Lab 8 is in SCI 134

Please, login into webassing, locate LectureMCQ_L19 (PY105) and answer question 1 (but ONLY Q1!).

Good morning!

When a feeling may play an important role.

Comcast

Downloaded from 24.147.70.49	09:57:48 AM EDT
Submitted LMCQ1 (4145471) part	09:57:53 AM EDT
Submitted LMCQ2 (3334375) part	09:57:58 AM EDT
Submitted LMCQ3 (3334376) part	09:58:03 AM EDT
Submitted LMCQ4 (3332949) part	09:58:06 AM EDT
Submitted LMCQ5 (3334377) part	09:58:13 AM EDT
Submitted LMCQ6 (3338115) part	09:58:16 AM EDT

1 minute

1m	
84m	
84m	
81m	
59m	
93m	
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68m	
80m	
21m	
76m	
62m	
30m	

Just some examples of the data webassign collects.

ParticipationL9-17

When a feeling may play an important role.

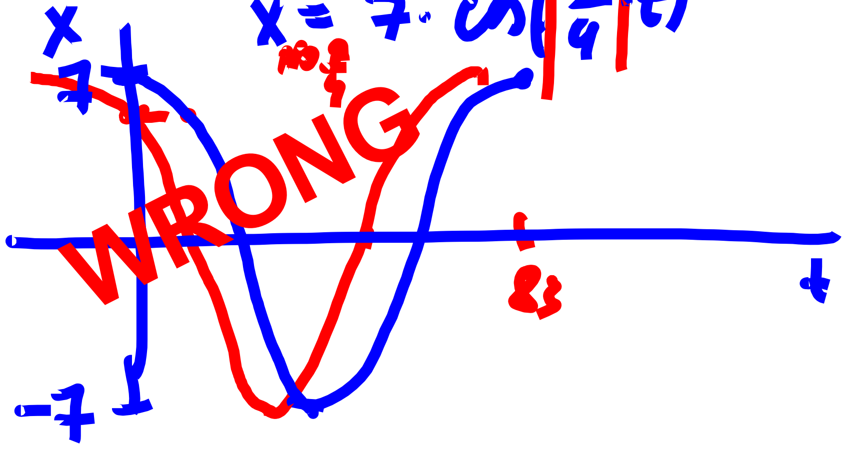
$x = 7 \cdot \cos\left(\frac{\pi}{4} \cdot t - \frac{\pi}{4}\right) + 0;$

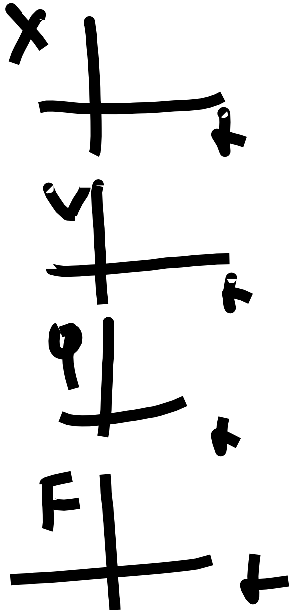
$m = 100$ gram

$T;\ \omega;\ \varphi;\ v_{max};\ a_{max}$

$F_{max};\ K$

$x = 7 \cdot \cos\left(\frac{\pi}{4} t\right)$





$\omega = \frac{\pi}{4}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi/4} = 8;$

$x_{t=0} = 7 \cdot \cos\left(\frac{\pi}{4} \cdot 0 - \frac{\pi}{4}\right) = 7 \cdot \frac{\sqrt{2}}{2}$

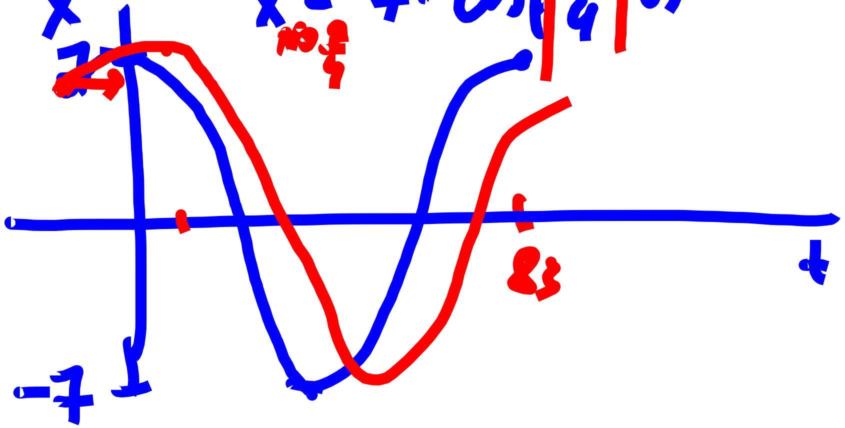
$$X = 7\cdot\cos\left(\frac{\pi}{4}\cdot t - \frac{\pi}{4}\right) + 0;$$

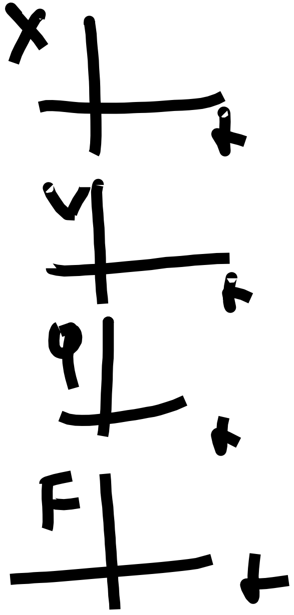
$m = 100$ gram

$T;\ \omega;\ f;\ V_{max};\ a_{max}$

$F_{max};\ K$

$$X = 7\cdot\cos\left(\frac{\pi}{4}\cdot t\right)$$





$\omega = \frac{\pi}{4}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi/4} = 8\,s$

$X_{t=0} = 7\cdot\cos\left(\frac{\pi}{4}\cdot 0 - \frac{\pi}{4}\right) = 7\cdot\frac{\sqrt{2}}{2}$

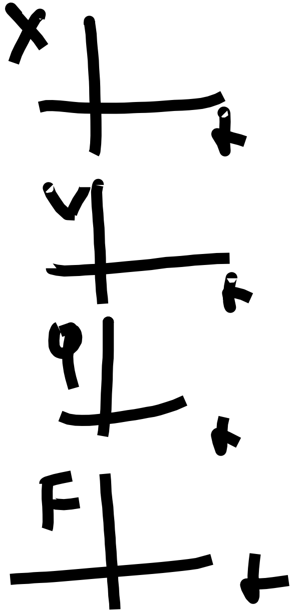
$t=1;\quad X(t=1) = 7\cdot\cos 0 = 7$

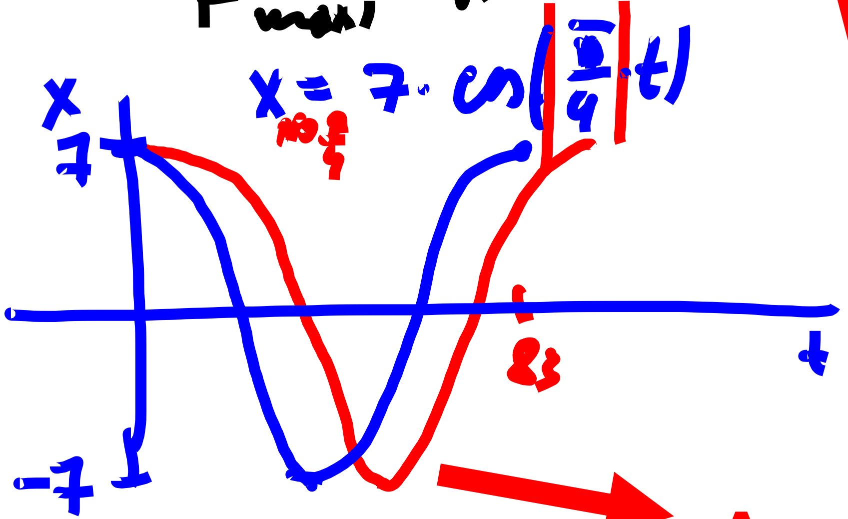
$X = 7\cdot\cos\left(\frac{\pi}{4}\cdot t - \frac{\pi}{4}\right) + 0;$

$m = 100$ gram

$T;\ \omega;\ f;\ V_{max};\ a_{max}$

$F_{max};\ K$





$\omega = \frac{\pi}{4}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{\frac{\pi}{4}} = 8\,s$

$X_{t=0} = 7\cdot\cos\left(\frac{\pi}{4}\cdot 0 - \frac{\pi}{4}\right) = 7\cdot\frac{\sqrt{2}}{2}$

A minus means = shift to the right

When feelings may play an important role.

