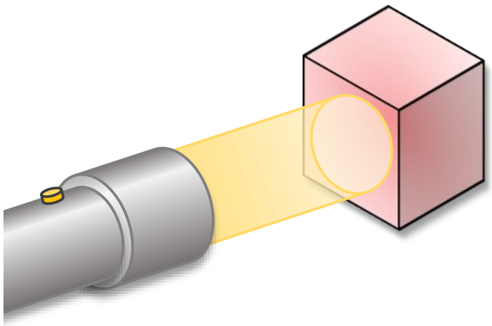
CONCEPT: RADIATION PRESSURE

● Remember: Like all waves, EM waves carry energy. Additionally, EM waves also have ________________.

- When light "hits" an object, it ____________ its momentum and "___________" objects with a Force!

ABSORBED LIGHT



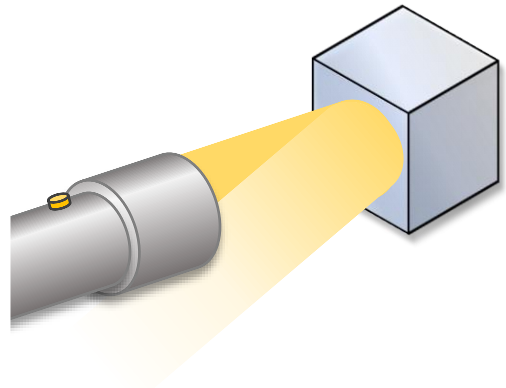
● Similar to a(n) _________________ collision

F_{abs} = ______

$p_{abs} = \frac{F}{A}$ = ______

REFLECTED LIGHT

(e.g. mirror)



● Similar to a(n) _________________ collision

F_{ref} = ______

$p_{ref} = \frac{F}{A}$ = ______

EXAMPLE: You shine a laser pointer onto your hand. The laser pointer has an average power output of 5mW and the beam focuses onto a 1.0×10^{-6} m^2 area on the palm of your hand. If your hand completely absorbs the incoming light, calculate the **a)** radiation pressure and **b)** force exerted on your hand.

PROBLEM: A radio transmits a wave with intensity 27.0 W/m^2 towards a flat surface (perfectly reflecting) with area 2m^2. Calculate the force and radiation pressure on the surface.

E.M. WAVES EQUATIONS	
$I = \frac{P}{A} = \frac{1}{2} c\varepsilon_0 E_{max}{}^2 = \frac{1}{2}\frac{c}{\mu_0} B_{max}{}^2$	
$E_{rms} = \frac{E_{max}}{\sqrt{2}}$;	$B_{rms} = \frac{B_{max}}{\sqrt{2}}$
$E_{max} = cB_{max}$	
$F_{abs} = \frac{IA}{c}$;	$F_{ref} = \frac{2IA}{c}$
$p_{abs} = \frac{F}{A} = \frac{I}{c}$;	$p_{ref} = \frac{F}{A} = \frac{2I}{c}$
CONSTANTS	
$c = 3.0\times10^{8}\ \frac{m}{s}$	
$\mu_0 = 1.26\times10^{-6}\ \frac{N}{A^2}$	
$\varepsilon_0 = 8.85\times10^{-12}\ \frac{C^2}{N\cdot m^2}$	

PROBLEM: You wish to use a laser beam to make an object float in the air. The laser points straight upwards and exerts radiation pressure on a horizontal disc of mass 7.80g and radius 100mm. If the disc, which completely absorbs light, is 2.75 m from the laser, and the radius of the beam is 50mm, what must the laser's power be to balance the disc?

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<u>PROBLEM</u>**:** A spacecraft with a reflective "sail" to capture sunlight may eventually be used for low-cost space travel**.** A 400-kg satellite near Earth is equipped with two completely reflective sails, each with an area of 5000m^2**.** If the intensity of sunlight is approximately 1350 W/m^2, **a)** calculate the force exerted on the satellite**. b)** Assuming the satellite starts from rest, how fast is it moving after 1 year?

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