Fri.	11.1 Angular Momentum Quiz 10	RE 11.a; HW10: 13*, 21, 30, 35, “39”
Mon. Tues.	11.2-.3, (.12) Rotational + Translational	RE 11.b EP10
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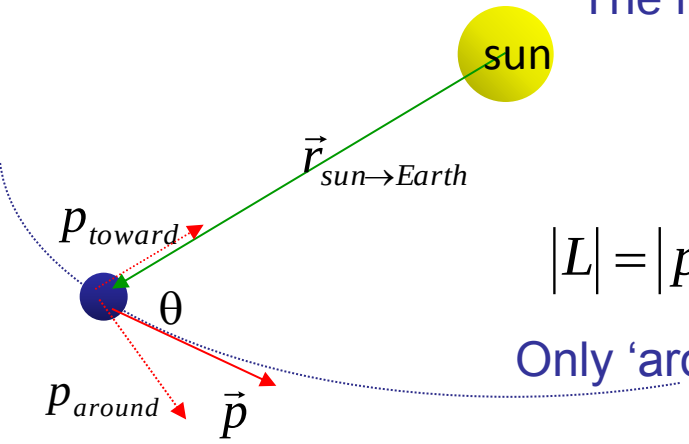
Mon.	Review for Final (1-11)	HW11: Ch 11 Pr’s 39, 57, 64, 74, 78 & Practice Exam

Introducing Angular Momentum

The measure of motion *about* a point

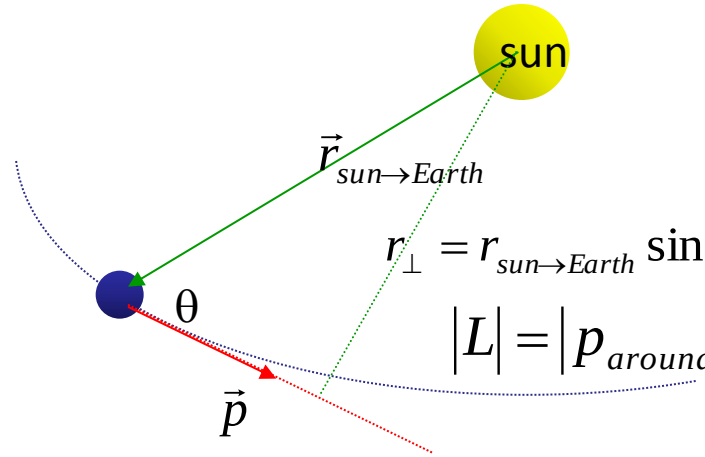
Magnitude



$$|L| = |p_{around}||r_{sun\to Earth}| = |p||r_{sun\to Earth}|\sin(\theta)$$

Only 'around' component of momentum counts

$$p_{around} = p\cos(90° - \theta) = p\sin(\theta)$$



$$r_{\perp} = r_{sun\to Earth}\sin(\theta)$$

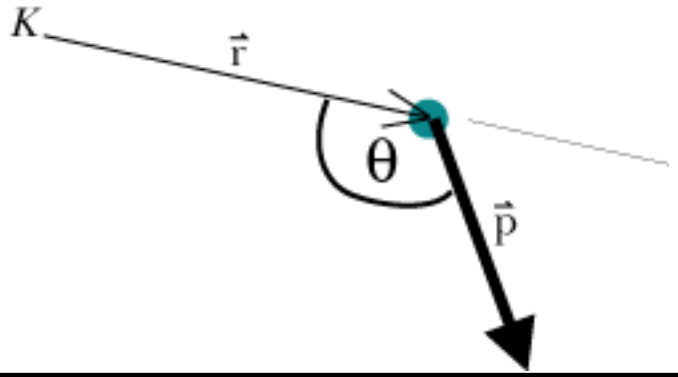
$$|L| = |p_{around}||r_{sun\to Earth}| = |p||r_{sun\to Earth}|\sin(\theta) = |p||r_{\perp}|$$

Using Angular Momentum

The measure of motion *about* a point

Magnitude

$$|L| = |p_{around}||r| = |p||r_{\perp}| = |p||r|\sin(\theta)$$



What is the magnitude of the angular momentum about location *K*, for the object shown below? The magnitude of the object's momentum $|\vec{p}|$= 7 kg·m/s, the distance $|\vec{r}\ |$= 0.6 m, and the angle θ = 150 °