When It Comes to Learning, Emotions Play an Important Role | ASCD ...
inservice.ascd.org/when-it-comes-to-learning-emotions-play-an-important-role/
Oct 1, 2015 - On this episode of the Whole Child Podcast, we explore what educators **can** do to create a school environment where all kids feel safe, secure, ...

Emotions Play An Important Role In Keeping You Healthy - Forbes
https://www.forbes.com/.../emotions-play-an-important-role-in-keeping-you-healthy/
Sep 22, 2017 - Prior to 2007, researchers **would** say things along the lines of: We do not understand why humans evolved with **emotions** as they seem to serve ...

The Role of Emotions in your Decision-making and its Effects
https://psychologenie.com/the-role-of-emotions-in-your-decision-making
Mar 12, 2018 - These **emotions play** a very **important role** in every aspect of our life and ... In such a situation, the decisions **may** or **may** not be correct.

Emotions play an extremely important role in human mental life – but it ...
www.goertzel.org/dynapsyc/2004/Emotions.htm
Feb 20, 2004 - **Emotions play** an extremely **important role** in human mental life – but it is ... In this approach, the qualia and pattern aspects of **emotion may** be ...

Achievement emotions play important role in motivation
https://www.ernweb.com/.../achievement-emotions-play-important-role-in-motivation/
Jun 30, 2009 - Achievement **emotions play important role** in motivation ... engagement and those **emotions can** be predicted by students' achievement goal ...

$$\boxed{U=\frac{kx^2}{2}}=\frac{k[A\cos(\omega t)]^2}{2}=$$
$$=U_{\max}\cos^2(\omega t)=E_{total}\cos^2(\omega t)$$

$$\boxed{K=\frac{mv^2}{2}}=\frac{m[A\omega\sin(\omega t)]^2}{2}=$$
$$=K_{\max}\sin^2(\omega t)=E_{total}\sin^2(\omega t)$$

$$ME_{total} = KE + U = const = KE_1 + U_1 = KE_2 + U_2$$

Webassign: L19 Q2

When a 250 gram cart is traveling *through* the equilibrium position its speed is 4 m/s. Calculate the *maximum potential energy* of the cart.

1. 1 J   2. 2 J   3. 3 J   …

$$ME_{total} = KE + U = const = KE_1 + U_1 = KE_2 + U_2$$

[Webassign: L19 Q2]()

When a 250 gram cart is traveling *through* the equilibrium position its speed is 4 m/s. Calculate the *maximum* *potential* *energy* of the cart.

1. 1 J
2. 2 J
3. 3 J

…

$ME = KE + PE$

$PE = \frac{kx^2}{2}$; $PE_{max} = \frac{k \cdot A^2}{2}$

$k = ?$ $A = ?$

$KE_{max} = PE_{max} = E_{total}$

$KE_{max} = \frac{mv_{max}^2}{2} = \frac{.25 \cdot 4^2}{2} = 2\,J$

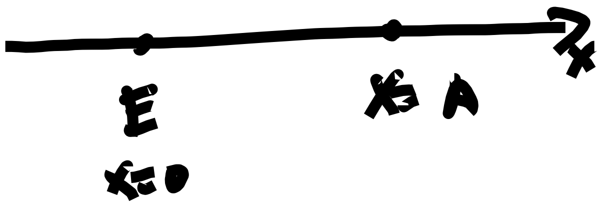
$x_{max} = A$ $\quad v_{max} = A\omega$ $\quad a_{max} = A\omega^2$ $\quad a_x = -\omega^2 x$

A definition

???????

N2L for SHM

Prove $\underline{v_{max}} = A\sqrt{\dfrac{k}{m}} = \underline{A\omega}$ **using LCME**



$KE_{max} = PE_{max}$

$\dfrac{m v_{max}^2}{2} = \dfrac{k A^2}{2}$

$v_{max} = A\sqrt{\dfrac{k}{m}} = \underline{\underline{A\omega}}$

Energy in a spring system

$$U_i + K_i + W_{nc} = U_f + K_f$$

$K_i = 0$ because the object starts from rest.
$W_{nc} = 0$ because there is no friction.
$U_f = 0$ because at the equilibrium position $x = 0$.
$U_i = K_f$

hence

$$\tfrac{1}{2} kx_i^2 = \tfrac{1}{2} mv_f^2$$

$$v_f = x_i\left(\frac{k}{m}\right)^{1/2}$$

$$v_{max} = A\sqrt{\frac{k}{m}} = A\omega$$

The mass keeps going, and the kinetic energy is transformed back into potential energy. This continues, with the total energy remaining constant and the energy going back and forth between potential and kinetic.

The motion equation of an object is

$x(t) = 5\cos(\pi t/2)$ (<u>*assume SI units*</u>) $\omega = \frac{2\pi}{T}$

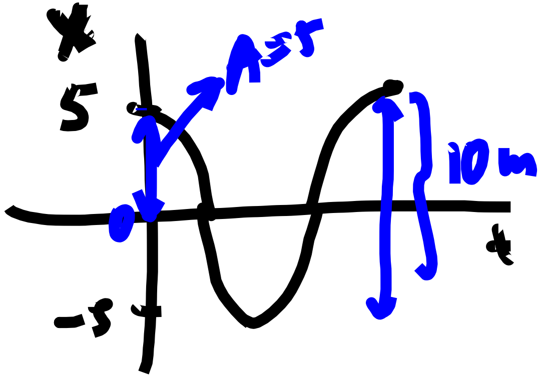
If the mass of the object is 2 kg, find:

A, T, f, ω, k, v_{max}, a_{max}, F_{max}, U_{max}, KE_{max}, E_{max}; find all quantities at $t = 1$ s, $t = 2$ s; find all quantities at $x = 1.25$ m, $x = 2.5$ m

$x(t) = 5\cos(\pi t/2)$ $= 5\cdot\cos\left(\frac{\pi}{2}\cdot 4\right)$ (assume SI units) $\quad \omega = \frac{2\pi}{T}$

If the mass of the object is 2 kg, find: A, T, f, ω, k, v_{max}, a_{max}, F_{max}, U_{max}, KE_{max}, E_{max}; find all quantities at t = 1 s, t = 2 s; find all quantities at x = 1.25 m, x = 2.5 m

$A = 5\text{ m}$



$\omega = \frac{\pi}{2}\ \frac{\text{rad}}{\text{s}}$

$f = \frac{1}{T} = \frac{1}{4} = .25\text{ Hz}$

$v_{max} = A\cdot\omega$

$a_{max} = A\cdot\omega^2$

$F_{max} = k\cdot A$

$k \to m,\ \omega$

$\omega^2 = \frac{k}{m}$

$k = m\cdot\omega^2$

$\frac{1}{T} = f \quad T = \frac{t}{N}$

$\frac{2\pi}{T} = \omega$

$\boxed{\omega T = 2\pi}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi/2} = 4\text{ s}$

$L_{1\,min} = N\cdot 20\text{ m} = \frac{t}{T}\cdot 20 = \frac{60\text{ s}}{T}\cdot 20 = \frac{60}{4}\cdot 20 = 15\cdot 20 = 300\text{ m}$

$x(t) = 5\cos(\pi t/2)$ (***assume SI units***) $\omega = \frac{2\pi}{T}$

If the mass of the object is 2 kg, find: *A*, *T*, *f*, ω, *k*, v_{max}, a_{max}, F_{max}, U_{max}, KE_{max}, E_{max}; find all quantities at *t* = 1 s, *t* = 2 s; find all quantities at *x* = 1.25 m, *x* = 2.5 m

$X(t=1) = 5 \cdot \cos(\pi \cdot \frac{1}{2}) =$

0

no answer

4.998 → wrong

switch $\boxed{}$ rad

convert rad → deg

$\frac{\pi}{2}$ rad $= \underline{90}$

$X = 5 \cdot \cos(90°) = 0$

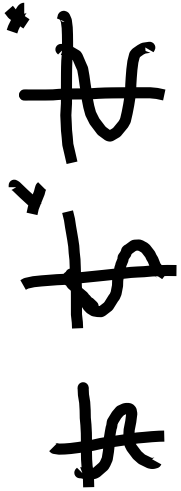
$x(t) = 5\cos(\pi t/2)$ (*assume SI units*) $\omega = \frac{2\pi}{T}$

If the mass of the object is 2 kg, find: *A*, *T*, *f*, *ω*, *k*, v_{max}, a_{max}, F_{max}, U_{max}, KE_{max}, E_{max}; find all quantities at *t* = 1 s, *t* = 2 s; find all quantities at *x* = 1.25 m, *x* = 2.5 m

