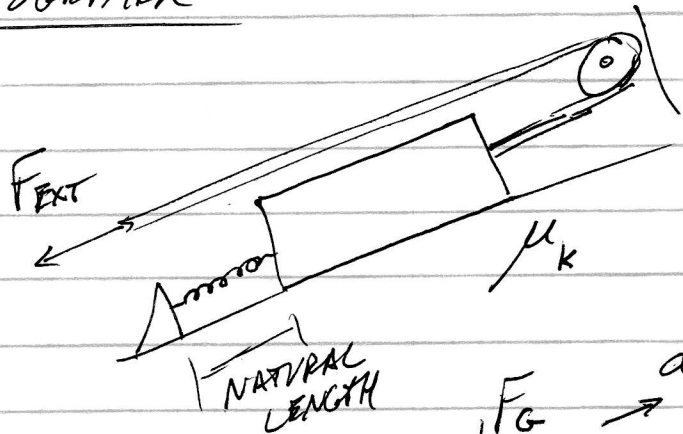
$F_{ON \text{ BLOCK}} = F_{EXT}$

$F_{OPPOSITE} = F_{EXT}$

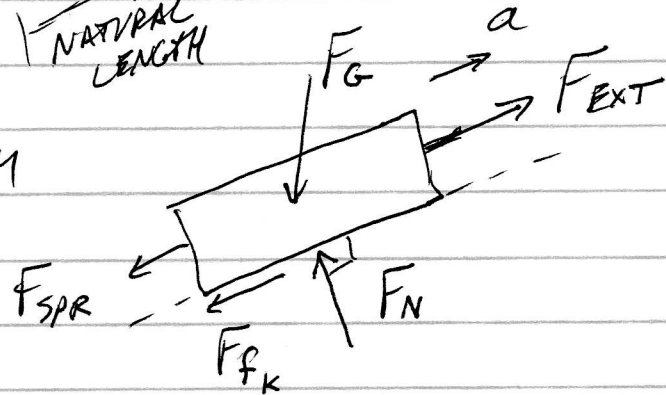
- WE IGNORE THE WEIGHT OF ROPE
- DOESN'T STRETCH
- FORCE OF TENSION IS ALONG THE ROPE

PULLEYS~~FOR~~

REDIRECTS FORCE,
~~DOESN'T~~ DOESN'T ADD
 OR SUBTRACT FORCE

MANY FORCES TOGETHER

FREE-BODY DIAGRAM



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

CIRCULAR MOTION

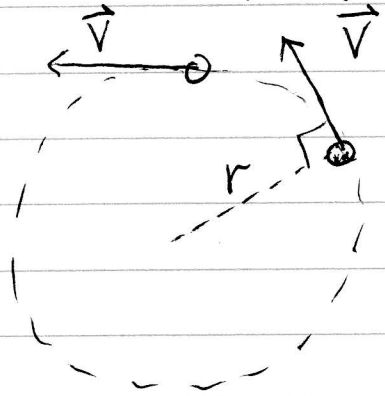
(CURVILINEAR MOTION)

UNIFORM CIRCULAR MOTION

CONSTANT SPEED ALONG A CIRCULAR PATH

V IS CONSTANT
BUT DIRECTION
IS CHANGING

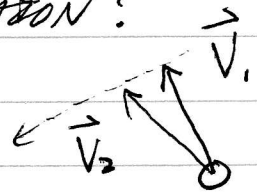
(TURNING ONLY)



ACCELERATION IS A CHANGE IN VELOCITY

IN WHAT DIRECTION IS ACCELERATION?

TOWARD THE CENTER
OF THE CIRCULAR PATH



CENTRIPETAL ACCELERATION OR CENTER-SEEKING

 a_{CENT} OR a_c MAGNITUDE IS
CONSTANT

CALCULATING CENTRIPETAL ACCELERATION:

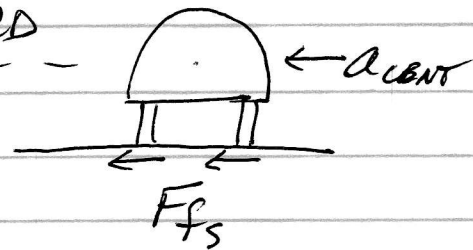
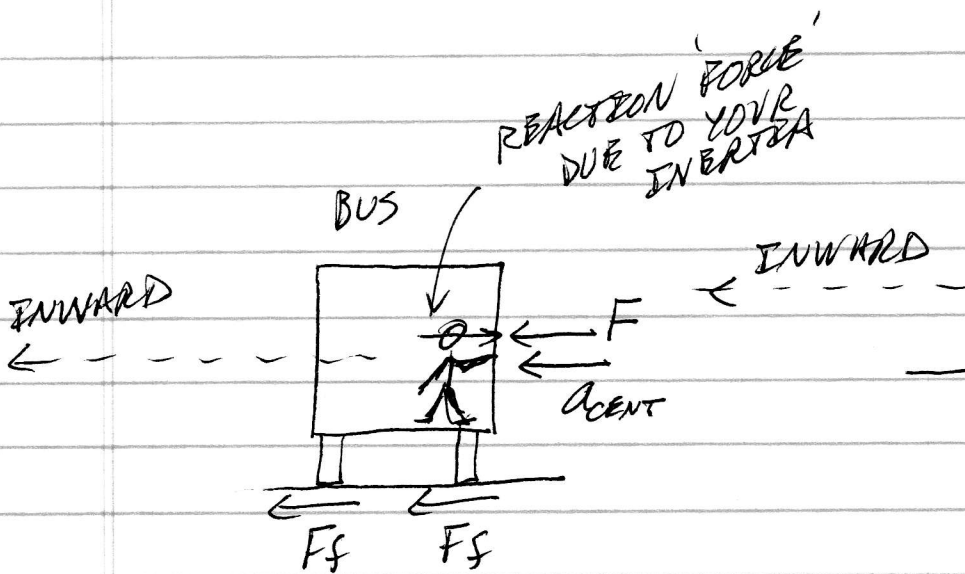
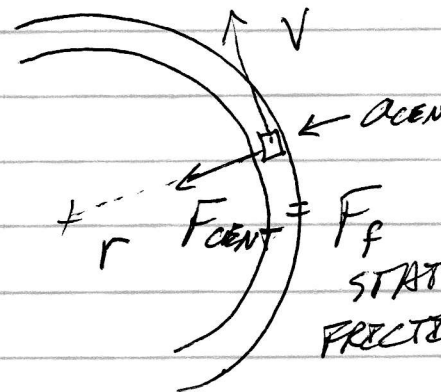
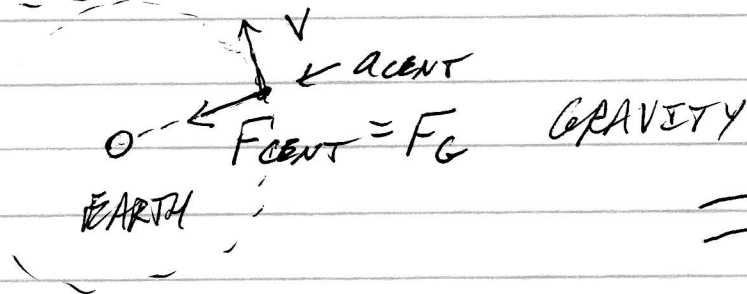
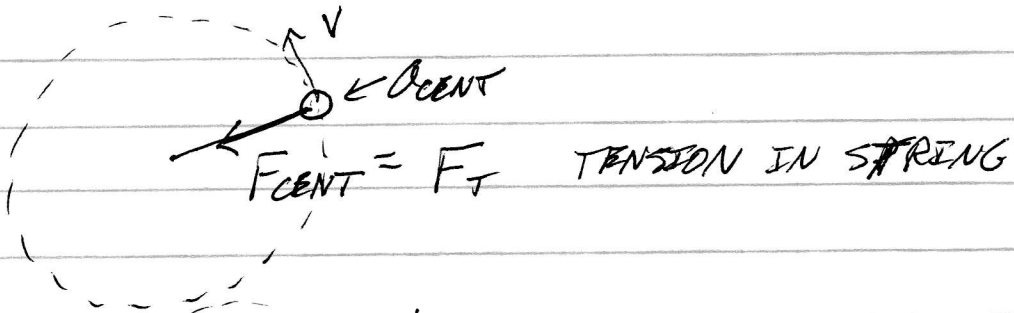
a_{CENT} DEPENDS ON: V SPEED
 r RADIUS OF CIRCLE

$$a_{\text{CENT}} = \frac{V^2}{r} \quad \frac{(m/s)^2}{(m)} = \left(\frac{m}{s^2}\right)$$

WHAT CAUSES CENTRIPETAL ACCELERATION?

CENTRIPETAL FORCE

↑ LABEL FOR A FORCE ALREADY DISCUSSED

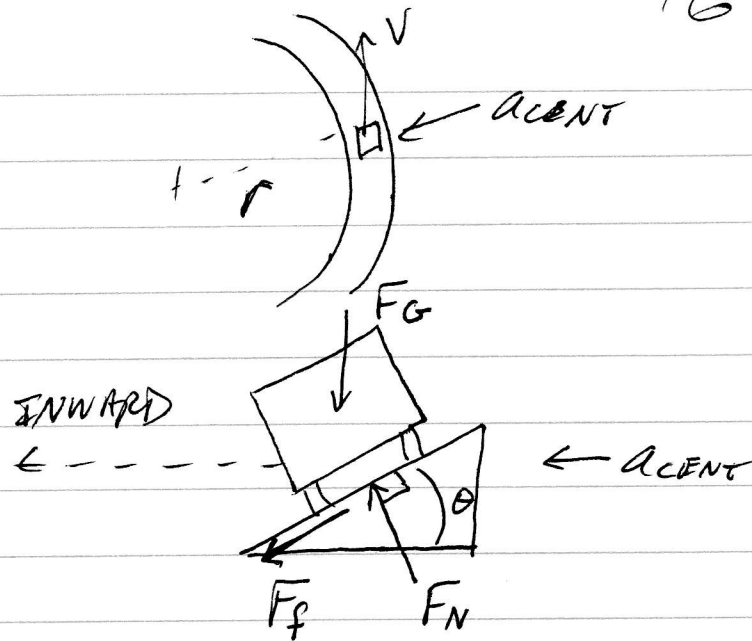


REACTION 'FORCE' IS THE CENTRIFUGAL 'FORCE'

FEELS OUTWARD DUE TO YOUR INERTIA

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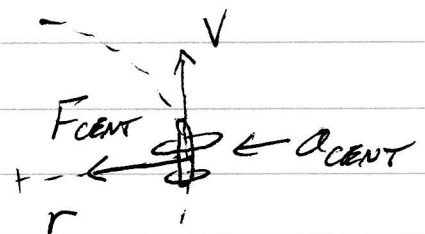
PART OF F_N HOLD UP
AGAINST GRAVITY
AND FRICTION



PARTS OF F_N AND F_f ARE INWARD SO THESE PARTS
CAUSE CENTREPETAL ACCELERATION

I CAN CHOOSE A r AND ANGLE AND A SUGGESTED
SPEED SO THAT ALL IS DONE BY F_N
AND NONE BY FRICTION

AIRPLANE



PART OF F_{LIFT} BALANCES F_G

INWARD PART IS F_{CENT}