Using Angular Momentum

The measure of motion *about* a point

Magnitude

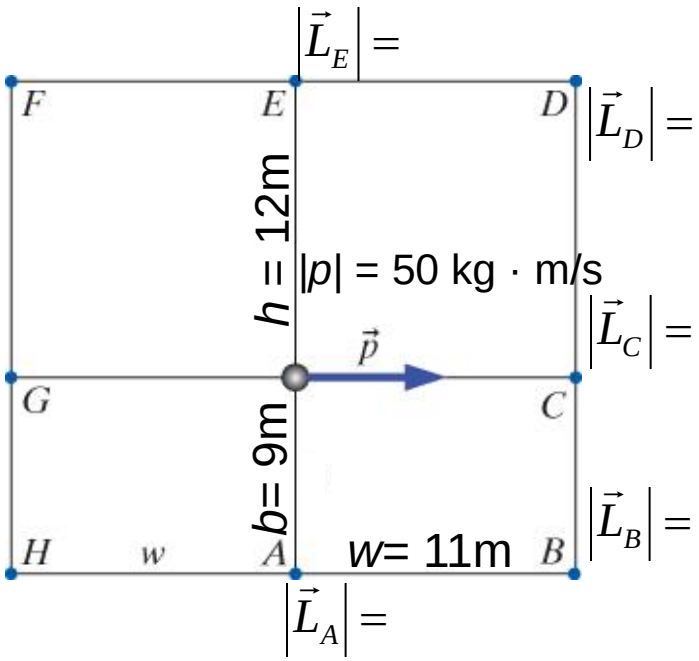
$$|L| = |p_{around}||r| = |p||r_{\perp}| = |p||r|\sin(\theta)$$

Determine the magnitude of the translational angular momentum of the particle at location *O* relative to each point: *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*.

$|\vec{L}_F| =$

$|\vec{L}_G| =$

$|\vec{L}_H| =$



$|\vec{L}_D| =$

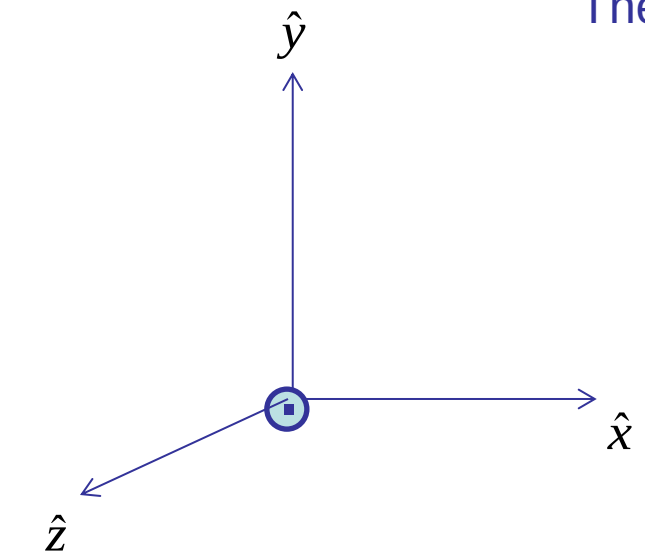
$|\vec{L}_C| =$

$|\vec{L}_B| =$

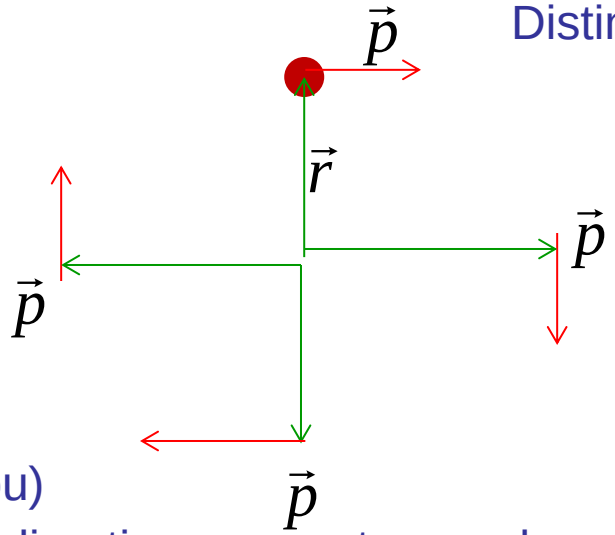
Using Angular Momentum

The measure of motion *about* a point

Direction



(tip of z-axis arrow pointing at you)