$x = 5 \cdot \cos(\frac{\pi}{2} \cdot t)$

$v = -5\omega \cdot \sin(\frac{\pi}{2} \cdot t)$

$a_x = -\omega^2 \cdot x = -5\omega^2 \cos\frac{\pi}{2}t$



any t (rad v. degree)

$x = 1.25$: $1.25 = 5 \cdot \cos(\frac{\pi}{2} \cdot t^*)$

$.25 = \frac{1}{4} = \frac{1.25}{5} = \cos(\frac{\pi}{2} \cdot t^*)$

$\cos^{-1}(.25) = \frac{\pi}{2} \cdot t^*$

1.3 rad

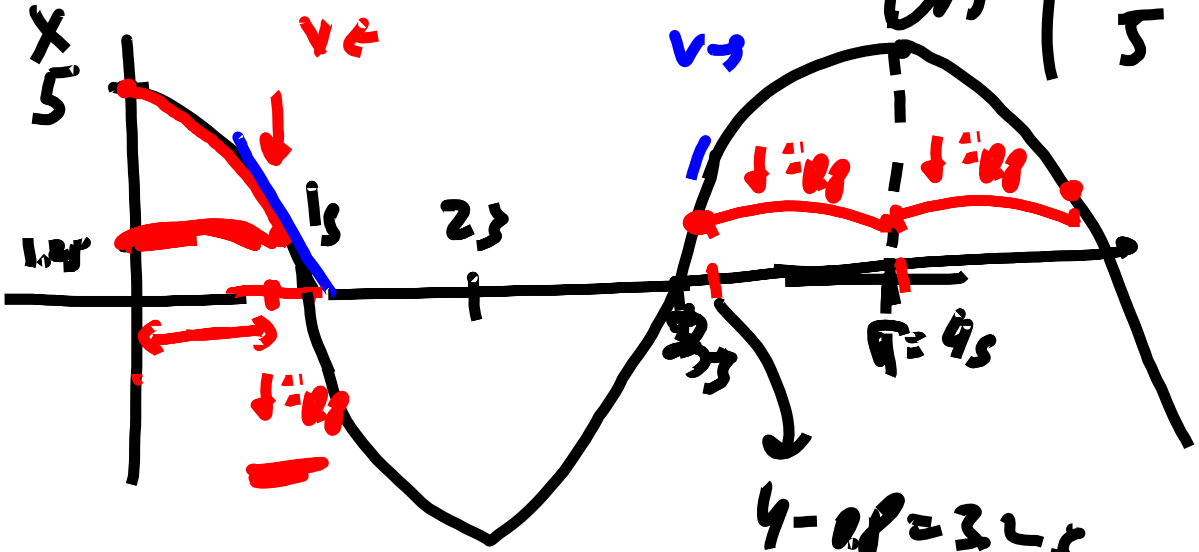
$\Downarrow$

$75.52 = \frac{\pi}{2} \cdot t^*$

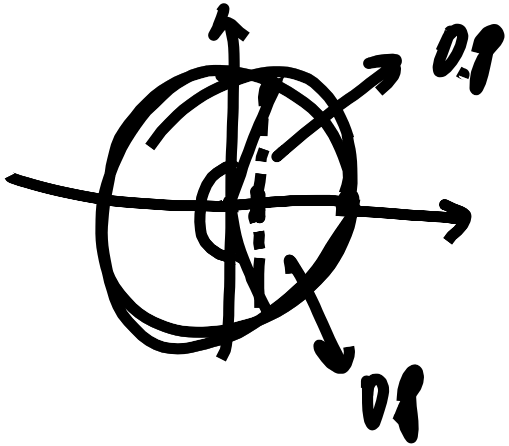
$\frac{75.52° \cdot 2}{\pi \text{ rad}} = t^* \Rightarrow t^* = \frac{75.52 \cdot 2}{180} = .84\text{ s}$

$X = 5 \cdot \cos\left(\frac{\pi}{2} \cdot t\right)$

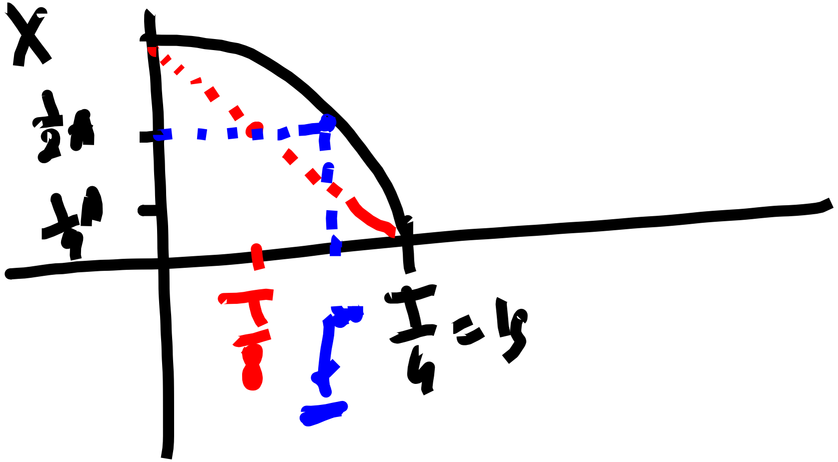
$\cos^{-1}\left(\frac{1.25}{5}\right) = \frac{\pi}{2} t \pm 2\pi$

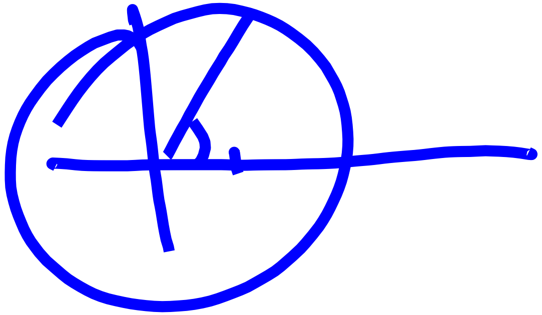


$4 - 0.8 = 3.2\,s$



$X = 5\cdot\cos\left(\frac{\pi}{2}\cdot t\right)$;





