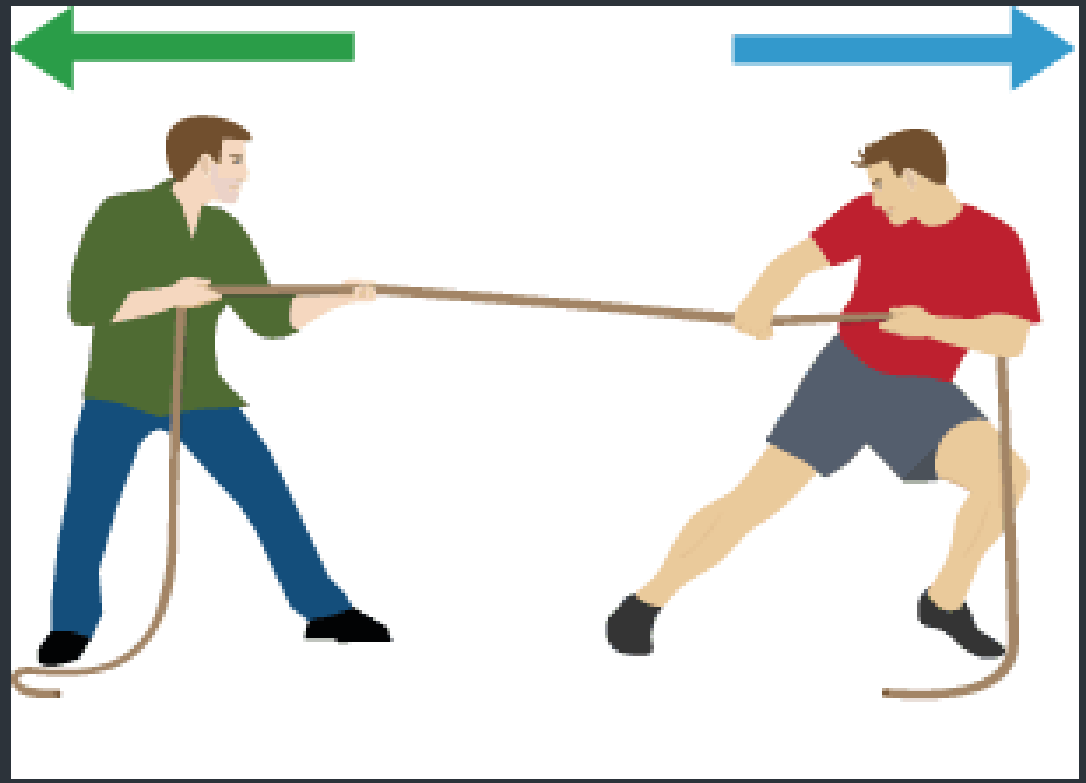
MECHANICS



MRS KL FALING

Grade 11 Physical Science

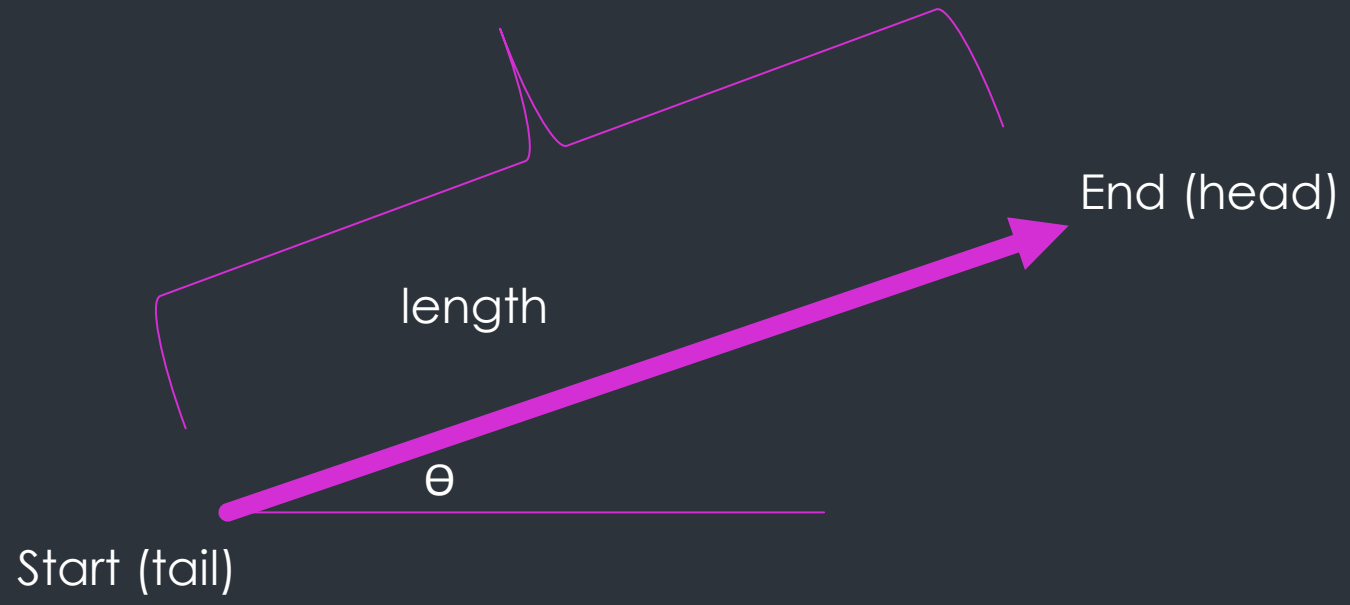
Revision from grade 10

Fill in the missing words

- A quantity can be either a scalar or a _____.
- Examples of scalars are _____, _____, _____ and _____.
- A vector quantity is only fully described if we give its magnitude and _____.
- Examples of vectors are _____, _____, _____ and _____.

Graphical representation of a vector

1. **Adding vectors (same and opposite direction)**
2. **RESULTANT**
3. **Head to Tail**
4. **Parallelogram**
5. **CLOSED vector diagram**



