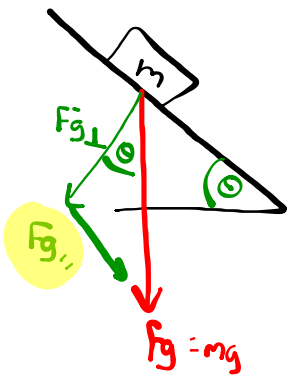
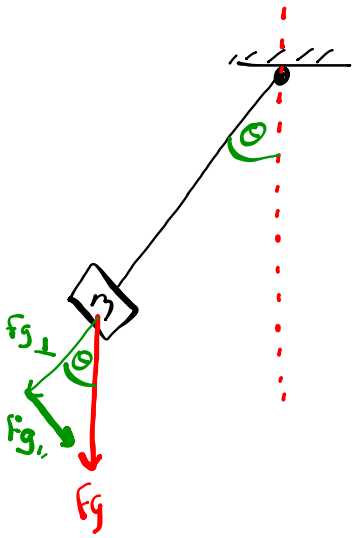
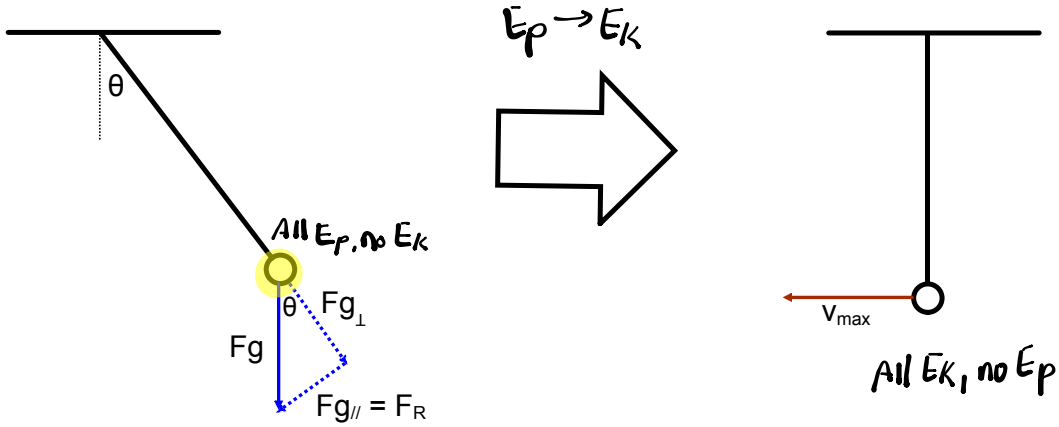
Pre-Lesson

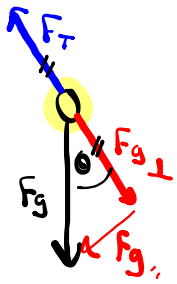




L12 – Oscillatory Motion of Pendulums

Q1: Discuss each diagram in terms of: F_R, a, and v.





① Knowing Fg and θ...

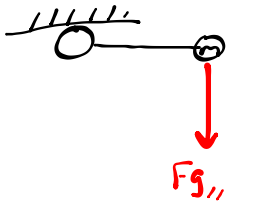
(A) Find $Fg_\perp$ which is equal to F_T

(B) Find the unbalanced "Restoring Force", $Fg_{//}$ (or F_R)

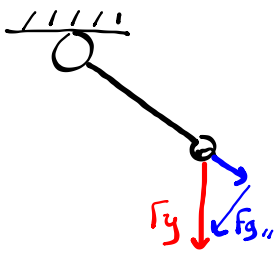
then $a = \frac{F_{net}}{m}$

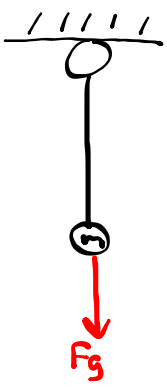
Q2: How can we determine the tension in the pendulum string?

