

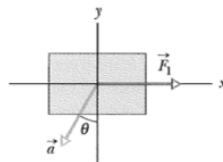


**The University of Zambia
School of Natural Sciences
Department of Physics**

PHY1015 Tutorial Sheet 05

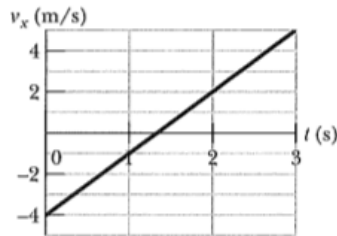
Newton's Laws

1. Two horizontal forces act on a 2.0 kg chopping block that can slide over a frictionless kitchen counter, which lies in an xy plane. One force is $F_1 = (3.0 \text{ N})\hat{i} + (4.0 \text{ N})\hat{j}$. Find the acceleration of the chopping block in unit-vector notation when the other force is (a) $F_2 = (-3.0 \text{ N})\hat{i} + (-4.0 \text{ N})\hat{j}$, (b) $F_2 = (-3.0 \text{ N})\hat{i} + (4.0 \text{ N})\hat{j}$, and (c) $F_2 = (3.0 \text{ N})\hat{i} + (-4.0 \text{ N})\hat{j}$.
2. If the 1 kg standard body has an acceleration of 2.00 m/s at 20.0° to the positive direction of an x axis, what are (a) the x component and (b) the y component of the net force acting on the body, and (c) what is the net force in unit-vector notation?
3. There are two forces on a 2.00 kg box of COVID-19 vaccines in the overhead view of the figure shown below. For $F_1 = 20.0 \text{ N}$, $a = 12.0 \text{ m/s}^2$, and $\theta = 30.0^\circ$, find the second force (a) in unit-vector notation and as (b) a magnitude and (c) an angle relative to the positive direction of the x axis.

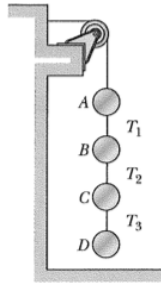


4. A 2.00 kg infant is subjected to three forces that give it an acceleration $\vec{a} = -(8.00 \text{ m/s}^2)\hat{i} + (6.00 \text{ m/s}^2)\hat{j}$. If two of the three forces are $\vec{F}_1 = (30.0 \text{ N})\hat{i} + (16.0 \text{ N})\hat{j}$ and $\vec{F}_2 = -(12.0 \text{ N})\hat{i} + (8.00 \text{ N})\hat{j}$, find the third force acting on the infant.
5. A 0.150 kg particle moves along an x axis according to $x(t) = -13.00 + 2.00t + 4.00t^2 - 3.00t^3$, with x in meters and t in seconds. In unit-vector notation, what is the net force acting on the particle at $t = 3.40 \text{ s}$?
6. A 2.0 kg wheelchair moves along an x axis, being propelled by a variable force directed along that axis. Its position is given by $x = 3.0 \text{ m} + (4.0 \text{ m/s})t + ct^2 - (2.0 \text{ m/s}^3)t^3$, with x in meters and t in seconds. The factor c is a constant. At $t = 3.0 \text{ s}$, the force on the wheelchair has a magnitude of 36 N and is in the negative direction of the axis. What is c ?

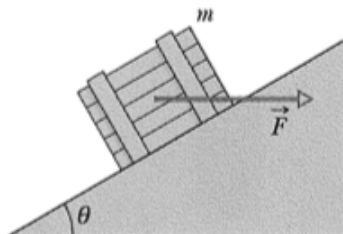
7. Two horizontal forces \vec{F}_1 and \vec{F}_2 act on a 4.0 kg disk that slides over frictionless ice, on which an xy coordinate system is laid out. Force \vec{F}_1 is in the positive direction of the x axis and has a magnitude of 7.0 N. Force \vec{F}_2 has a magnitude of 9.0 N. The figure below gives the x component v_x of the velocity of the disk as a function of time t during the sliding. What is the angle between the constant directions of forces \vec{F}_1 and \vec{F}_2 ?



8. The figure below shows an arrangement in which four disks are suspended by cords. The longer, top cord loops over a frictionless pulley and pulls with a force of magnitude 98 N on the wall to which it is attached. The tensions in the three shorter cords are $T_1 = 58.8$ N, $T_2 = 49.0$ N, and $T_3 = 9.8$ N. What are the masses of (a) disk A, (b) disk B, (c) disk C, and (d) disk D?



9. A block with a weight of 3.0 N is at rest on a horizontal surface. A 1.0 N upward force is applied to the block by means of an attached vertical string. What are the (a) magnitude and (b) direction of the force of the block on the horizontal surface?
10. In the figure shown below, a crate of mass $m = 100$ kg is pushed at constant speed up a frictionless ramp ($\theta = 30.0^\circ$) by a horizontal force \vec{F} .



What are the magnitudes of (a) \vec{F} and (b) the force on the crate from the ramp?