- Any vector can be represented by an arrow
- The length of the arrow represents the magnitude of the vector. (must give scale)
- The arrow head shows the direction of the vector

Dividing a vector into its components

- Any force at an angle to the horizontal can be divided into vertical and horizontal components, using trig rules.
- We do this because some of the force is used to lift the object (vertical component) and some of the force is used to move the object forward (horizontal component).
- (Also sometimes called components parallel and perpendicular to the plane)

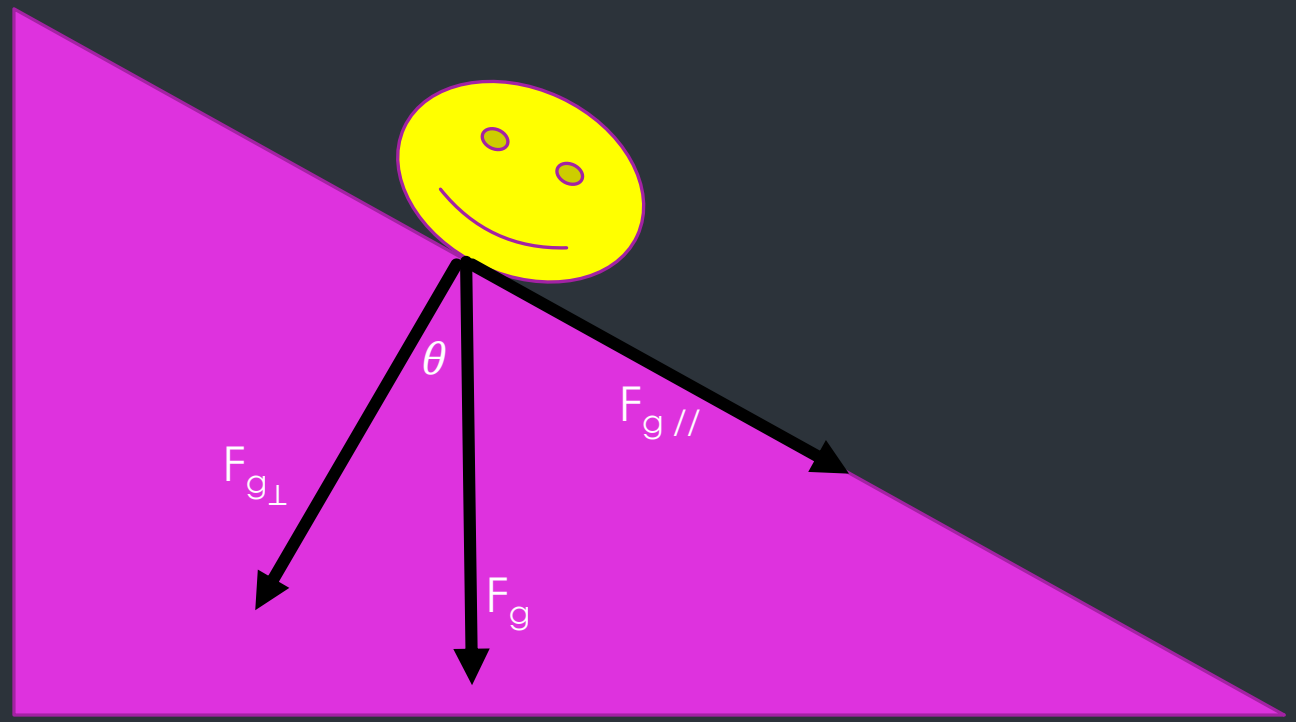
LEARN!

