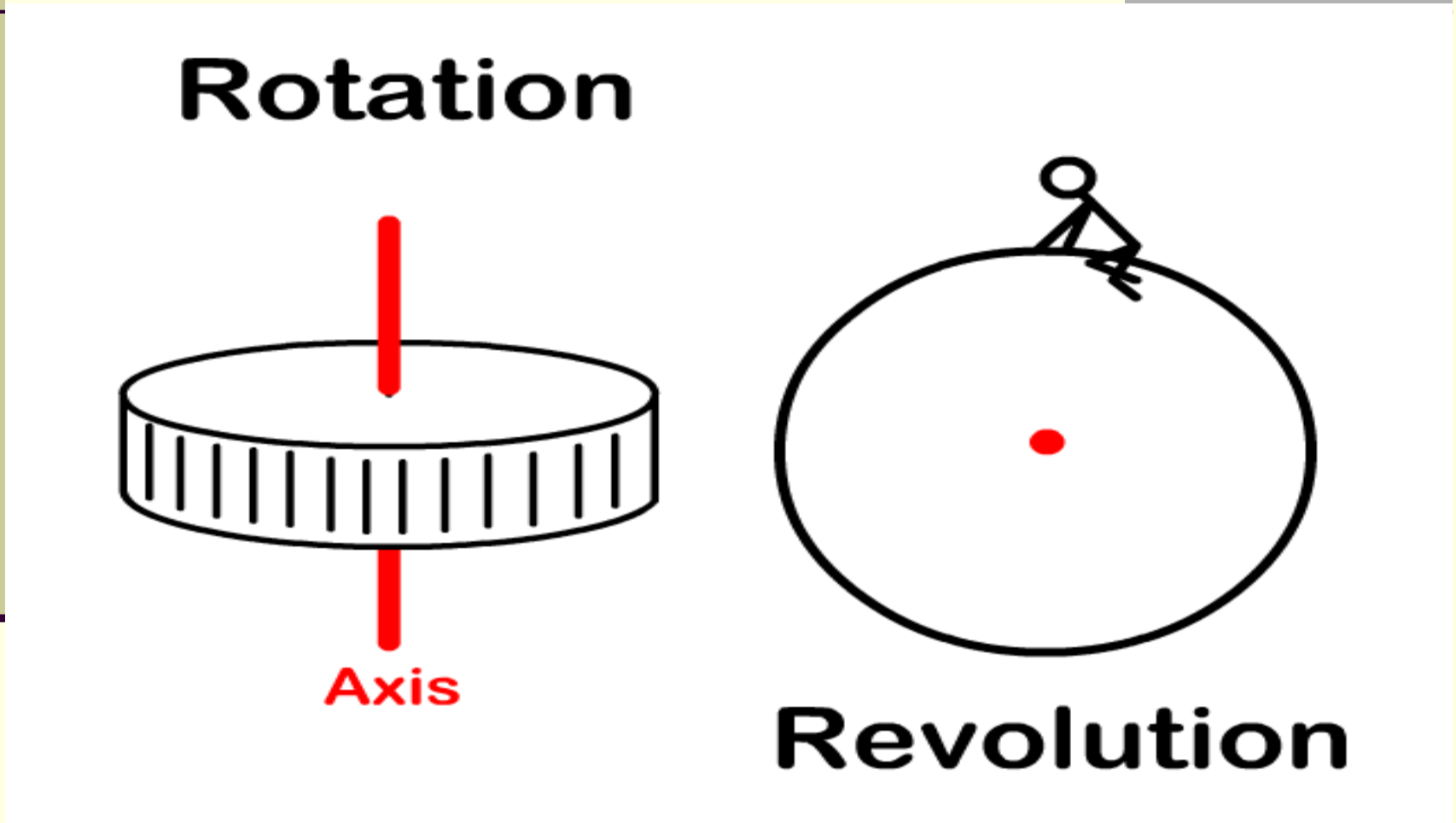
Pakistan School
Kingdom of Bahrain

Rules of the Class:

- 1) Always be on time for all your classes
- 2)Always Respect your all Class fellows.
- 3)Do not create any disturbance.
- 4)Raise hand if you have any question or you wish to answer any question.
- 5)Pay attention to your teacher.
- 6)Please, Enter into the class with your actual Name and CPR number.
- 7)Always follow your Time Table.