$$\frac{A}{2} = A\cdot\cos\left(\frac{\pi}{2}\cdot t''\right)$$

$$\frac{1}{2} = \cos\left(\frac{\pi}{2}\cdot t''\right)$$

$$\cos\left(\frac{1}{2}\right) = \frac{\pi}{2}\, t''$$

$$60° = \frac{\pi}{3} = \frac{\pi}{2}\cdot t''$$

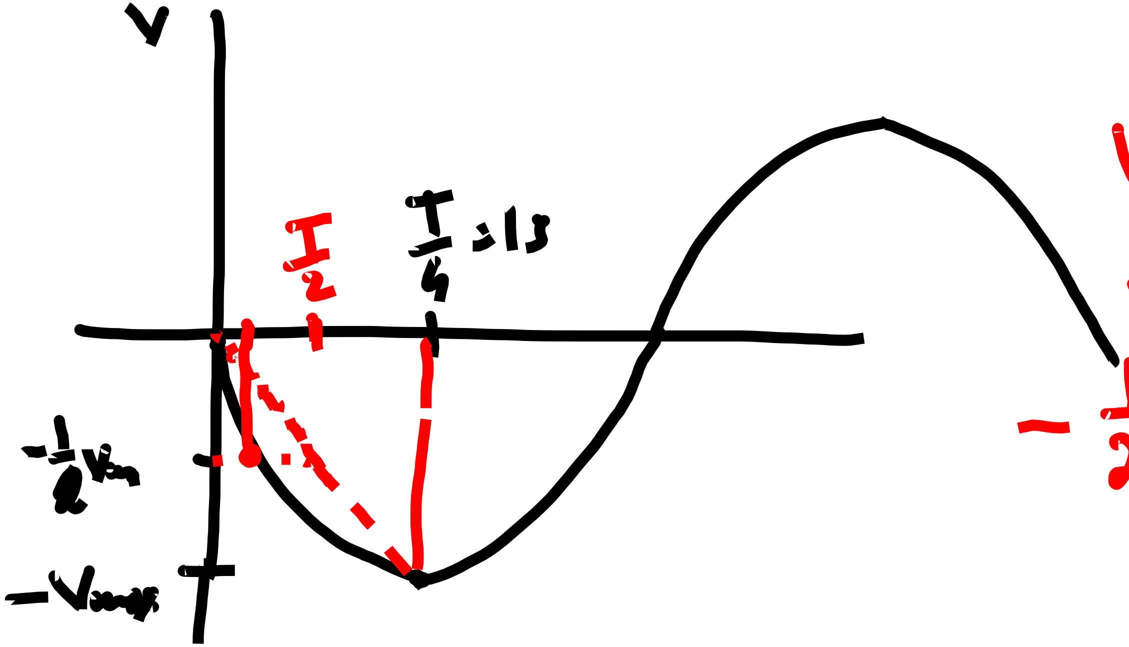
$$\frac{2}{3} = t''$$

$$\frac{A}{2} = A\cdot\cos(\omega t)$$

$$\frac{1}{2} = \cos\left(\frac{2\pi}{T}\cdot t''\right)$$

$$\frac{\pi}{3} = \frac{2\pi}{T}\cdot t''$$

$$t'' = \frac{T}{6}$$

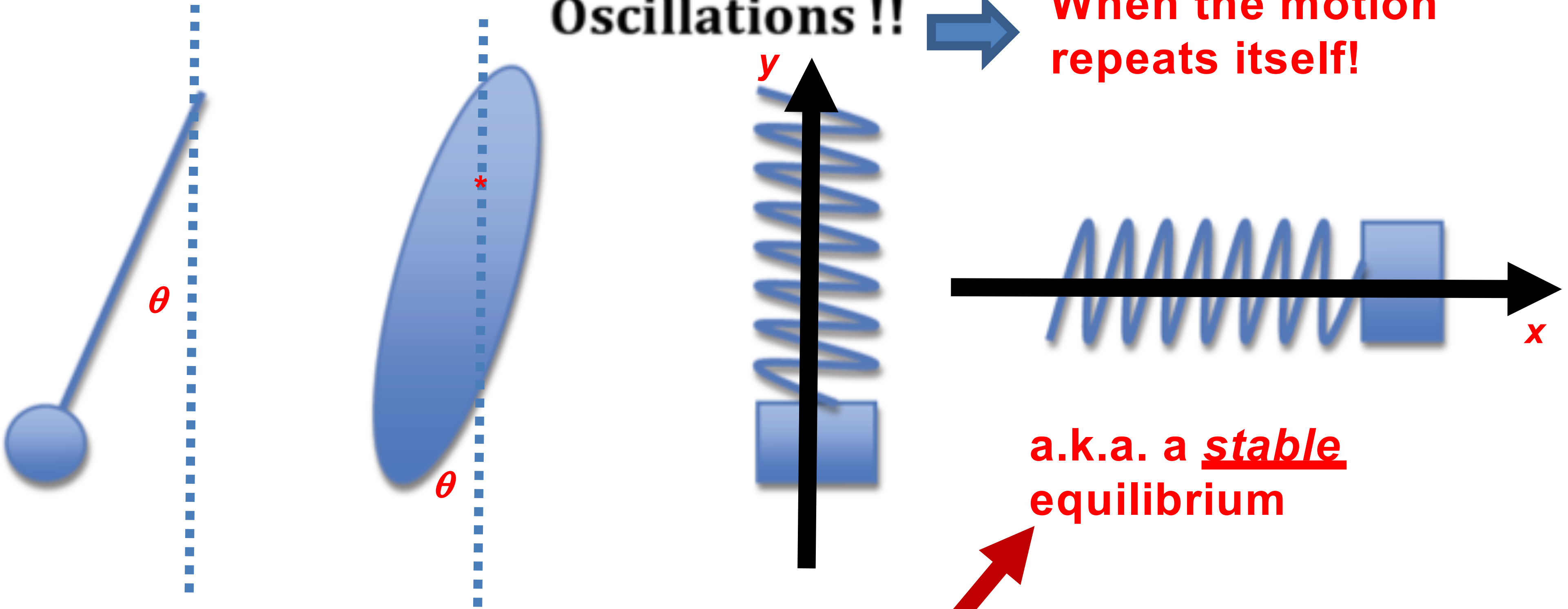


$$V = -V_{max} \cdot \sin\left(\frac{2\pi}{T} t\right)$$

$$\downarrow$$

$$-\frac{1}{2} V_{max} = -V_{max} \sin\left(\frac{2\pi}{T} \cdot t\right)$$

Oscillations !! ⇒ When the motion repeats itself!

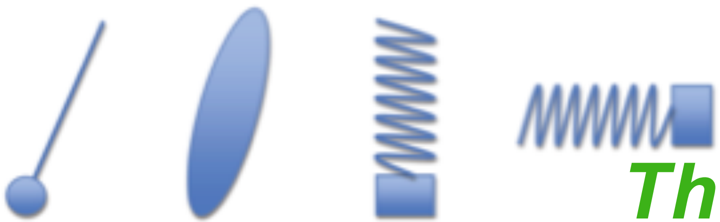


a.k.a. a ***stable*** equilibrium

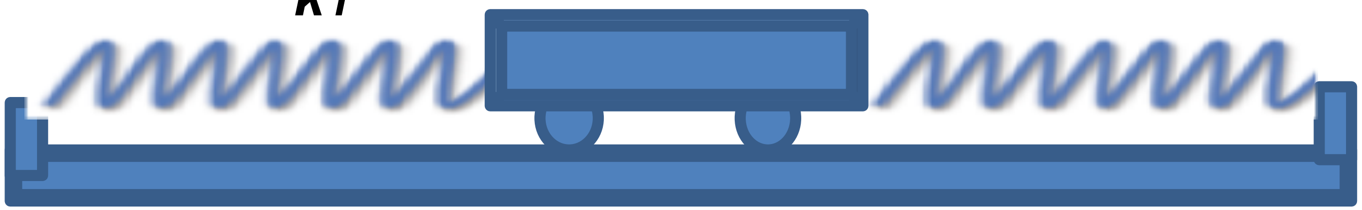
Always choose the origin at the equilibrium position !!!!

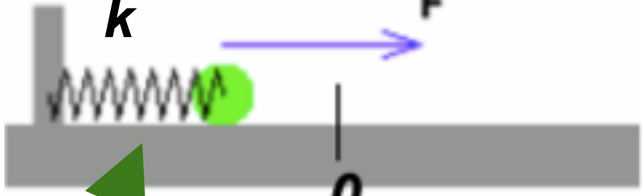
Restoring force always points at the equilibrium position !!!!

Dynamics of SHM: for ANY system => exists an *effective* one; the same *T*, *A*.



The same period



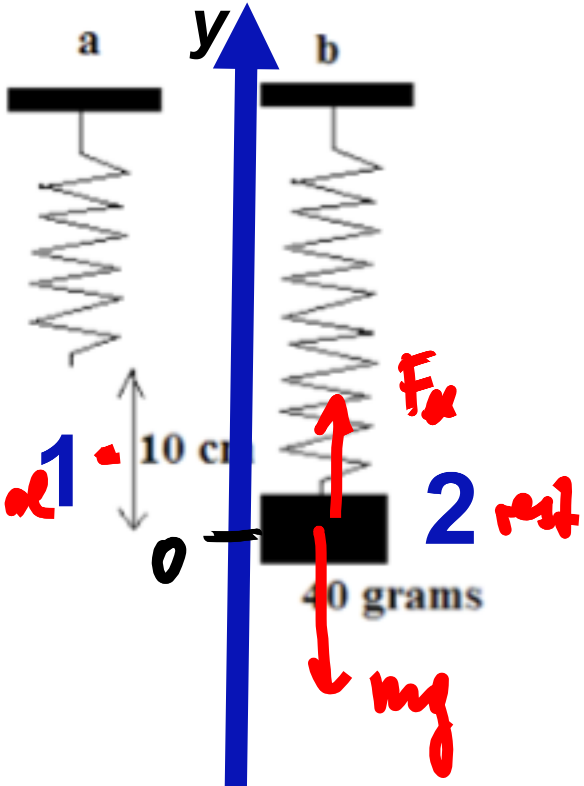


$$a_x = -\frac{k}{m}x$$

Effective spring constant

The same mass

$$\frac{k}{m} = \omega^2$$



$k \cdot 10\,cm = F_{el} = mg$

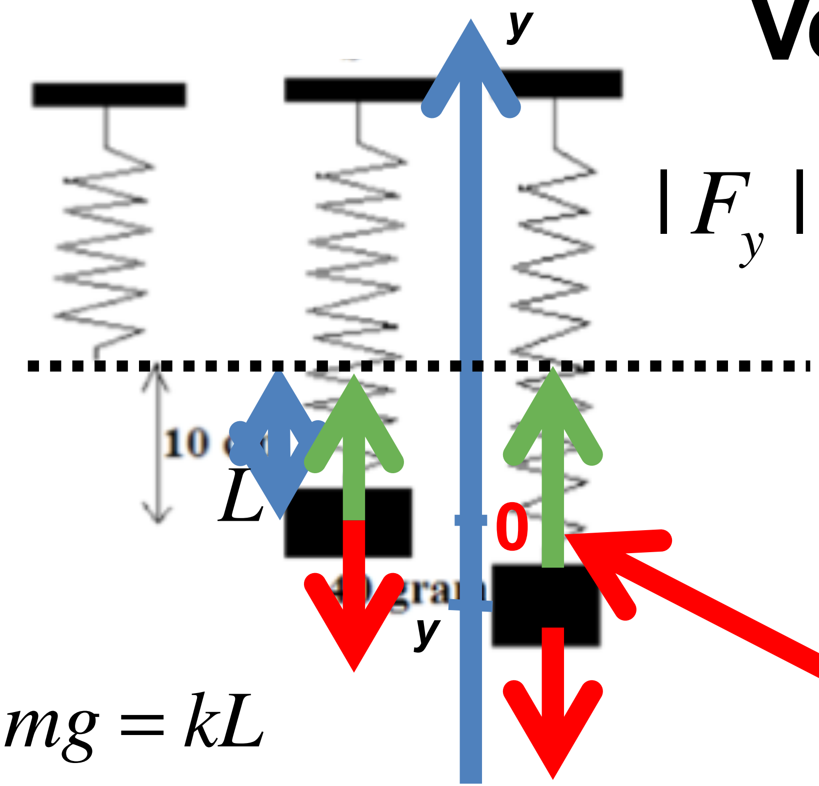
Position 1: a *free* spring

Position 2: a *resting* weight.

Which position should we chose as $y = 0$?

Hint: NOT 1!

Vertical SHM



$$|F_y| = k(|y| + L) \qquad F_y = -k(y - L)$$

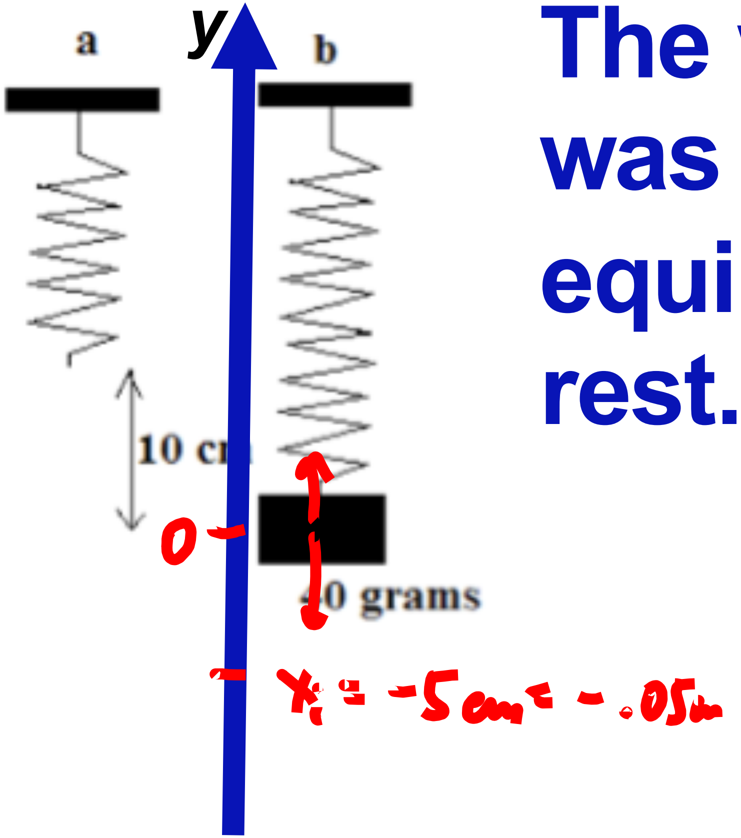
$$F_y - mg = ma_y$$

$$ma_y = -k(y - L) - mg$$

$$= -ky + kL - mg = -ky$$

$$mg = kL$$

$$a_y = -\frac{k}{m}y \qquad \omega^2 = \frac{k}{m} \qquad \boxed{a_y = -\omega^2 y}$$



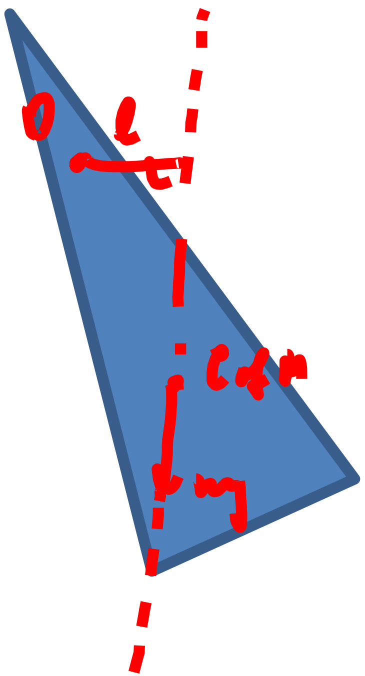
The weight attached to a spring was puled 5 cm below the equilibrium and released from rest. Write the motion equation.

$y = -.05 \cdot \cos(\omega \cdot t)$; $\omega = \sqrt{\frac{K}{m}}$

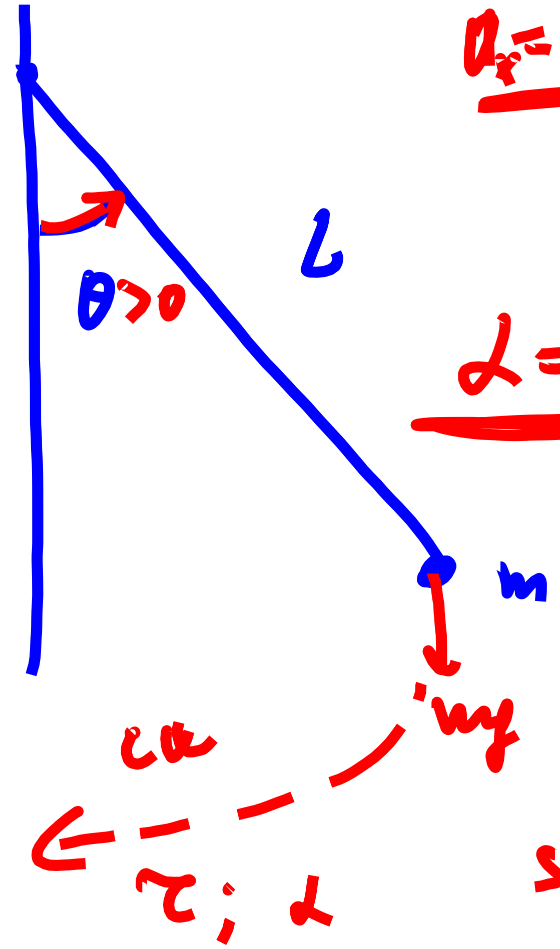
$m = 0.04\,kg$

$mg = K \cdot \Delta l \Rightarrow K = \frac{mg}{\Delta l} = \frac{0.04 \cdot 10}{0.1}$

A pendulum



$\tau_{net} = I \cdot \alpha$



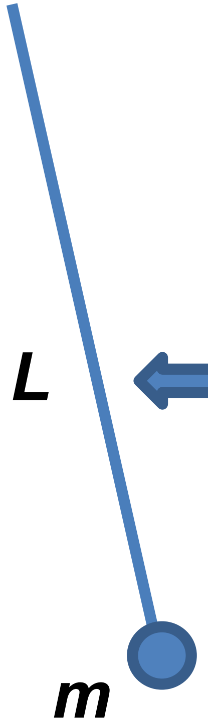
$a_x = -\omega^2 x$

$\alpha = -\omega^2 \cdot \theta$

only for small angles

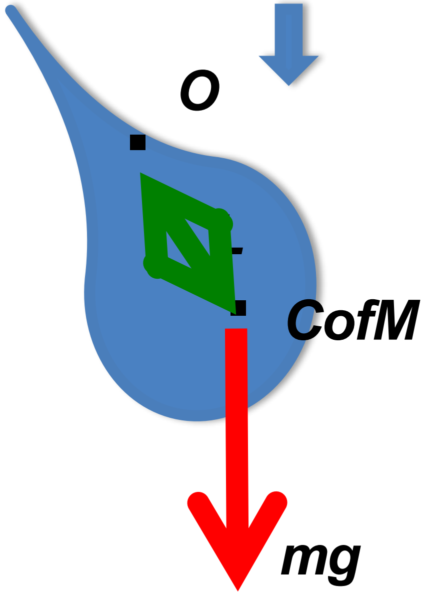
SMALL amplitudes!

$$\alpha = -\omega^2\theta$$



So, the angular frequency is $\omega = \left(\frac{m\,g\,L}{I}\right)^{1/2}$

For ANY pendulum



For a simple pendulum the rotational inertia is given by:

$I = mL^2$

For a SIMPLE pendulum

This gives $\omega = \left(\frac{g}{L}\right)^{1/2}$

$$\omega^2 = \frac{g}{L} \qquad \omega = \sqrt{\frac{g}{L}}$$

Note that this is *independent of the mass* of the pendulum.