- $\text{Cos}\theta = \frac{Fx}{F}$ ($F_x = F \text{ Cos } \theta$)
- $Sin\ \theta = \frac{Fy}{F}$ ($F_y = F \text{ Sin } \theta$)

- EXAMPLES!

Components of a force acting at an angle to a slope

What forces do you think are acting on Mr Smiley Man?


θ
$F_{g\perp}$
$F_{g//}$
F_g

- $\text{Cos}\theta = \frac{Fg\perp}{Fg}$ ($F_{g_\perp} = F_g \text{ Cos } \theta$)
- $Sin\ \theta = \frac{Fg\parallel}{Fg}$ ($F_{g//} = F_g \text{ Sin } \theta$)

- EXAMPLES!
- EX 1 page 16

FORCES
symbol: F
unit: Newtons

- Push or pull action
- Vector (direction force acts is VERY important)
- Get contact and non-contact forces

NON-CONTACT forces

- Acts over a distance
- Examples:
  - Magnetic force
  - Electrostatic force
  - Gravitational force

Contact force

- Two objects must be in contact with each other for the contact force to act
- Example:
  1. Applied forces: A person/object exerts a force on another person/object
  2. Friction: Any force that opposes a motion
  3. Normal force: A force by a surface on an object on that surface
  4. Tension: A force that acts through a rope or bar
  5. Air friction: Air particles offer resistance to an object moving through air (always opposite to the movement)
  6. Compression: (force exerted on a compressed spring)

Force diagrams and free body diagrams

FORCE

- NB If asked to draw in test/exam – MUST DRAW CORRECT ONE ASKED FOR!
- TABLE OF FORCES – explaining diagram
- Either actual force OR components NOT BOTH!!!
- MANUAL: PAGE 22 and 25
- Ex 2 page 26

Free body

FRICTION FORCE

- Friction is a contact force
- Friction is any force that resists the intended motion.
- It occurs when two objects are in close contact and attempt to move across each other.

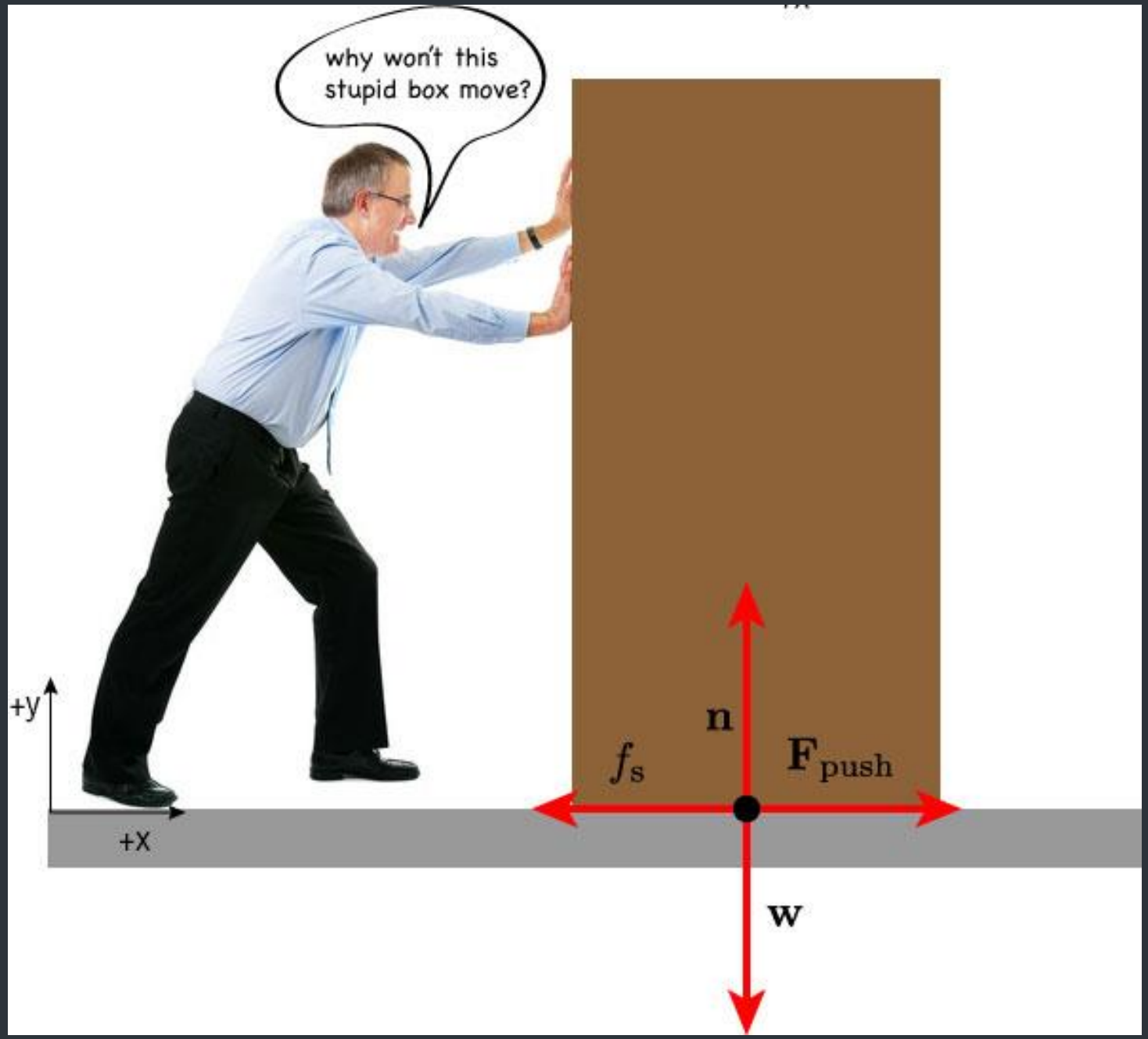
- Frictional forces act parallel to the plane of motion but are ALWAYS opposite to the direction of the motion.

