

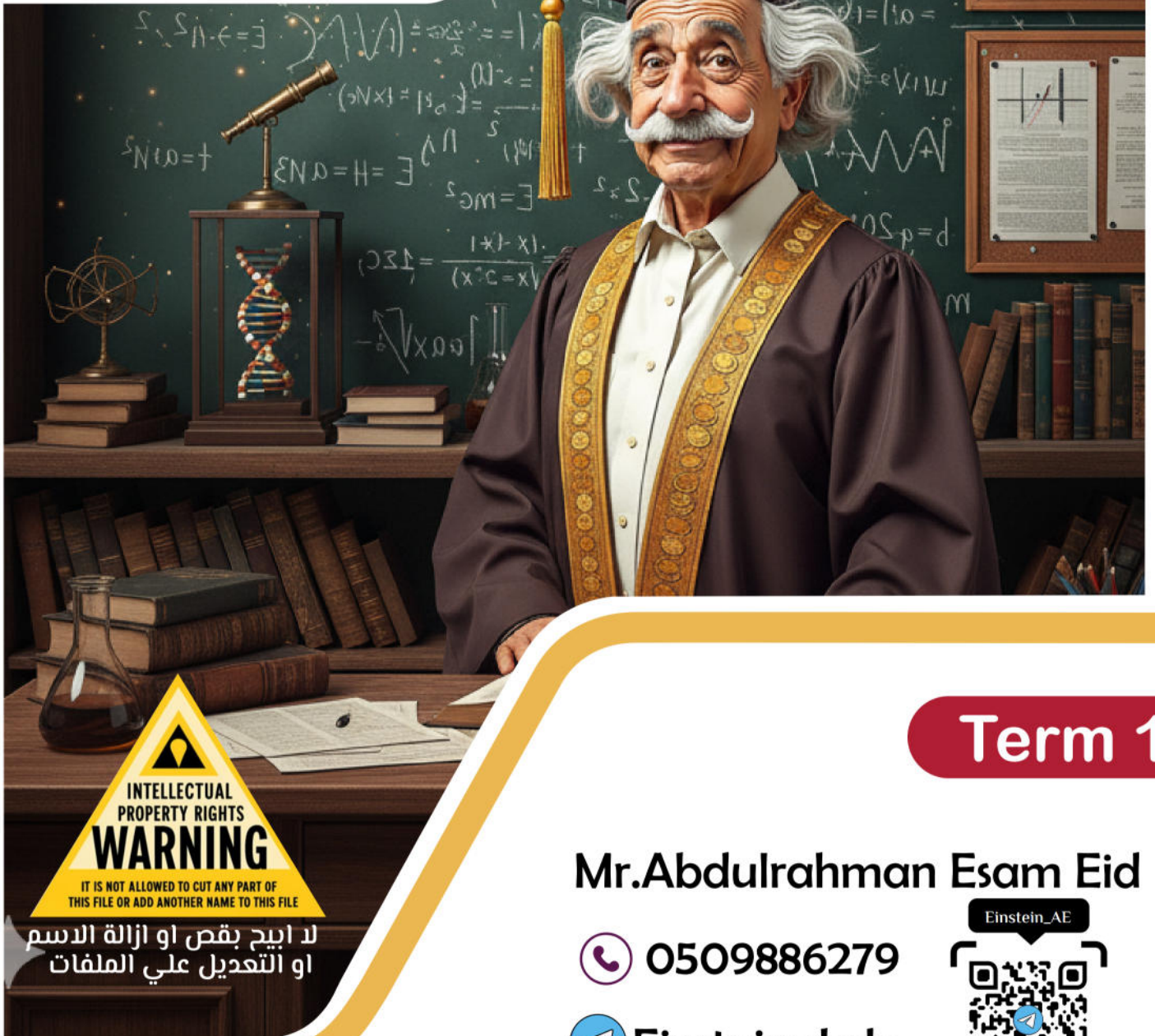


Einstein_AE

اينشتاين العرب

Eot Exam Coverage

10 General



Term 1

Mr. Abdulrahman Esam Eid



0509886279



Einsteinabdo

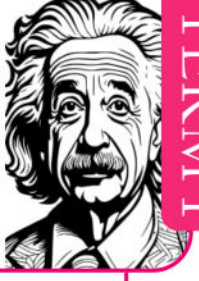
Einstein_AE



INTELLECTUAL
PROPERTY RIGHTS
WARNING

IT IS NOT ALLOWED TO CUT ANY PART OF
THIS FILE OR ADD ANOTHER NAME TO THIS FILE

لا ابيح بقص او ازالة الاسم
او التعديل علي الملفات



Q.1 Explain that a net force applied to an object causes the object to accelerate.

Combine forces to find the net force acting on an object.

Relate the direction of the acceleration to the direction of the net force

Apply Newton's Second Law to solve numerical problems.

Net Force Causes Acceleration

When a net force is applied to an object, it causes the object to accelerate. This is described by **Newton's Second Law of Motion**, which states:

Force = Mass × Acceleration

$$F_{\text{net}} = m \cdot a$$

This means that the acceleration of an object depends on two things:

- The **net force** acting on it.
- Its **mass**.