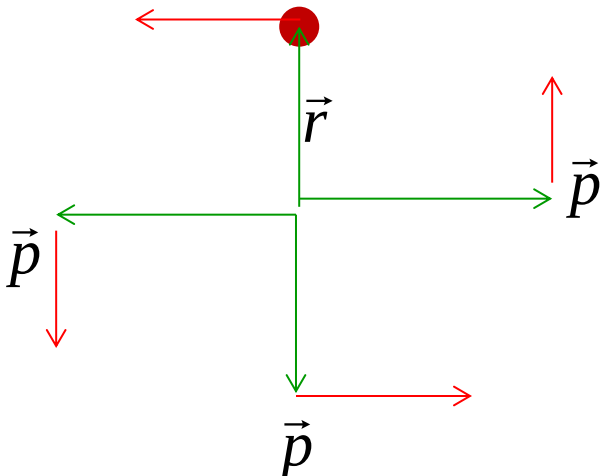


Distinguish with Right Hand Rule

Orient Right hand so fingers curl with motion, then thump points in conventional direction of angular momentum

The one direction momentum and position vectors *never* point is z – Axis of rotation

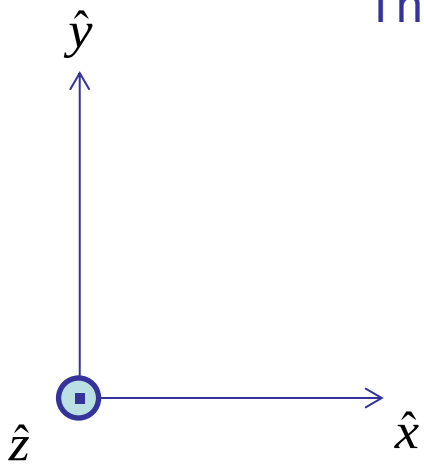
But that's also true for $\vec{p}$



Using Angular Momentum

The measure of motion *about* a point

Direction



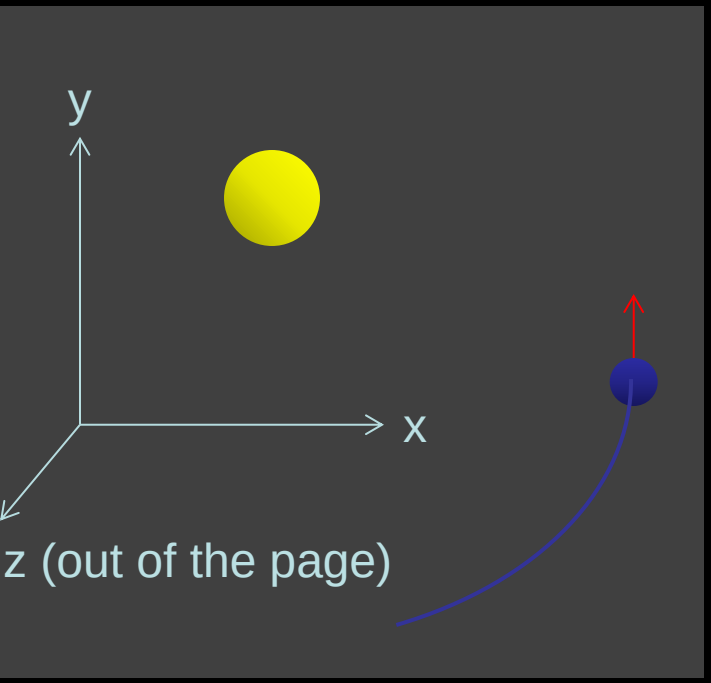
(tip of z-axis arrow pointing at you)

Distinguish with Right Hand Rule

Example

Orient Right hand so fingers curl with motion, then thump points in conventional direction of angular momentum

A comet orbits the Sun, in the xy plane. Its momentum is shown by the red arrow. What is the direction of the comet's ***angular momentum*** about the Sun?

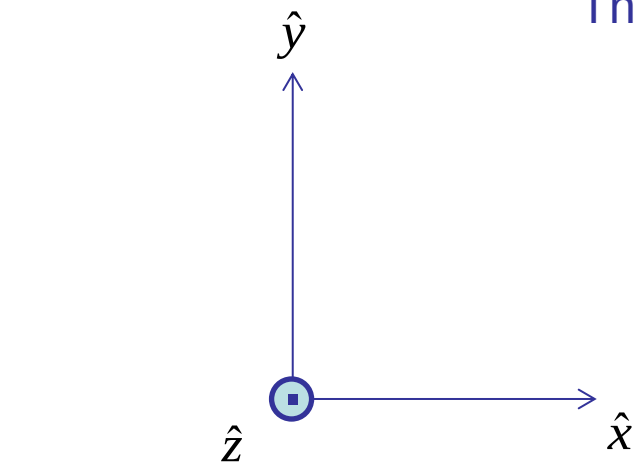


1) +x
2) –x
3) +y
4) –y
5) +z
6) –z
7) toward the sun
8) away from the sun

Using Angular Momentum

The measure of motion *about* a point

Direction



(tip of z-axis arrow pointing at you)