Resultant Force = Force – Frictional force

TWO TYPES OF FRICTION

- KINETIC FRICTION: two objects are in motion relative to each other.
- STATIC FRICTION: two objects at rest relative to each other.

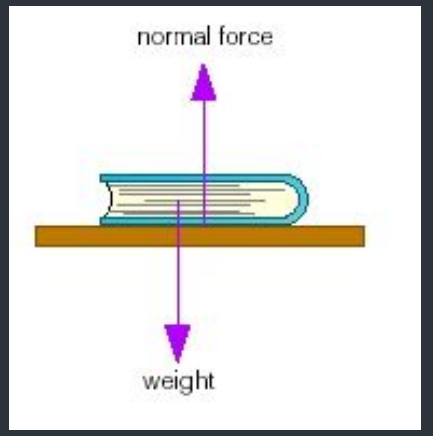
WHY????



Factors that influence the magnitude of the frictional force

- The NORMAL force
- The surface type

The NORMAL force



- The larger the force the two surfaces exert on each other (perpendicular to the surface) the larger the friction.
- The normal is an indication of this.
- The normal is often equal to the weight BUT not always.
- MANUAL: PAGE 30

The type of surface

- The material used in manufacturing
- Smooth tiles are slippery – especially if you are wet
- Ice-rink allows for gliding / slipping ;-)
- The rubber next to the ice-rink disallows gliding

- The rougher the surface the greater the friction between the 2 surfaces.
- The extent to which the 2 surfaces will affect one another is known as the coefficient of friction. SYMBOL: μ (pronounced “mu”)
- It has no UNIT as it is a factor of the roughness

- Every surface pair has two coefficients of friction
  1. Coefficient for static friction μ_s
  2. Coefficient for kinetic friction μ_k
- $\mu_s > \mu_k$
- The small the value of μ the less resistance offered by the surface
- The value is usually less than 1

STATIC FRICTION F_s

For an object at rest on a flat table, static friction is zero.

If you push horizontally with a small force, static friction establishes an equal and opposite force that keeps the book at rest.

As you push harder, the static friction force increases to match the force.

Eventually maximum static friction force is exceeded and the book moves.

The maximum static friction force is:

$(f_s)_{max} = \mu_s N$

where μ_s is the coefficient of static friction.

Static friction is subtle because the static friction force is variable and depends on the external forces acting on an object.

That is, $f_s \leq \mu_s N$, while $(f_s)_{max} = \mu_s N$.

In general, $\mu_s \geq \mu_k$.

It is harder to move a stationary object than it is to keep a moving object in motion.