Combining Forces to Find Net Force

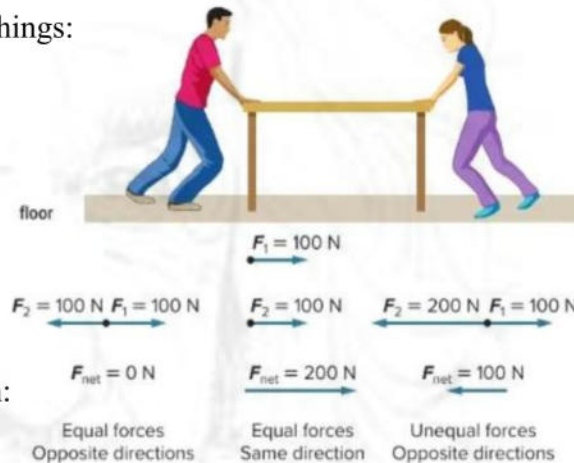
- If forces act in the **same direction**, you **add** them:

$$F_{\text{net}} = F_1 + F_2$$

- If forces act in **opposite directions**, you **subtract** them:

$$F_{\text{net}} = F_{\text{larger}} - F_{\text{smaller}}$$

- The direction of the net force is the direction of the **stronger force**.



Direction of Acceleration

The acceleration of an object is always in the **same direction** as the net force.

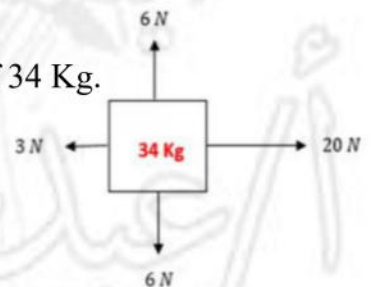
- If the net force is to the right, the object accelerates to the right.
- If the net force is upward, the object accelerates upward.

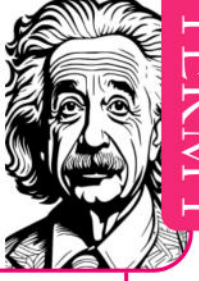
Applying Newton's Second Law (Examples)

To calculate acceleration, use the formula:

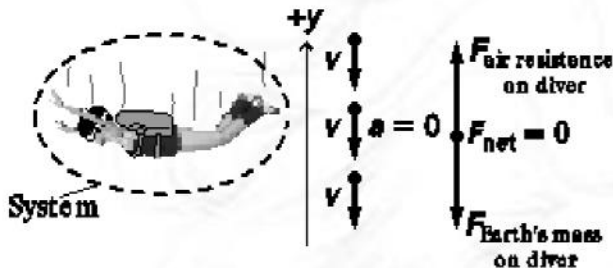
$$a = \frac{F_{\text{net}}}{m}$$

The free body diagram shows the forces acting on a box with a mass of 34 Kg. What is the acceleration of the box?

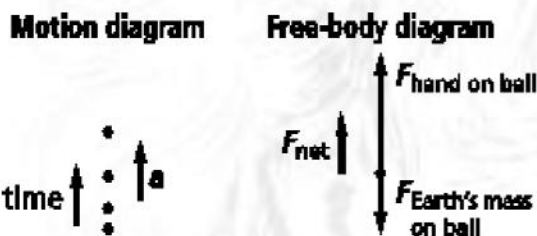




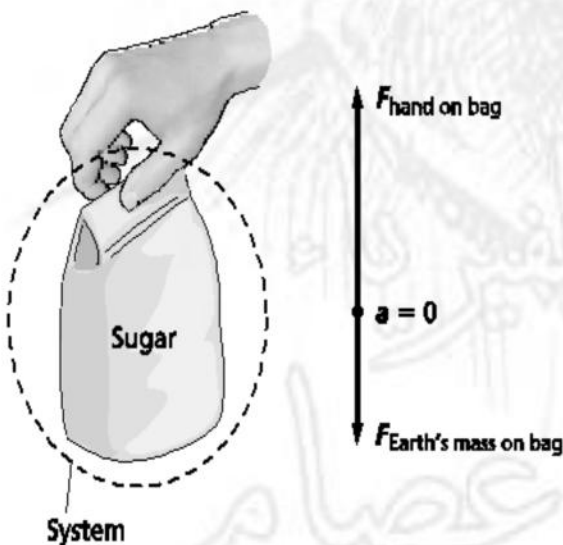
1. A skydiver falls downward through the air at constant velocity. (The air exerts an upward force on the person.)



2. You hold a softball in the palm of your hand and toss it up. Draw the diagrams while the ball is still touching your hand.



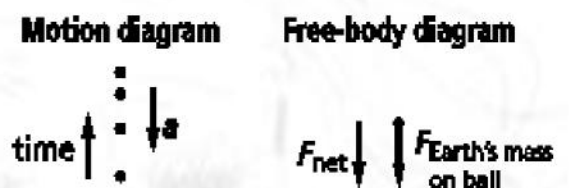
13. **Free-Body Diagram** Draw a free-body diagram of a bag of sugar being lifted by your hand at an increasing speed. Specifically identify the system. Use subscripts to label all forces with their agents. Remember to make the arrows the correct lengths.