Distinguish with Right Hand Rule

Orient Right hand so fingers curl with motion, then thump points in conventional direction of angular momentum

Example

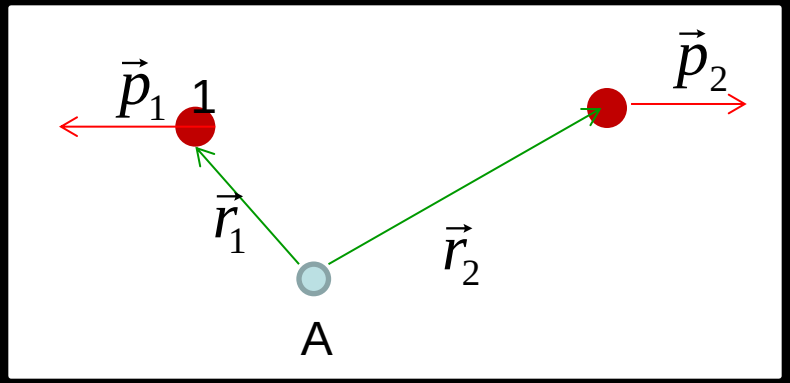
What are the directions of Angular Momentum for particle 1 about point A and particle 2 about point A

a) $\hat{L}_1 = +\hat{z}$ $\hat{L}_2 = +\hat{z}$

b) $\hat{L}_1 = -\hat{z}$ $\hat{L}_2 = +\hat{z}$

c) $\hat{L}_1 = +\hat{z}$ $\hat{L}_2 = -\hat{z}$

d) $\hat{L}_1 = -\hat{z}$ $\hat{L}_2 = -\hat{z}$



Using Angular Momentum

The measure of motion *about* a point

Direction

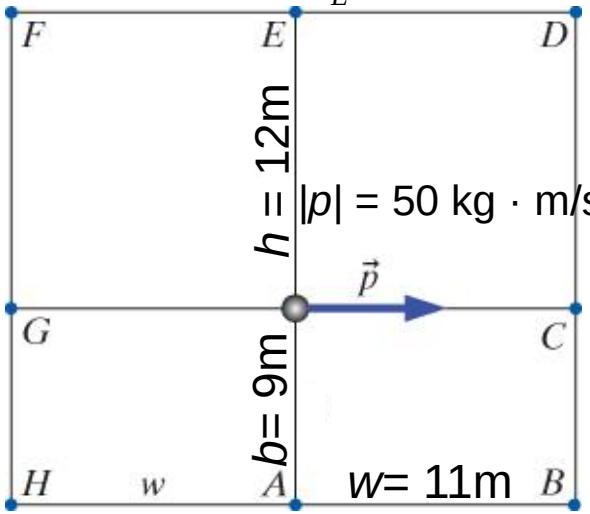
Distinguish with Right Hand Rule

Determine the direction of the translational angular momentum of the particle at location *O* relative to each point: *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*.

$\hat{L}_E =$

$\hat{L}_F =$

$\hat{L}_D =$



$\hat{L}_G =$

$\hat{L}_C =$

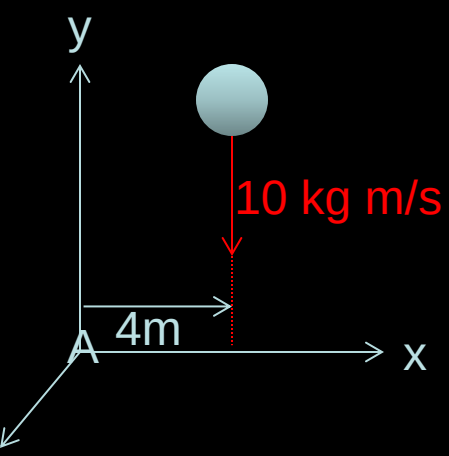
$\hat{L}_H =$

$\hat{L}_B =$

$\hat{L}_A =$

A ball falls straight down in the ***xy*** plane. Its momentum is shown by the red arrow. What is the direction of the ball's ***angular momentum*** about location *A*?

