

General Physics (Phys-1011)

Worksheet One

Department of Physics

June 2022

1. In what condition does the sum of two vectors having unequal magnitude be zero? Explain.
2. Under what circumstance would a non-zero vector lying in the x-y plane have its x and y components equal in magnitude?
3. The magnitude of two vectors \vec{A} and \vec{B} are $\vec{A} = 5$ units and $\vec{B} = 3$ units. Find the largest magnitude and smallest values possible for the magnitude of the resultant vector $\vec{R} = \vec{A} + \vec{B}$.
4. When $\vec{B} + \vec{A} = 5\hat{i} - \hat{j}$, and $\vec{B} - \vec{A} = \hat{i} - 7\hat{j}$. What is the magnitude and direction of \vec{A} ?
5. If $\vec{A} - \vec{B} = 2\vec{C}$, $\vec{A} + \vec{B} = 4\vec{C}$, and $\vec{C} = 3\hat{i} + 4\hat{j}$, then what are the vectors \vec{a} and \vec{b}
6. If the cross product and the sum of two vector are $5\hat{i} + 7\hat{j} - 15\hat{k}$ and $7\hat{i} - 2\hat{j} + 5\hat{k}$, respectively. Then find the two vectors.
7. Describe a unit vector located in the yz plane and perpendicular to the velocity vector $v = 3\hat{i} - 3\hat{j} + 5\hat{k}$
8. A particle starts from the origin at $t = 0$ with an initial velocity having an x component of 20 m/s and a y component of -15 m/s. The particle moves in the xy plane with an x component of acceleration only, given by $a_x = 4m/s^2$.
 - a. Determine the components of the velocity vector at any time and the total velocity vector at any time?
 - b. Calculate the velocity and speed of the particle at $t = 5s$?
 - c. Determine the x and y coordinates of the particle at any time t and the position vector at this time?
9. Two objects begin a free fall from the same height 1 second apart. How long after the first begin to fall will the two objects be 10m apart?
10. An airplane accelerates down a runway at $3.20m/s^2$ for $32.8s$ until it is finally lifts off the ground. Determine the distance traveled before takeoff.

11. A girl walks to her school at a distance of 2km with a speed of 2km/hr and comes back with a speed of 3km/hr . Then, what is the average speed for the round trip?
12. The range of cannon ball fired horizontally from a laboratory table is equal to $\frac{8}{3}$ times the height of the table. Calculate the direction of the velocity vector of the projectile as it strikes the ground.
13. Two projectiles are thrown with the same initial velocity, one at an angle θ and the other at an angle of $90 - \theta$.
 - a. Can both projectiles strike the ground at the same distance from the projection point?
 - b. Can both projectiles be in air for the same time interval?
14. A rescue helicopter wants to drop a package of supplies to isolated mountain climbers on a rocky ridge 200m below. If the helicopter is traveling horizontally with a speed of 70m/s (250km/h).
 - a. How far in advance of the recipients (horizontal distance) must the package be dropped (fig 1 a)?
 - b. Suppose, instead, that the helicopter releases the package a horizontal distance of 400m in advance of the mountain climbers. What vertical velocity should the package be given (up or down) so that it arrives precisely at the climbers' position (fig. 1 b)?
 - c. With what speed does the package land in the latter case?

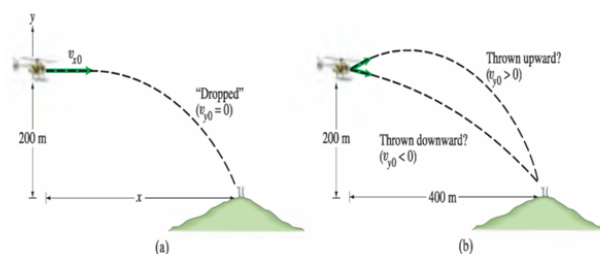


Figure 1:

15. If a projectile thrown vertically upward rises to a height of 500.0m , what is the range and the velocity it was thrown?
16. What is the maximum speed at which a 1500-kg car can round a curve on a flat road if the radius of the curve is 90 m and the coefficient of static friction is 0.50 ? Is it necessary to know the mass of the car to solve this problem?
17. Two bodies of mass 60 kg and 30 kg move in the same direction along straight line with velocity 40 cm s^{-1} and 30 cm s^{-1} respectively suffer one dimensional elastic collision. Find their velocities after collision.

18. Two blocks of mass 3.50 kg and 8.00 kg are connected by a mass less string that passes over a frictionless pulley (the fig2). The inclines are frictionless. Find
- The magnitude of the acceleration of each block and
 - The tension in the string.