Find $Fg_\perp$



Max F_R
Max a

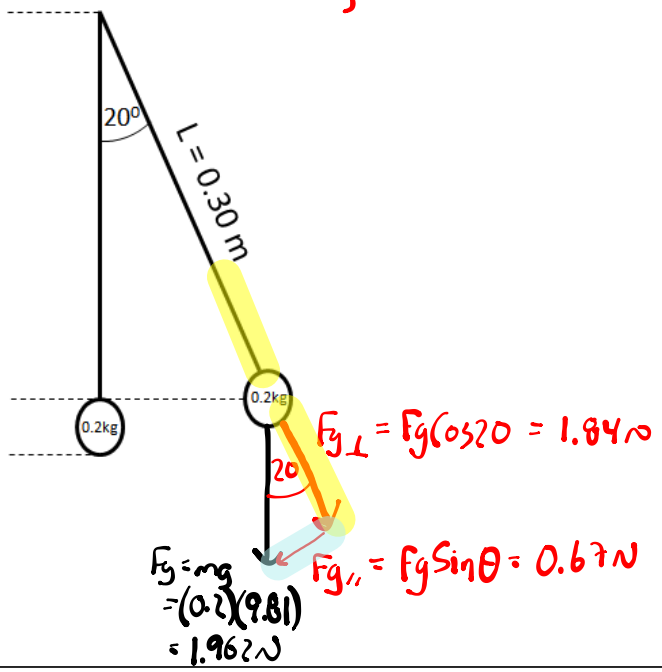




No F_R
No accel.
All Energy is E_K, max speed.

Use the following information to answer Q3-Q9:

A ~~30~~ 0.3m cm pendulum arm is pulled to an angle of 20° right of the vertical. The mass of the bob is ~~200~~ 0.2kg g.



Q3: What is the restoring force acting on the pendulum when 20° right of the vertical?

$F_R = 0.67N$

Q4: What is the tension in the rope when 20° right of the vertical?

$F_T = 1.84N$

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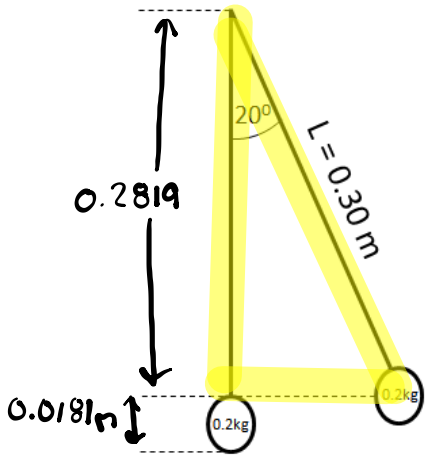
Use the following information to answer Q3-Q9:

A 30cm pendulum arm is pulled to an angle of 20° right of the vertical. The mass of the bob is 200g.



$\cos\theta = \frac{a}{h}$

$a = h\cos\theta$
$= (0.3)\cos 20$
$= 0.2819$

Q7 $E_p \rightarrow E_K$

$mgh \rightarrow \frac{1}{2}mv^2$

$(9.81)(0.0181) = \frac{1}{2}v^2$

$v = 0.596\ m/s$

Q5: What is the instantaneous acceleration of the bob when it is initially released?

$a = \frac{F_{net}}{m} = \frac{0.67\ N}{0.2} = 3.36\ m/s^2$

Q6: Does the acceleration of the bob remain constant? Explain.

$a = \frac{F_{net}}{m} = \frac{F_{g\perp}}{m} = \frac{F_g \sin\theta}{m} = \frac{(mg)\sin\theta}{m}$

$a = g\sin\theta$

No! As θ changes, a_{cal} also changes.

Q7: What is the maximum speed of the pendulum bob?

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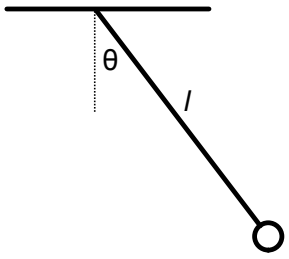
Period of a Pendulum

$$T = 2\pi\sqrt{\frac{l}{g}}$$

T = Period (s)
l = Length (m)
g = 9.81 m/s² on EARTH

Do not care!
m = mass (kg)
θ = Angle (deg)



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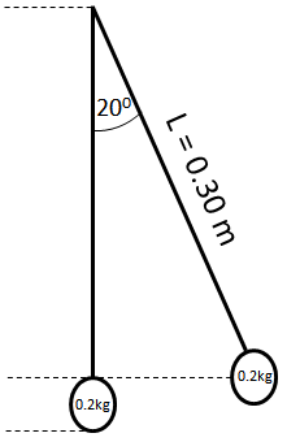

Q8: What is the period of oscillation of the pendulum?

$T = 2\pi\sqrt{\frac{0.3}{9.81}}$

$T = 1.099\,s$

Q9: What is the frequency of oscillation of the pendulum?

$f = \frac{1}{T}$

$f = 0.91\,Hz$

Practice

Pg 362 #1,2
Pg 380 #6,9,10
Pg 390 #11,15,20,24

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