Engaging Starter



Learning Objectives: By the end of the session, students will be able to:

1) **Define Torque.**

2) **Differentiate between Axis of rotation, Line of action of force and Moment arm.**

Grade 11th ” Physics ”

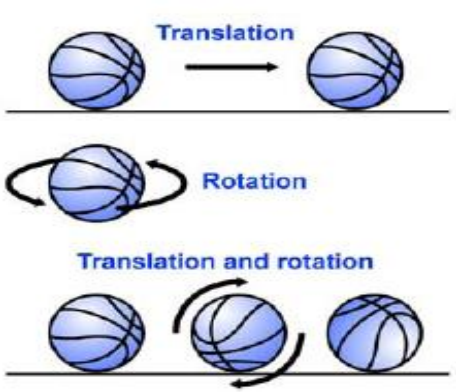
Unit: 2 “Vectors and Equilibrium”

Topic:2.1 “Torque”

Physics:

Torque: (The moment of force)

Torque: (Definition)



- The turning effect of a force about an axis of rotation.

Torque: is defined as the tendency to produce a change in rotational motion.

- A torque is an action that causes objects to rotate.
- A torque is required to rotate an object, just as a force is required to move an object in a line.

Dependence: Torque is created by force, but it also depends on where the force is applied and the point about which the object rotates.

- For example, a door pushed at its handle will easily turn and open, but a door pushed near its hinges will not move as easily. The force may be the same but the torque is quite different.

Torque

Lever arm (m)

Torque (N·m) $\tau = r \times F$ Force (N)

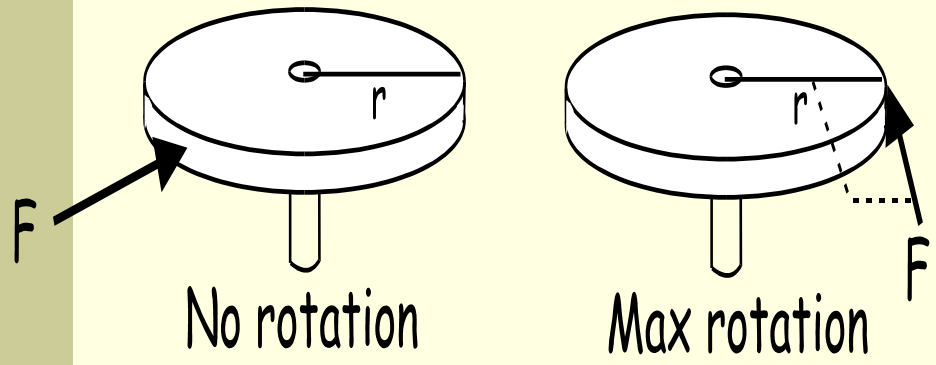
Torque: (Example of vector or cross product)

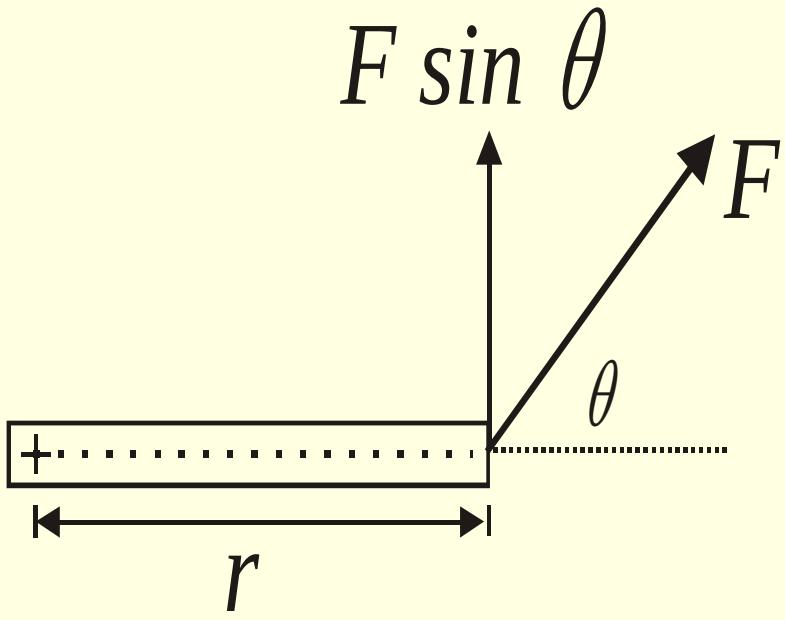
- Torques change angular velocity. The symbol for torque is the Greek letter τ. Torque is given by this equation: $\tau = r \times F$ or

$$\tau = rF\sin\theta$$

- ***r*** is the distance from axis of rotation (pivot) to the line of action of force.
- This variable distance is often called the Moment arm or ***lever arm***.
- ***F sin θ*** be the force component that is perpendicular to the moment arm

Diagrammatic Analysis:





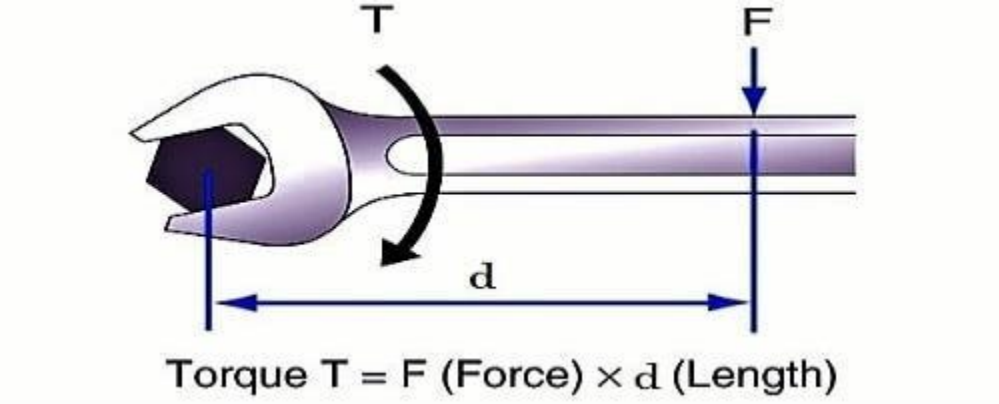
$$\tau = rF\sin\theta$$

Torque Units:

- The unit for torque is going to be a newton meter (N m).
- This looks very similar to the unit for work, the joule, but it is quite different.
- So energy and work are in joules and torque is left in Newton meters.

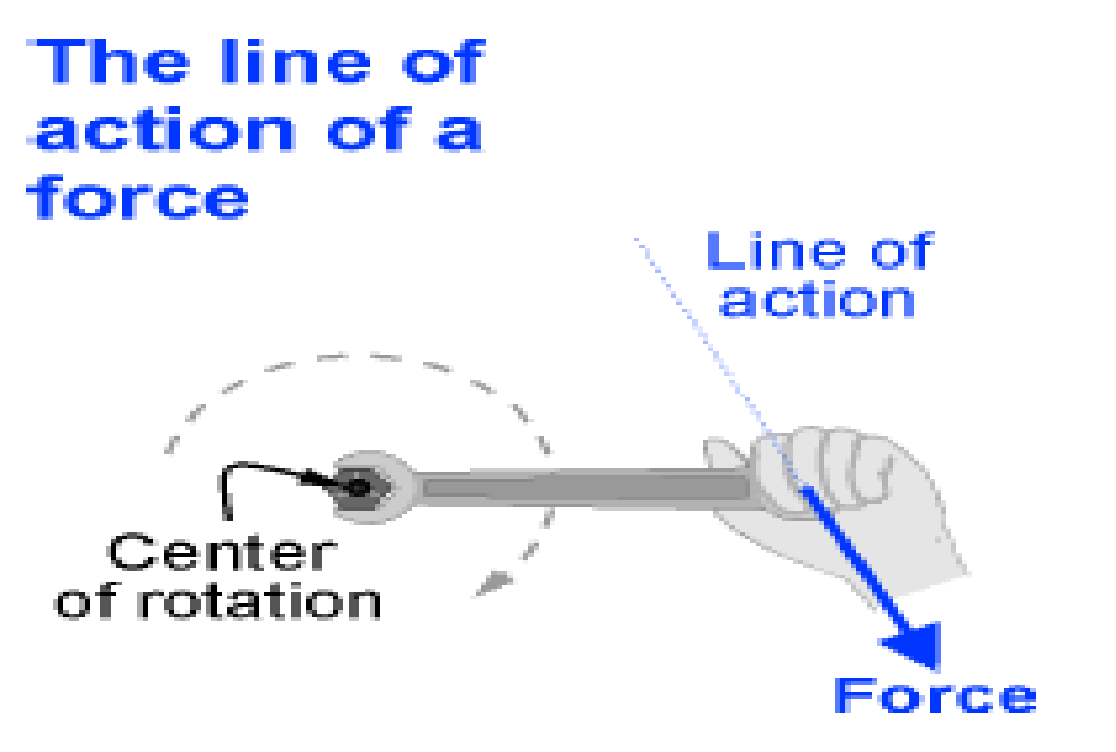
Center of rotation: (Axis of rotation)

- The point or line about which an object turns is its center of rotation.
- For example, a door's center of rotation is at its hinges.
- A force applied far from the center of rotation produces a greater torque than a force applied close to the center of rotation.



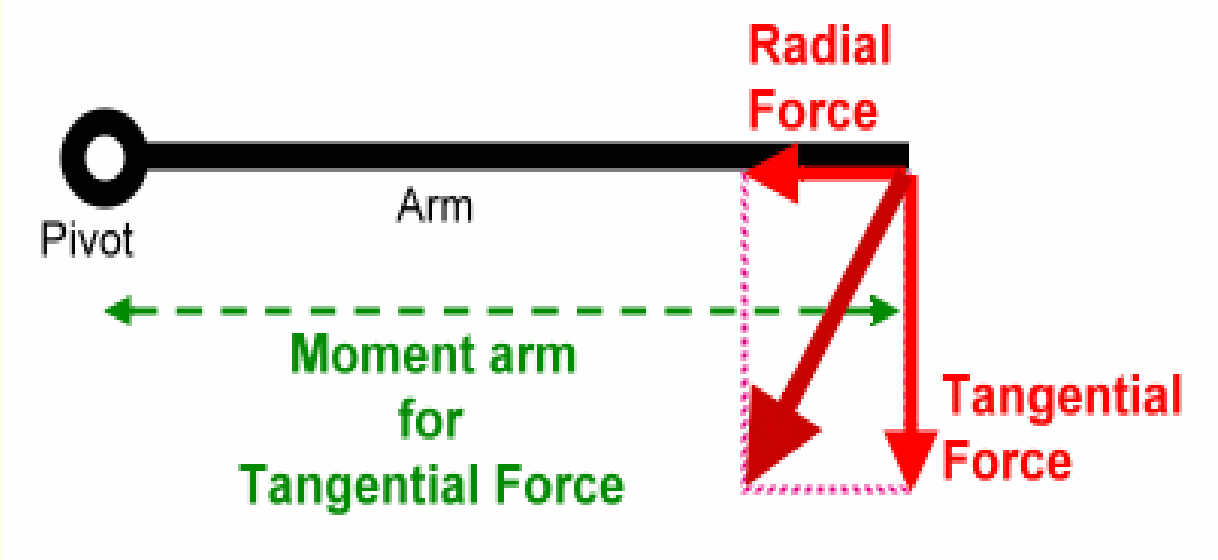
Line of action of force:

- Torque is created when the line of action of a force does not pass through the center of rotation.



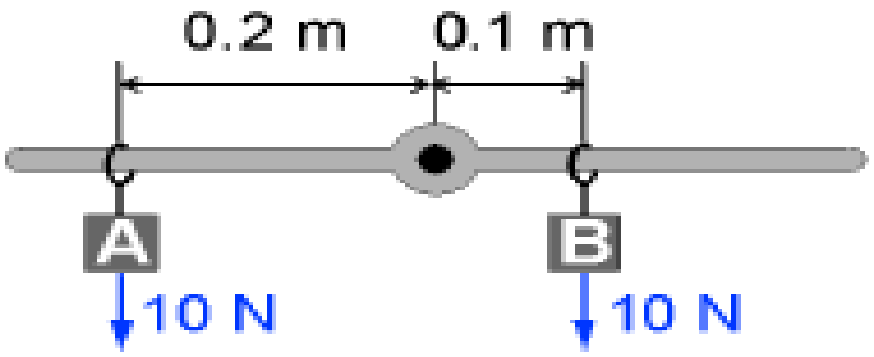
Moment arm:

- The **Moment arm** is the perpendicular distance from axis of rotation to the line of action of force.



Adding Torques: (Practice)

Adding torques



$$\tau_A = +2\ \mathrm{N \cdot m}$$

$$\tau_B = -1\ \mathrm{N \cdot m}$$

$$\tau_A + \tau_B = +1\ \mathrm{N \cdot m}$$

Example:(Practice)

- A torque of 857 Nm is applied to flywheel that has a radius of 45.5 cm. What is the applied force?

$$\tau = Fr \qquad F = \frac{\tau}{r} = 857\ N\cancel{m}\left(\frac{1}{0.455\ \cancel{m}}\right) = \boxed{1880\ N}$$

Home Work

Assignment is given in uploaded notes.

Closure

a) Define moment arm.

b) Define axis of rotation.

c) Define torque.

d) Differentiate b/w axis of rotation and momentarm.

e) Clock-wise torque is _____.

f) Anti-Clock Wise torque is _____..

Thank you…..