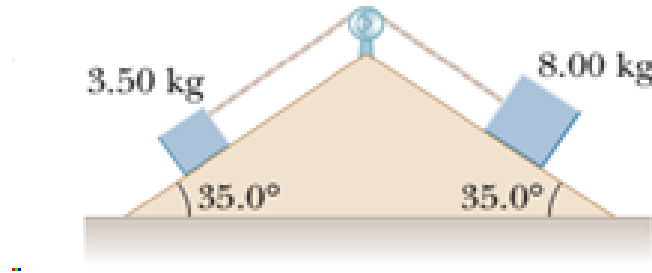


Figure 2:

19. An object of mass m moves with velocity v toward a stationary object of the same mass. After their impact, the objects move off in the directions shown in the following diagram (Fig 3):
- If K_{1i} denotes the kinetic energy of Object 1 before collision, what is the kinetic energy of this object after collision? (Write your answer in terms of K_{1i} and θ_1 .)
 - What is the kinetic energy of Object 2 after the collision? (Write your answer in terms of K_{1i} and θ_1 .)
 - What is the relationship between θ_1 and θ_2 ?

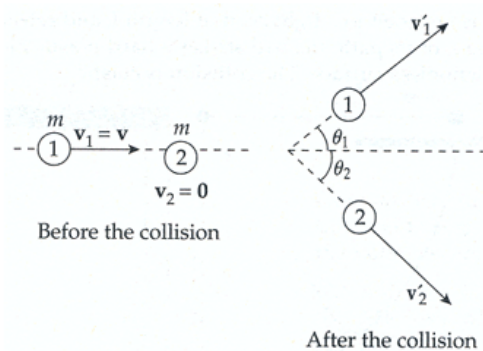


Figure 3:

20. A block slides down a curved frictionless track and then up an inclined plane as in the figure (fig4). The coefficient of kinetic friction between block and incline is μ_k . Use energy methods to show that the maximum height reached by the block is $y_{max} = \frac{h}{1 + \mu_k \cot \theta}$

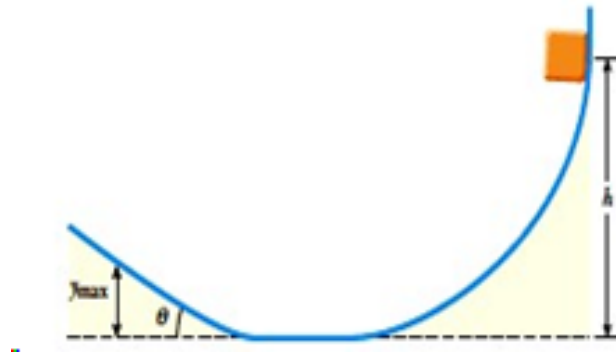


Figure 4:

21. A body of mass 2.0 kg makes an elastic collision with another body at rest and continues to move in the original direction but with one-fourth of its original speed.
 - a. What is the mass of the other body?
 - b. What is the speed of the two-body center of mass if the initial speed of the 2.0 kg body was 4.0 m/s ?
22. The asteroid pallas has an orbital period of 4.62 years and an orbital eccentricity of 0.23. Find the semi-major axis of its orbit. (mass of the sun $= 1.99 \times 10^{30}\text{ kg}$)
23. A bead slides without friction around a looptheloo (see figure 5). The bead is released from rest at a height $h = 3.30R$.
 - a. What is its speed at point A (Use the following as necessary: the acceleration due to gravity g , and R)?
 - b. How large is the normal force on the bead at point A if its mass is 5.20 grams ?

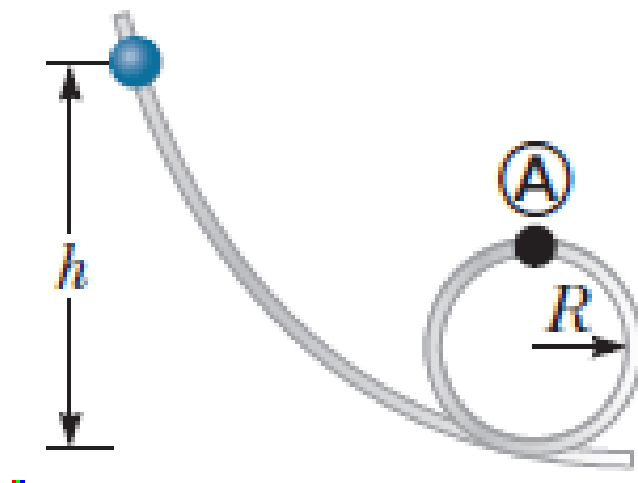


Figure 5: