1ST LEVEL DEGREE IN BIOTECHNOLOGIES

Module: GENERAL PHYSICS

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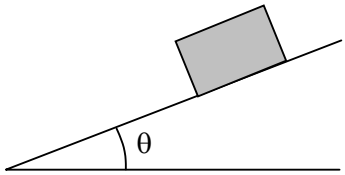
Problems

1) Given the two vectors $\vec{a} = -3\hat{i} + 4\hat{j}$ e $\vec{b} = 3\hat{i} - 4\hat{j}$, calculate the modulus of both, their sum $\vec{s} = \vec{a} + \vec{b}$ and their difference $\vec{d} = \vec{a} - \vec{b}$.

2) In stage 10 of the 2000 Tour de France, Lance Armstrong captured the overall lead with an impressive climb to the finish line at Lourdes-Hautacam, elevation 1560 m. Armstrong made the 13.5 km climb in 36 minutes.
a) Calculate his average speed.
b) If the altitude at the base of the climb was 493.5 m, what was his average vertical velocity?

3) In the figure, a block has been placed on an inclined plane and the slope angle θ of the plane is increased until the block begins to slide down the plane. The static friction coefficient is μ_s. Calculate the angle θ.

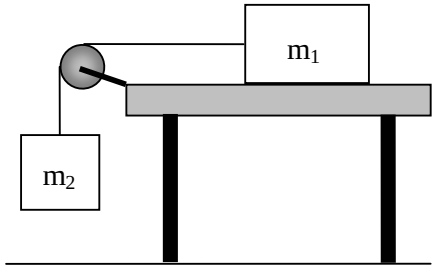


4) In the same figure as the above problem, once that the block has begun to slide, the angle θ is adjusted until the block slides down at a constant speed. The kinetic friction coefficient is μ_k. Find the new angle θ.

5) An astronaut wants to go from the shuttle to a disabled satellite 1000m away to perform a repair. His MMU (Manned Maneuver Unit) can provide 2.0m/s2 acceleration in any direction. If he accelerates from rest at the maximum rate for the first 100 meters what should his rate of acceleration be so that he reaches the satellite with exactly zero velocity?

6) An object of mass m = 100 g is at rest. A net force of 0.2 N is applied for 10 s.
a) What is the final velocity?
b) How far will the object have moved in the 10 s interval?

7) A block of mass m_1 = 32.0 kg rests on a horizontal frictionless table top. This block is connected to a second block of mass m_2 = 25.0 kg hanging off the edge of the table by a rope that passes over a light frictionless pulley. Initially a peg holds the first block in place.
a) What is the tension in the rope before the peg is removed ?
b) What is the acceleration of either block after the peg is removed ? (But before the hanging block hits the floor.)
c) What is the tension in the rope after the peg is removed and the blocks are accelerating?



8) In a car accident, a car, of mass 800 kg, crashes into the rear of a truck. While trying to stop, the car skids (with the wheels blocked) leaving on the road a trace 50 m long. The road is asphalt and the coefficient of kinetic drag is 0.6. If the speed limit on that road is 70 km per hour, calculate if the car's driver was respecting the speed limit prior to the accident.

SOLUTIONS

1) 5; 5; $\vec{s} = 0\hat{i} + 0\hat{j}$; $\vec{d} = -6\hat{i} + 8\hat{j}$

2) a) 6.25 m/s; b) 0.49 m/s

3) $\theta = \arctan(\mu_s)$

4) $\theta = \arctan(\mu_k)$

5) $0.011 m/s^2$

6) a) 10 m/s; b) 100 m

7) a) 245 N, b) 4.3 m/s^2; c) 133.5 N

8) Yes