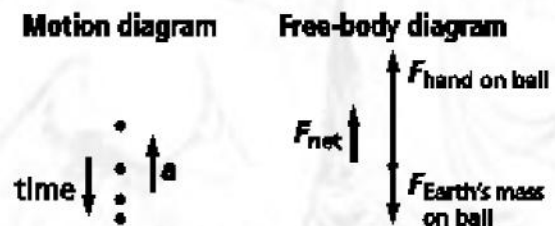
3. After the softball leaves your hand, it rises, slowing down.



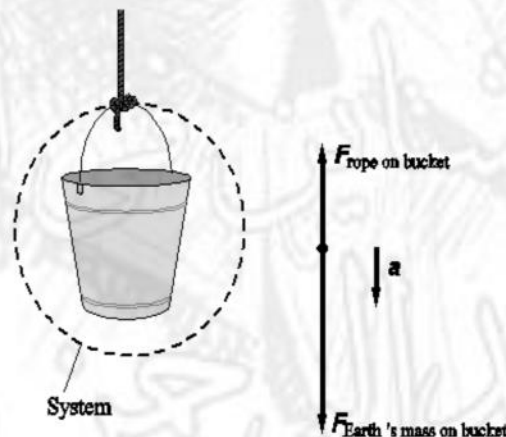
4. After the softball reaches its maximum height, it falls down, speeding up.

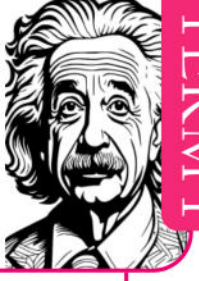


5. **CHALLENGE** You catch the ball in your hand and bring it to rest.



14. **Free-Body Diagram** Draw a free-body diagram of a water bucket being lifted by a rope at a decreasing speed. Specifically identify the system. Label all forces with their agents and make the arrows the correct lengths.





Two horizontal forces, 225 N and 165 N, act on a canoe in the same direction. Find the net horizontal force on the canoe.

$$F_{\text{net}} = 225 \text{ N} + 165 \text{ N} = 390 \text{ N or } 3.90 \times 10^2 \text{ N}$$

Direction: In the direction of the two forces.

The same two forces act on the canoe in opposite directions. Find the net horizontal force and indicate its direction.

$$F_{\text{net}} = 225 \text{ N} - 165 \text{ N} = 60 \text{ N or } 6.0 \times 10^1 \text{ N}$$

Direction: In the direction of the larger force (225 N).

Three sled dogs are trying to pull a sled across the Alaskan snow:

- Alutia pulls east with a force of 35 N.
- Seward also pulls east with a force of 42 N.
- Kodiak pulls west with a force of 53 N.

What is the net force on the sled?

Explain how Newton's Second Law predicts the sled's change in motion.

Solution

Identify east as positive and the sled as the system.

$$F_{\text{net}} = F_{\text{Alutia}} + F_{\text{Seward}} - F_{\text{Kodiak}}$$

$$F_{\text{net}} = 35 \text{ N} + 42 \text{ N} - 53 \text{ N}$$

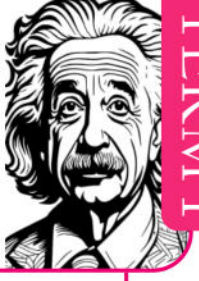
$$F_{\text{net}} = 24 \text{ N (east)}$$

Direction: East (toward the combined pull of Alutia and Seward).

A spring scale exerts a net force of 2.7 N on a cart. The cart's mass is 0.64 kg. What is the cart's acceleration?

$$a = \frac{F_{\text{net}}}{m}$$

$$a = \frac{2.7 \text{ N}}{0.64 \text{ kg}} = 4.2 \text{ m/s}^2$$



Kamaria wants an acceleration of 0.80 m/s^2 while skating. Her mass is 27.2 kg . What force does her mother need to apply? (Neglect resistance.)

$$F_{\text{net}} = m \cdot a$$

$$F_{\text{net}} = (27.2 \text{ kg})(0.80 \text{ m/s}^2) = 22 \text{ N}$$

Net Force on a Crate Two horizontal forces act on a large crate:

- 317 N to the right
- 173 N to the left

a. Force Diagram

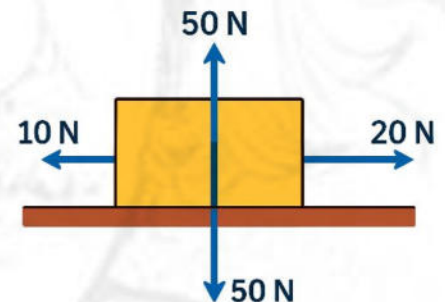


b. Net Force

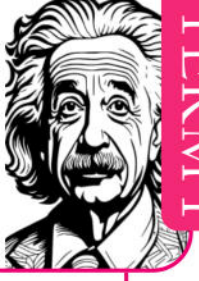
$$F_{\text{net}} = F_{\text{right}} - F_{\text{left}}$$

$$F_{\text{net}} = 317 \text{ N} - 173 \text{ N} = 144 \text{ N To the right.}$$

The forces acting on a **17-kg box** are shown in the figure below.



1. What is the **net force** acting on the box?
2. What is the **acceleration** of the box?
3. What is the **equilibrant force** that would balance all forces?



Weight is the gravitational force acting on an object near Earth's surface:

$$F_g = m \cdot g$$

Where:

- F_g = weight (in newtons)
- m = mass (in kilograms)
- g = gravitational field strength ($\approx 9.8 \text{ N/kg}$ on Earth)

Identify each of the following as either:

- a contact force
- a field force
- not a force

Mass- inertia - the push of a door- friction-air resistance- spring force -gravity magnets repulsion -tension -acceleration



Contact force



Field force



Not a force

You place a **4.0 kg watermelon** on a spring scale that measures in newtons. What is the scale's reading?

$$F_g = m \cdot g$$

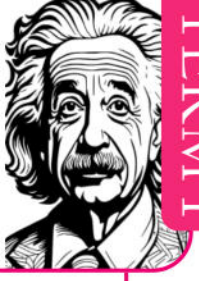
$$F_g = (4.0 \text{ kg})(9.8 \text{ N/kg}) = 39 \text{ N}$$

You place a **22.50 kg television** on a spring scale. If the scale reads **235.2 N**, what is the gravitational field?

$$F_g = m \cdot g$$

$$g = \frac{F_g}{m}$$

$$g = \frac{235.2 \text{ N}}{22.50 \text{ kg}} = 10.5 \text{ N/kg}$$



A **0.50 kg guinea pig** is lifted from the ground. What is the smallest force needed to lift it? Describe the motion.

$$F_{\text{lift}} = m \cdot g$$

$$F_{\text{lift}} = (0.50 \text{ kg})(9.8 \text{ N/kg}) = 4.9 \text{ N}$$

Motion: It would move at a **constant speed** because the lifting force equals its weight.

A grocery sack can withstand a maximum of **230 N** before ripping. Will a bag holding **15 kg** of groceries lifted at **7.0 m/s²** hold?

Use Newton's Second Law:

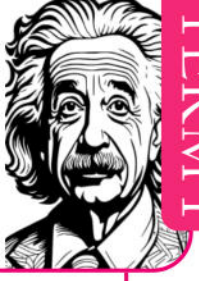
$$F_{\text{net}} = m \cdot a$$

$$F_{\text{bag on groceries}} = F_{\text{net}} + F_g$$

$$F_{\text{bag on groceries}} = (15 \text{ kg})(7.0 \text{ m/s}^2) + (15 \text{ kg})(9.8 \text{ N/kg})$$

$$F_{\text{bag on groceries}} = 105 \text{ N} + 147 \text{ N} = 252 \text{ N}$$

The bag does **not** hold because **252 N > 230 N**.



Apply the relationships that relate the normal force to maximum static friction and to kinetic friction to calculate unknown parameters like friction force, coefficient of friction or the normal force.

Solve problems related to friction.

Friction and Normal Force

Friction is a force that **opposes motion** between two surfaces in contact. There are two main types:

1. Static Friction (f_s)

- ✓ Prevents motion when an object is at rest.
- ✓ Maximum static friction:

$$f_s^{\max} = \mu_s \cdot F_N$$

Where:

- μ_s = coefficient of static friction $\mu = \frac{f}{F_N}$
- F_N = normal force

2. Kinetic Friction (f_k)

- ✓ Acts when the object is sliding.
- ✓ Formula:

$$f_k = \mu_k \cdot F_N$$

Where:

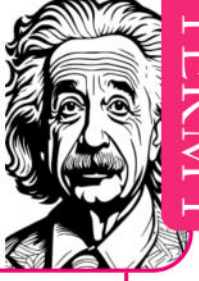
- μ_k = coefficient of kinetic friction $\mu = \frac{f}{F_N}$
- F_N = normal force

Normal Force

- For a horizontal surface with no vertical acceleration:

$$F_N = m \cdot g$$

- If there is an additional vertical force (up or down), adjust accordingly.



You push a **25.0 kg wooden box** across a wooden floor at a **constant speed of 1.0 m/s**.

Question: How much force do you exert on the box?

1. Analyze and Sketch the Problem

- Known:

- ✓ $m = 25.0 \text{ kg}$

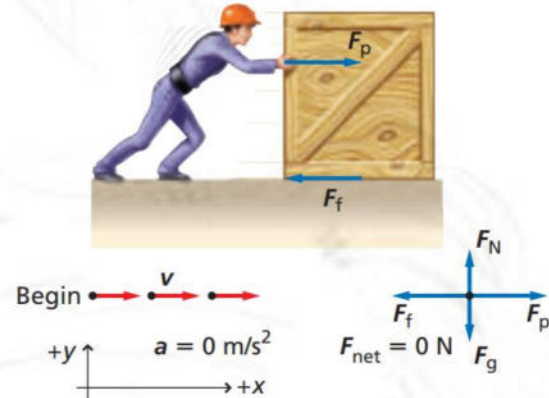
- ✓ $v = 1.0 \text{ m/s}$

- ✓ $a = 0.0 \text{ m/s}^2$

- ✓ $\mu_k = 0.20$

- Unknown:

- ✓ $F_p = ?$



2. Solve for the Unknown

- Normal Force:**

$$F_N = F_g = m \cdot g$$

$$F_N = (25.0 \text{ kg})(9.80 \text{ m/s}^2) = 245 \text{ N}$$

- Friction Force:**

$$F_f = \mu_k \cdot F_N = (0.20)(245 \text{ N}) = 49 \text{ N}$$

- Since the box moves at constant speed:

$$F_p = F_f = 49 \text{ N to the right}$$

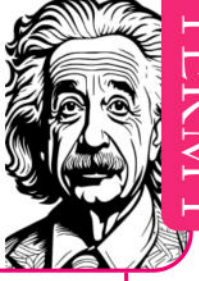
A girl exerts a **36-N horizontal force** as she pulls a **52-N sled** across a cement sidewalk at constant speed. What is the coefficient of kinetic friction between the sidewalk and the metal sled runners? Ignore air resistance.

Given:

- $F_{\text{applied}} = 36 \text{ N}$
- Weight of sled = 52 N
- Constant speed $\rightarrow F_{\text{applied}} = f_k$
- $F_N = 52 \text{ N}$

Steps:

$$\mu_k = \frac{f_k}{F_N} = \frac{36}{52} = 0.69$$



You need to move a **105-kg sofa** to a different location in the room. It takes a force of **102 N** to start it moving. What is the coefficient of static friction between the sofa and the carpet?

Given:

- $m = 105 \text{ kg}$
- $f_s^{\max} = 102 \text{ N}$
- $g = 9.8 \text{ m/s}^2$

Steps:

$$F_N = m \cdot g = (105)(9.8) = 1029 \text{ N}$$

$$\mu_s = \frac{f_s^{\max}}{F_N} = \frac{102}{1029} = 0.099$$

Mr. Abdulrahman is dragging a box full of books from his office to his car. The box and books together have a combined weight of **134 N**. If the coefficient of static friction between the pavement and the box is **0.55**, how hard must Mr. Abdulrahman push the box in order to start it moving?

Given:

- $F_N = 134 \text{ N}$
- $\mu_s = 0.55$

Steps:

$$f_s^{\max} = \mu_s \cdot F_N = (0.55)(134) = 73.7 \text{ N}$$

Suppose that the sled in problem 17 is resting on packed snow. The coefficient of kinetic friction is now only **0.12**. If a person weighing **650 N** sits on the sled, what force is needed to pull the sled across the snow at constant speed?

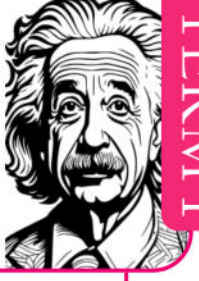
Given:

- Sled weight = 52 N
- Person weight = 650 N
- $\mu_k = 0.12$

Steps:

$$F_N = 52 + 650 = 702 \text{ N}$$

$$f_k = \mu_k \cdot F_N = (0.12)(702) = 84.24 \text{ N}$$



Suppose that a particular machine in a factory has two steel pieces that must rub against each other at a constant speed. Before either piece of steel has been treated to reduce friction, the force necessary to get them to perform properly is **5.8 N**. After the pieces have been treated with oil, what will be the required force?

Given:

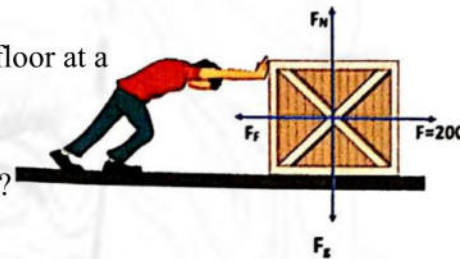
- Original force = 5.8 N
- After oil treatment → friction greatly reduced (assume coefficient drops by factor of 10)

Steps:

$$F_{\text{new}} = \frac{5.8}{10} = 0.58 \text{ N}$$

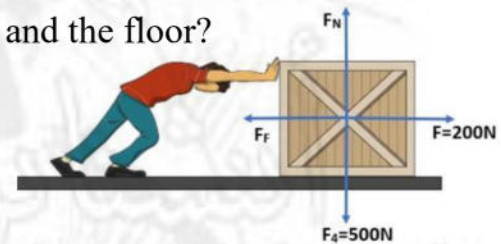
Ahmed is pushing a wooden box with a mass of 50 Kg across a wooden floor at a constant speed. He exerts a force of 200 N on the box as shown.

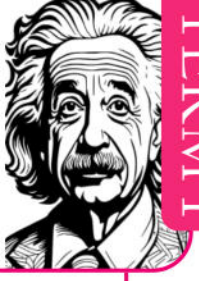
Calculate the coefficient of kinetic friction between the box and the floor?



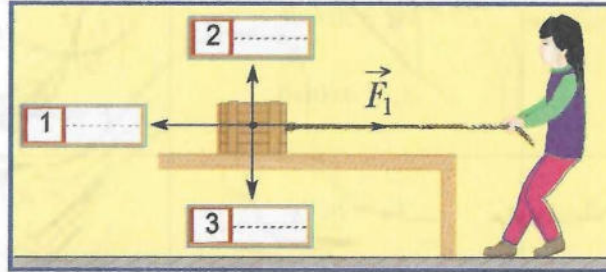
Ahmed is pushing a wooden box with a weight of 500 N across a wooden floor at a constant speed. He exerts a force of 200 N on the box.

What is the coefficient of kinetic friction between the box and the floor?





Mariam pulls a box weighing **10 kg** at a constant speed on a horizontal table. The coefficient of kinetic friction between the table and the box is **0.25**.



a) Write the symbol of each of the following forces in the correct label shown in the free-body diagram above:

(Weight(F_g) – kinetic friction force(F_k) – Normal force(F_N))

b) Calculate the force (F_1) exerted by Mariam on the box.

Apply the relationships that relate the normal force to maximum static friction and to kinetic friction to calculate unknown parameters like friction force, coefficient of friction or the normal force. Solve problems related to friction.

A **1.4-kg block** slides across a rough surface such that it slows down with an acceleration of **1.25 m/s²**. What is the coefficient of kinetic friction between the block and the surface?

Given:

- $m = 1.4 \text{ kg}$
- $a = 1.25 \text{ m/s}^2$
- $g = 9.8 \text{ m/s}^2$

Steps:

1. The friction force causes the deceleration:

$$f_k = m \cdot a$$

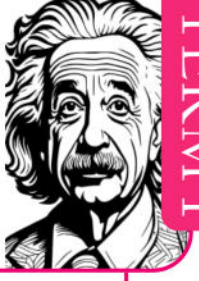
$$f_k = (1.4)(1.25) = 1.75 \text{ N}$$

2. Normal force:

$$F_N = m \cdot g = (1.4)(9.8) = 13.72 \text{ N}$$

3. Coefficient of kinetic friction:

$$\mu_k = \frac{f_k}{F_N} = \frac{1.75}{13.72} = 0.128$$



You help your mom move a **41-kg bookcase** to a different place in the living room. If you push with a force of **65 N** and the bookcase accelerates at **0.12 m/s²**, what is the coefficient of kinetic friction between the bookcase and the carpet?

Given:

- $m = 41 \text{ kg}$
- $F_{\text{push}} = 65 \text{ N}$
- $a = 0.12 \text{ m/s}^2$
- $g = 9.8 \text{ m/s}^2$

Steps:

1. Net force:

$$F_{\text{net}} = m \cdot a = (41)(0.12) = 4.92 \text{ N}$$

2. Friction force:

$$f_k = F_{\text{push}} - F_{\text{net}} = 65 - 4.92 = 60.08 \text{ N}$$

3. Normal force:

$$F_N = m \cdot g = (41)(9.8) = 401.8 \text{ N}$$

4. Coefficient of kinetic friction:

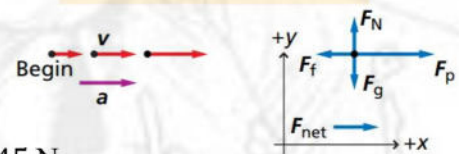
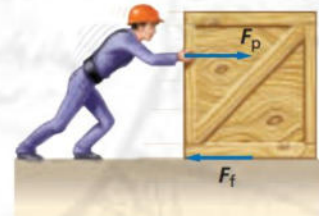
$$\mu_k = \frac{f_k}{F_N} = \frac{60.08}{401.8} = 0.15$$

If the force that you exert on a **25.0-kg wooden box** is **doubled**, what is the resulting acceleration of the box?

The coefficient of kinetic friction is $\mu_k = 0.20$, and the box was originally moving at **1.0 m/s**.

Given

- Mass: $m = 25.0 \text{ kg}$
- Coefficient of kinetic friction: $\mu_k = 0.20$
- Gravitational acceleration: $g = 9.80 \text{ m/s}^2$
- Original push force: $F_p = 49 \text{ N}$
- Doubled push force: $F_p = 98 \text{ N}$
- Unknown: $a = ?$



Step 1: Calculate Normal Force

$$F_N = m \cdot g = (25.0)(9.80) = 245 \text{ N}$$

Step 2: Calculate Friction Force

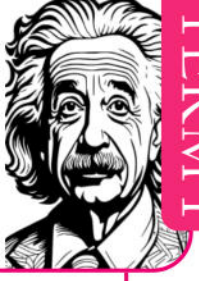
$$F_f = \mu_k \cdot F_N = (0.20)(245) = 49 \text{ N}$$

Step 3: Find Net Force

$$F_{\text{net}} = F_p - F_f = 98 - 49 = 49 \text{ N}$$

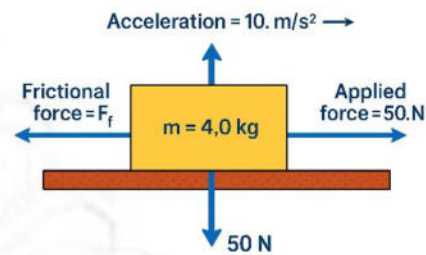
Step 4: Calculate Acceleration

$$a = \frac{F_{\text{net}}}{m} = \frac{49}{25.0} = 1.96 = 2.0 \text{ m/s}^2$$



The diagram shows a **4.0 kg object** accelerating at **10 m/s²** on a rough horizontal surface when a force of **50 N** is applied to it.

- What is the magnitude of the **frictional force** F_f acting on the object?
- Calculate the **normal force** exerted on the box.
- Find the **coefficient of kinetic friction** between the box and the surface.



When an object rests on an inclined plane, its weight (F_g) can be resolved into two components:

- Parallel to the plane:**

$$F_{g\parallel} = F_g \cdot \sin \theta$$

This component causes the object to slide down the incline.

- Perpendicular to the plane (Normal force):**

$$F_N = F_g \cdot \cos \theta$$

This component presses the object against the surface.

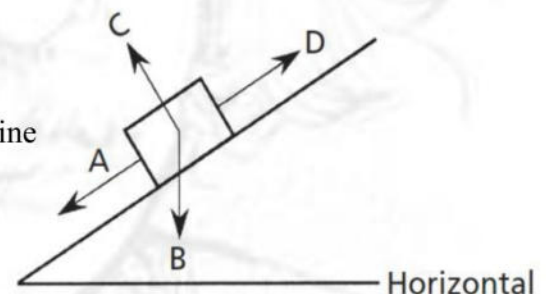
In the diagram below, a box is at rest on an inclined plane.

Force A Component of the weight of the box parallel to the incline

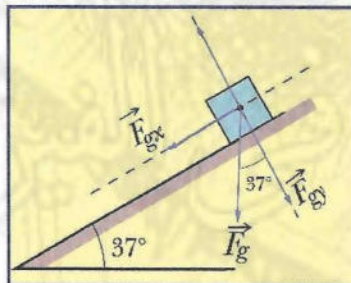
Force B Weight of the box

Force C Normal force

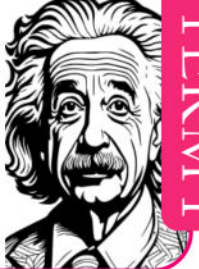
Force D Frictional force



A **90 N crate** is resting on a plane inclined at **37° above the horizontal**. Find the following:



- The weight component **parallel to the plane** ($F_{g\parallel}$)
- The **normal force** (F_N)



Define periodic motion and the quantities associated with it like period, wavelength and amplitude.

Relate the period of a wave to its frequency.

Relate the wavelength of a wave to its speed and frequency in a medium.

Use the wave equation to solve related numerical problems.

1. Amplitude (A)

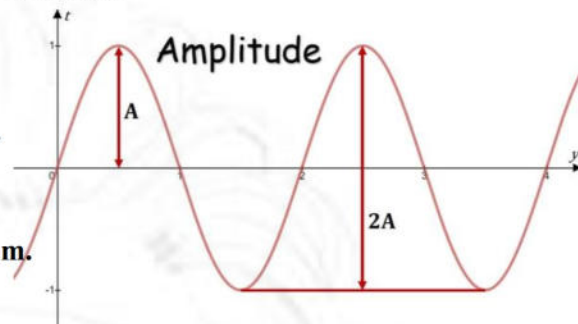
- The **maximum displacement** from the equilibrium position.
- Symbol:** A
- Energy of wave is energy of oscillating particles of medium.**

$$\text{Energy } E = \frac{1}{2} kA^2$$

- Waves with greater amplitudes transfer more energy.
- For waves that move at the same speed, the rate at which energy is transferred power, is proportional to the square of the amplitude.

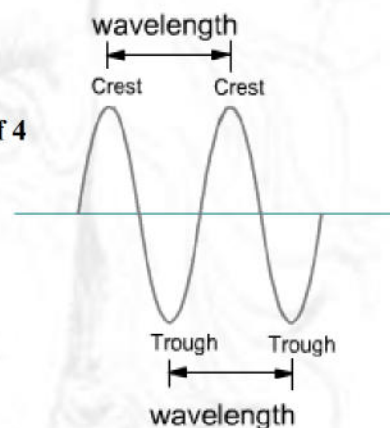
$$\frac{\text{Energy}}{\text{time}} \propto A^2$$

- Doubling the amplitude of a wave increase**
- the amount of energy that wave transfers each second by a factor of 4**



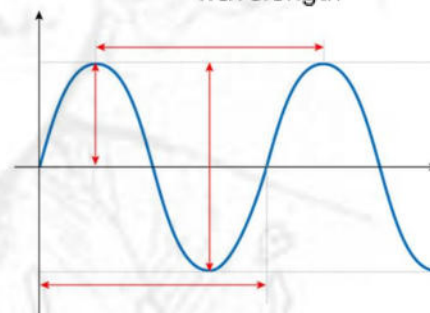
2. Wavelength (λ)

- The **shortest distance** between repeating points in a wave pattern.
- Symbol:** λ
- Unit:** meters (m)
- Crests are spaced by one wavelength.**
- Each trough is also one wavelength from the next.**



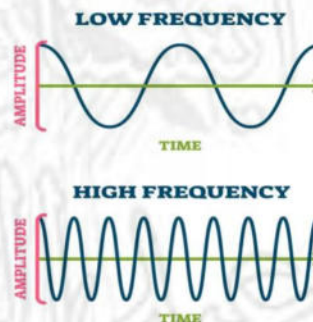
3. Period (T)

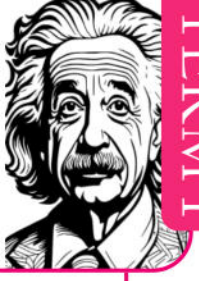
- Time taken by a particle to complete **one full cycle**.
- Measured from:** displacement vs. time graph.
- Symbol:** T
- Unit:** seconds (s)



4. Frequency (f)

- Number of **oscillations per second**.
- Symbol:** f
- Unit:** Hertz (Hz)
- Formula:** $f = \frac{1}{T}$



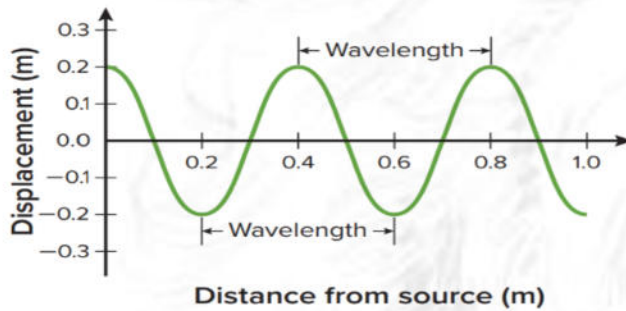
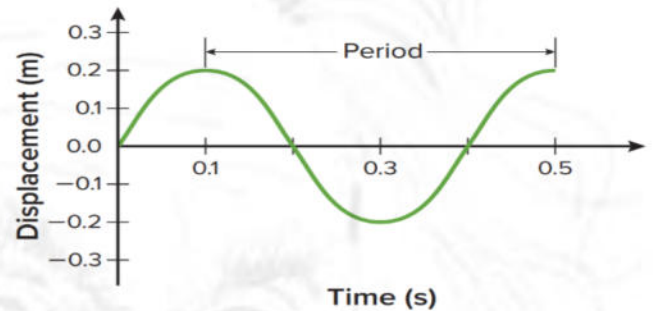
**Wave Relationship**

- The fundamental wave equation:

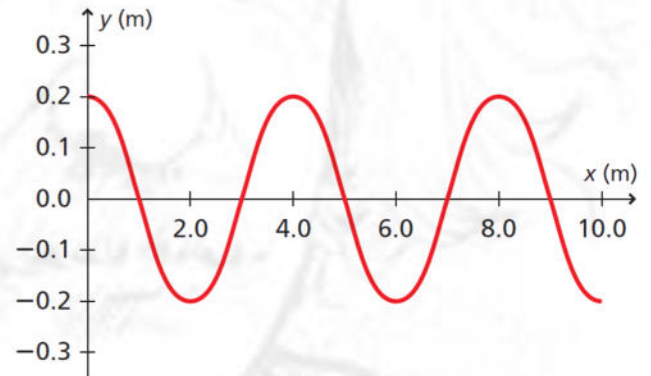
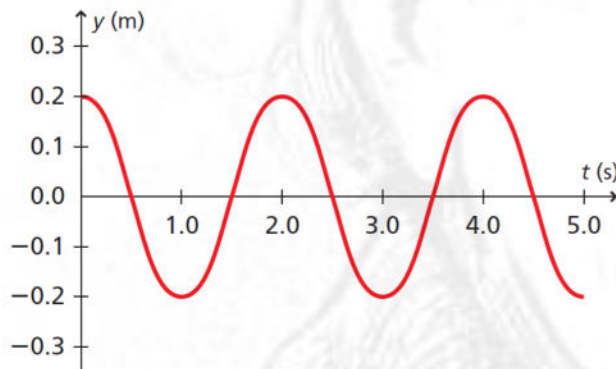
$$v = \lambda f$$

Where:

- v : wave speed - λ : wavelength - f : frequency

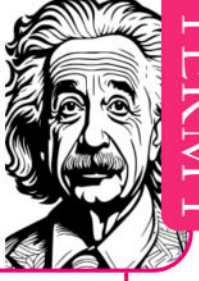
Displacement v. Distance from Source**Displacement v. Time**

- The two graphs given below represent the same wave.



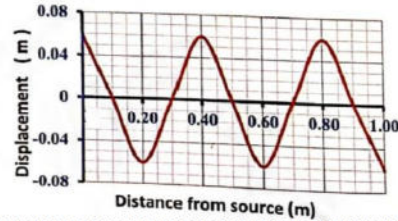
Find the following using the above graphs.

- The Amplitude of wave
- The period of wave
- The frequency of waves
- The wavelength of wave
- The Speed of wave



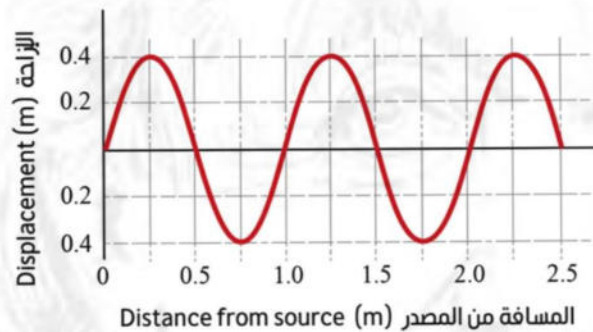
2. The graph shows the propagation of a wave in a rope caused by a source. Its frequency is 25 Hz.

- A. What is the **amplitude** of the wave?
- B. Calculate the **speed** of the wave in the rope.



A. Transverse waves propagate in a horizontally stretched rope, as shown in the curve (displacement of rope parts vs. distance of each part from the source of vibration).

If the wave travels a distance of **2.5 m** in **0.5 s**, and based on the curve, answer the following:



a) Fill in the following table with the appropriate answer:

Wave Property	Number of Waves	Wavelength	Amplitude
Answer			

b) Calculate the transverse speed of the rope wave.

23- The graph shows a wave propagation in a rope produced by a source. Its frequency is (25HZ)

-What is the wavelength of the wave?

- Calculate the speed of the wave in a rope.