1) +x
2) –x
3) +y
4) –y
5) +z
6) –z
7) zero magnitude



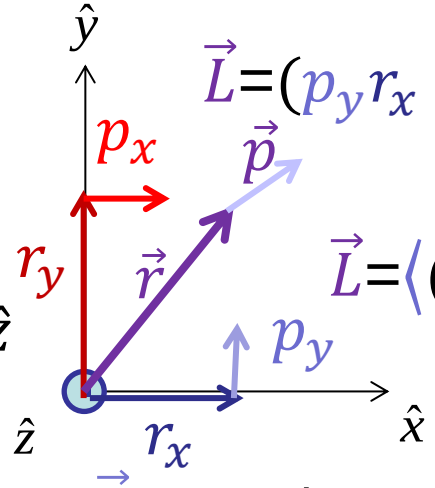
Given these values, what is the magnitude of the ball's angular momentum about A?

1) 10 kg m^2/s
3) 40 kg m^2/s
5) 0

Using Angular Momentum

The measure of motion *about* a point

Magnitude *and* Direction



$$\vec{L}=(p_y r_x - p_x r_y)\hat{z}$$

$$\vec{L}=-p_x r_y \hat{z}$$

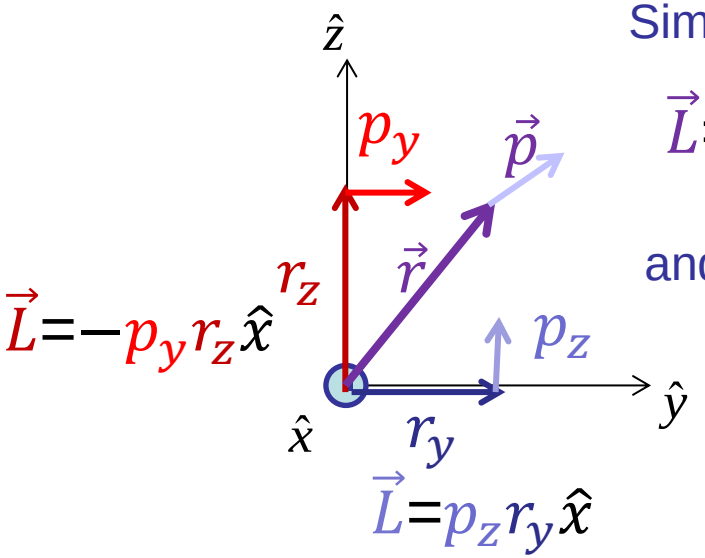
$$\vec{L}=p_y r_x \hat{z}$$

Most General Expression

$$\vec{L}=\langle (p_z r_y - p_y r_z), (p_x r_z - p_z r_x), (p_y r_x - p_x r_y)\hat{z} \rangle$$

$$\vec{L}=\vec{r}\times\vec{p}$$

Cross Product



Similarly for position and momentum in the y-z

$$\vec{L}=(p_z r_y - p_y r_z)\hat{x}$$

$$\vec{L}=-p_y r_z \hat{x}$$

$$\vec{L}=p_z r_y \hat{x}$$

and for position and momentum in the x-z

$$\vec{L}=(p_x r_z - p_z r_x)\hat{y}$$

09_Cross-product.py

Using Angular Momentum

The measure of motion *about* a point

Magnitude *and* Direction

$$\vec{L}=\vec{r}\times\vec{p}\ =\langle(p_z r_y - p_y r_z),(p_x r_z - p_z r_x),(p_y r_x - p_x r_y)\rangle$$

Example: say you have a mass that, at some instant, has linear momentum $\vec{p}=\langle 4,2,0\rangle kg\cdot m/s$ and is $\vec{r}_A=\langle 5,3,0\rangle m$ from some point A. What is its angular momentum about this point?

$$\vec{L}=\vec{r}\times\vec{p}\ =\langle(p_z r_y - p_y\, r_z),(p_x r_z - p_z\, r_x),(p_y r_x - p_x\, r_y)\rangle$$

What is the direction of

< 0, 0, 3> x < 0, 4, 0>?

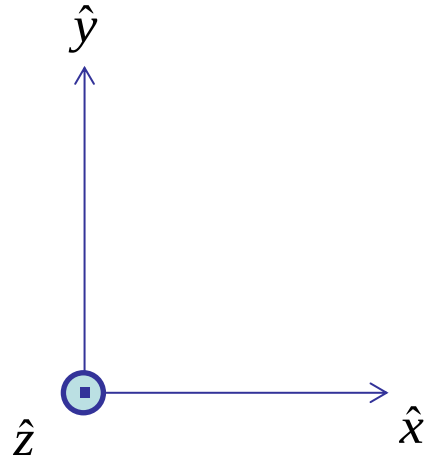
What is the direction of

< 0, 4, 0> x < 0, 0, 3>?

What is the direction of

< 0, 0, 6> x < 0, 0, -3>?

1) +x
2) –x
3) +y
4) –y
5) +z
6) –z
7) zero magnitude



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