The general equation giving the position of the pendulum as a function of time is:

$$\theta(t) = \theta_{max}\cos(\omega t + \phi)$$

A Simple Pendulum Question

We have two simple pendula of *equal lengths*. The *first* one is four times *heavier* than the *second* one.

Which has the *longer* period of oscillation?

Webassign: L19 Q3

1. The first (big) one
2. The second (small) one
3. None of the above
4. All of the above
5. ☹

$$T = \frac{2\pi}{\omega}$$

$$\omega^2 = \frac{g}{L}$$

Pendulum Question

We have two simple pendula of equal lengths. The first one is four times heavier than the second one. Which has the longer period of oscillation?

1. The first (big) one
2. The second (small) one
3. None of the above => equal
4. All of the above
5. ☹

$$T = \frac{2\pi}{\omega}$$

$$\omega^2 = \frac{g}{L}$$

Pendulum Question

We have two simple pendula of ***equal mass***. The first one is four times longer than the second one. Which has the *longer period of oscillation?*

1. The first (long) one
2. The second (short) one
3. Neither, they're equal

Webassign: L19 Q4

$$T = \frac{2\pi}{\omega}$$

$$\omega^2 = \frac{g}{L}$$

Pendulum Question

We have two simple pendula of equal mass. The first one is four times longer than the second one. Which has the longer period of oscillation?

1. **The first (long) one**
2. **The second (short) one**
3. **Neither, they're equal**

$$T = \frac{2\pi}{\omega}$$

$$\omega^2 = \frac{g}{L}$$

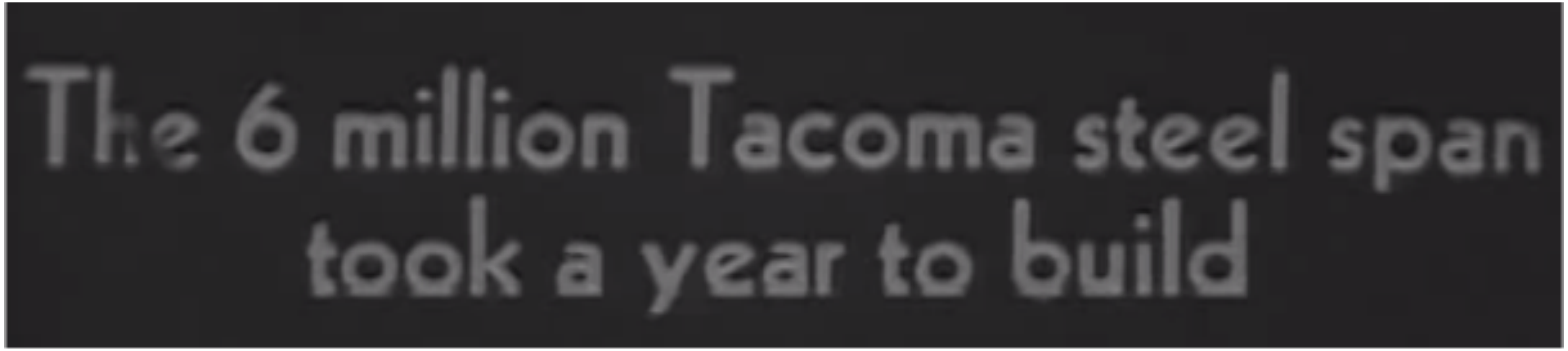
RESONANCE

When a force is applied to an oscillating system at all times, the result is ***driven harmonic motion***. Resonance is the condition in which a time-dependent force can transmit large amounts of energy to an oscillating object, leading to a large amplitude motion.

Resonance occurs when the frequency of the force matches a natural frequency at which the object will oscillate.

Tacoma Bridge Collapse

https://www.youtube.com/watch?v=6AISZT9k1ww



https://en.wikipedia.org/wiki/Tacoma_Narrows_Bridge_(1940)

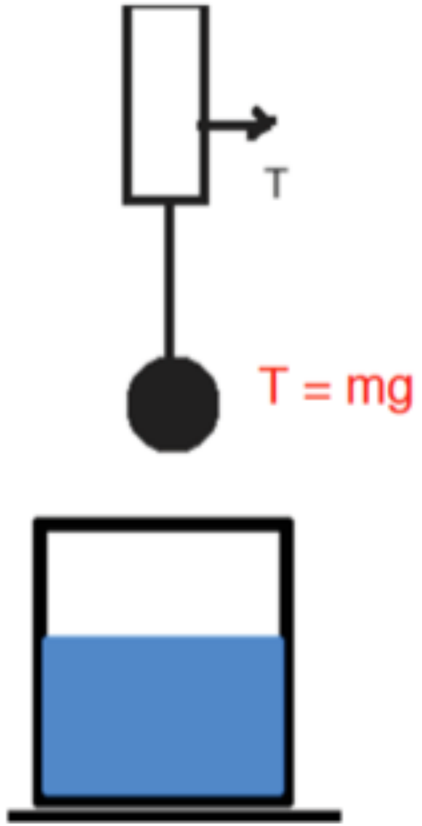
Fluids!

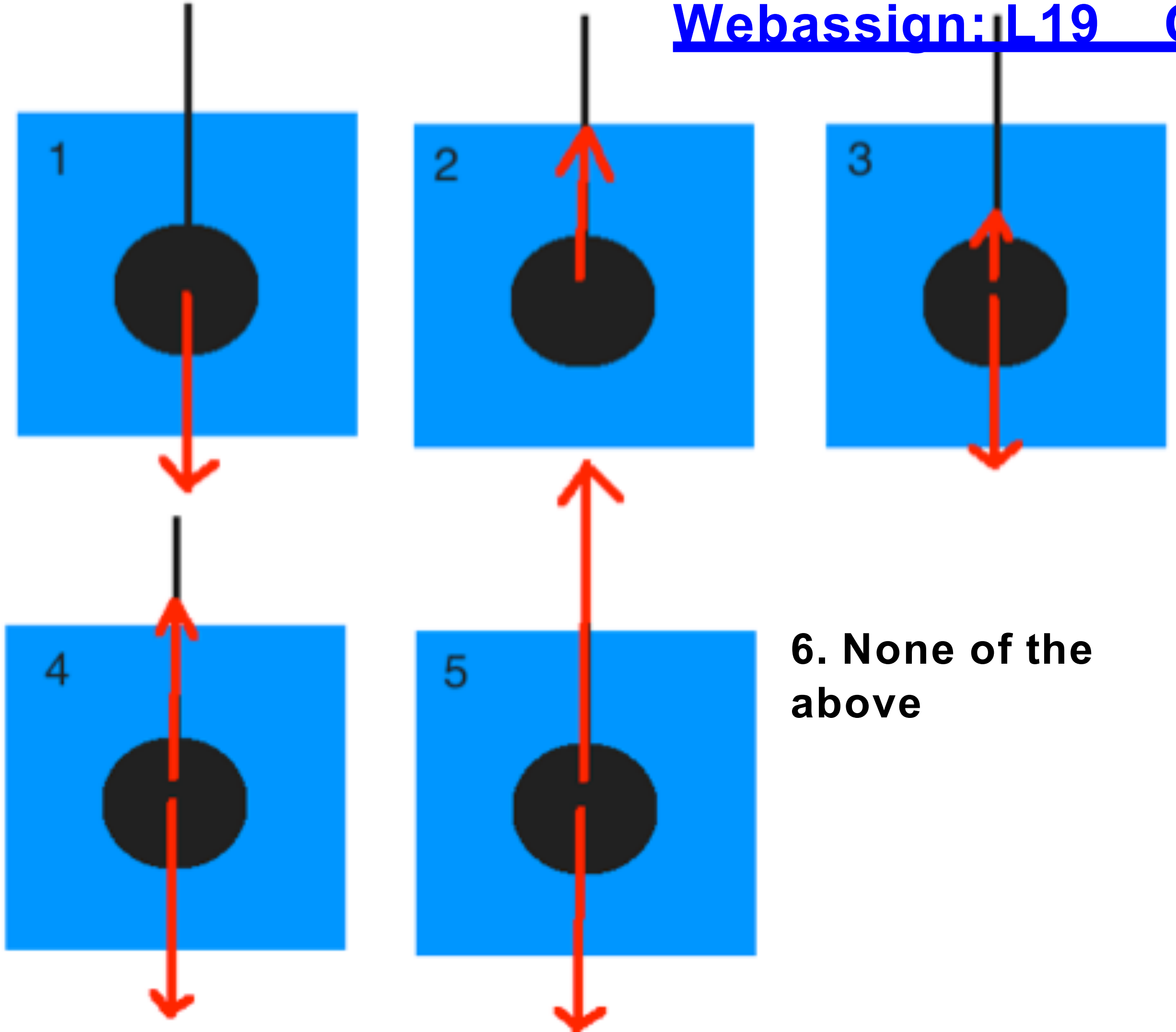
(do no read this slide!)

Fluids, density, pressure, pressure in a static fluid, atmospheric pressure, gauge pressure, absolute pressure, the Pascal's law, the buoyant force, Archimedes' principle, static equilibrium for objects in liquid, solving buoyancy problems, fluid dynamics, an ideal fluid, streamline flow, an incompressible fluid, mass flow rate, volume flow rate, the continuity equation, the Bernoulli's equation, solving fluid dynamics problems.

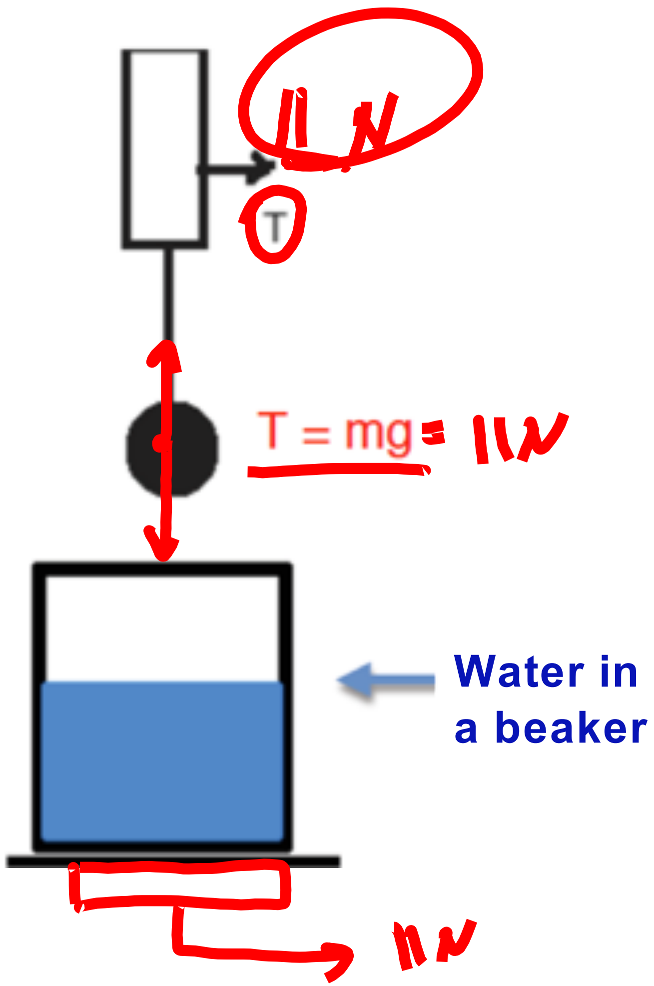
Picture # ... represents FBD for the ball when the ball is in water.

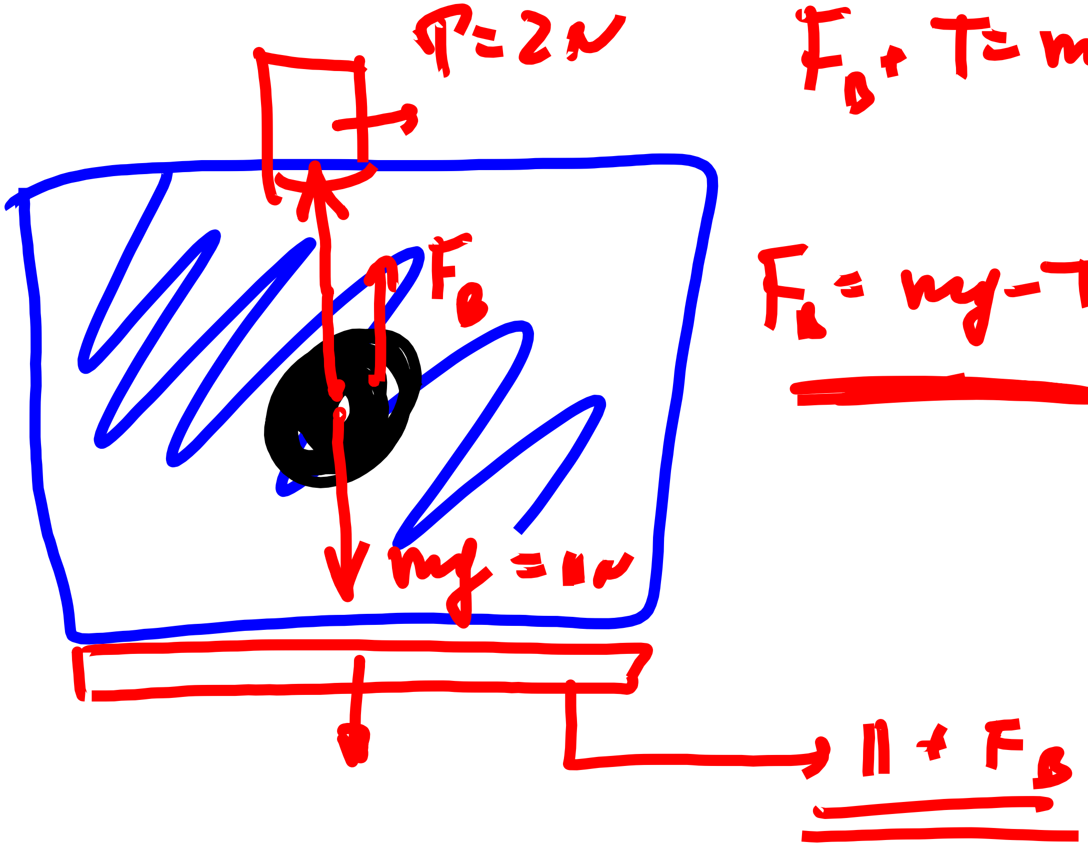
[Webassign: L19 Q5]





6. None of the above

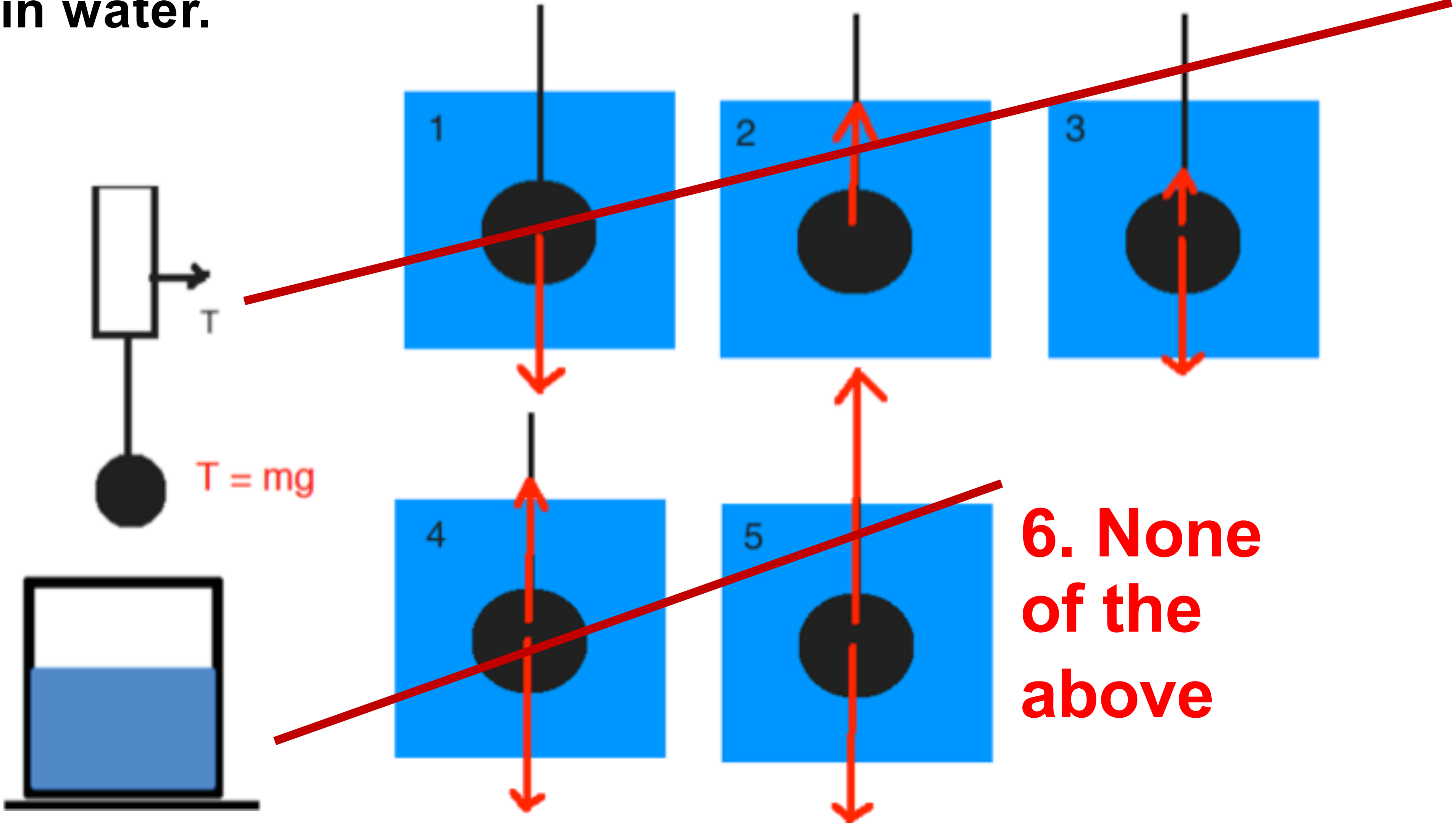




$F_B + T = mg$

$F_B = mg - T$

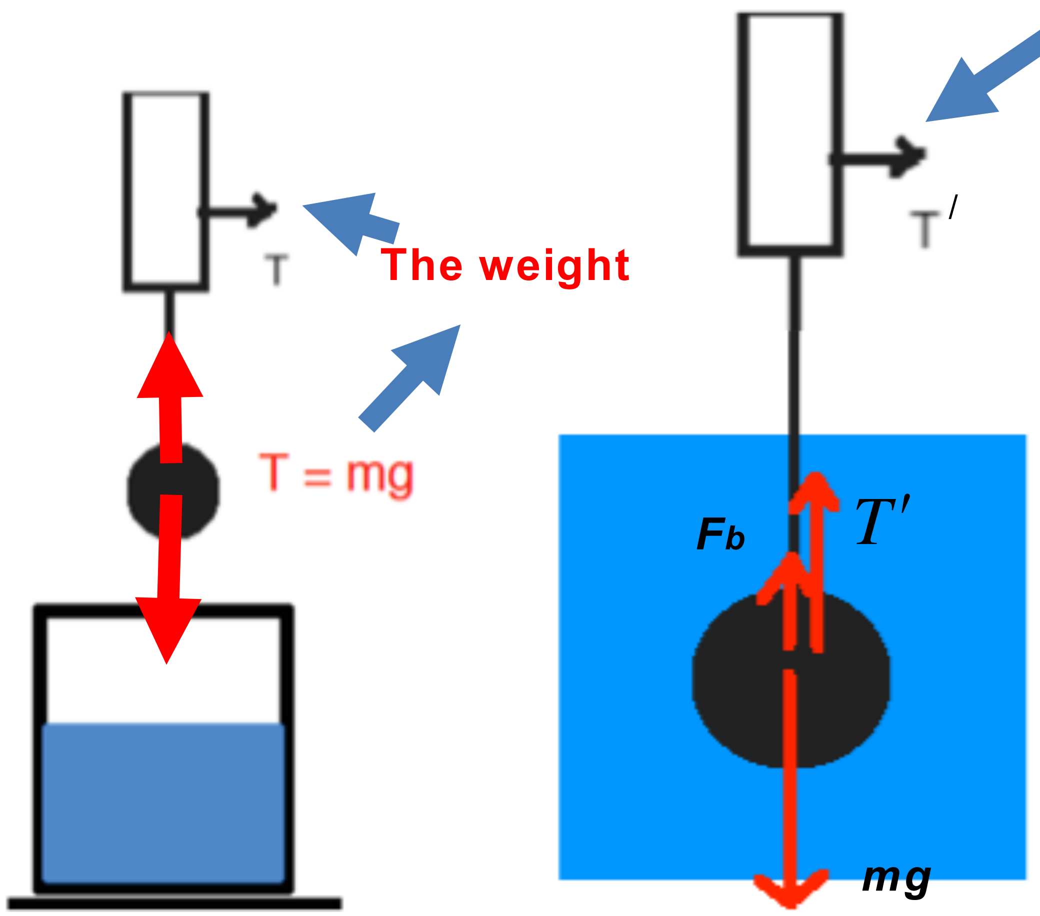
Picture # ... represents FBD for the ball when the ball is in water.



6. None of the above

The buoyant force!

The apparent weight

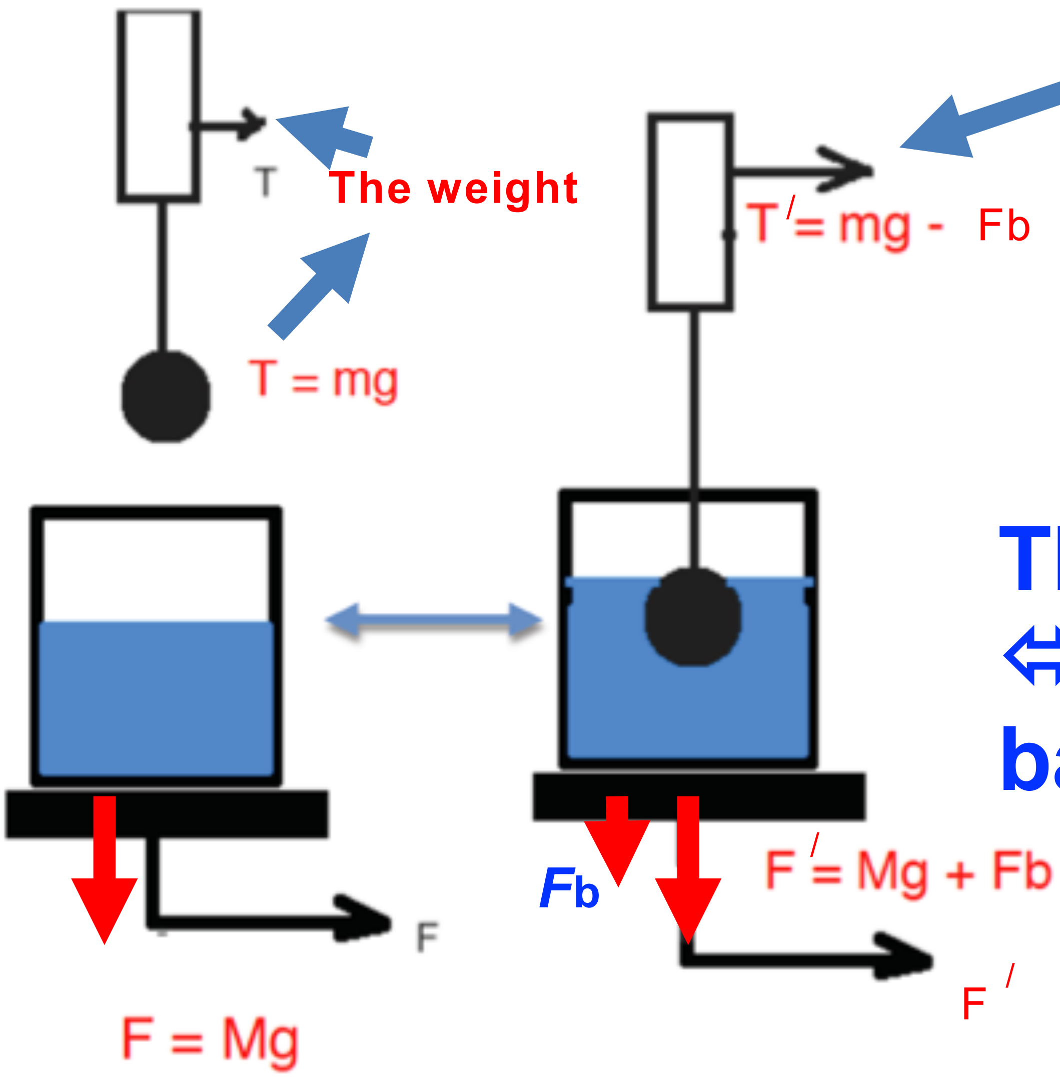


$$F_b + T' = mg$$

=>

$$F_b = mg - T' = T - T'$$

The ball pushes on water! ⇔ Water pushes on the ball => F_b



$$F_b + T' = mg$$

=>

$$F_b = mg - T' = T - T'$$

The ball pushes on water! ⇔ Water pushes on the ball => F_b AND Water pushes on the plate!