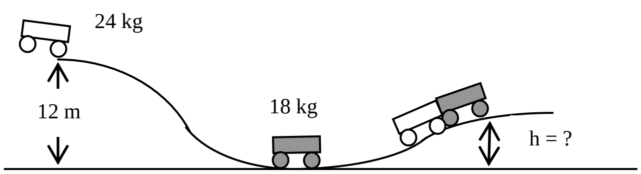
Physics 12

## <u>Momentum Review Questions</u>

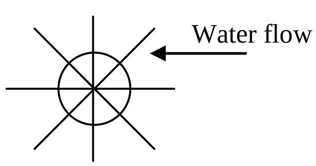
1. A 0.25 g fly is travelling at 12 m/s. What is its momentum?
2. A 112 kg football player is running with a speed of 4.8 m/s.
    a. What is the player's momentum?
    b. What impulse must a tackler impart to the player in part (a) to bring him to a stop?
    c. If the tackle is completed in 1.2 s, what average force must the tackler have exerted on the other player?
3. An astronaut is doing a "space walk" outside the space station with no cable attached between him and the station. *(Actually there is one but you can't see it because you have no **cablevision**.)* His small manoeuvring rocket pack suddenly quits working and he is now stranded outside the space station with his $50000 camera in his hands. What should he do to get back to the space station before his oxygen runs out?

4. A railway car of mass 60000 kg is coasting along at 7.0 m/s due east. Suddenly a 20000 kg load of coal is dumped into the car. What is the resultant speed of the car?
5. A 1200 kg car travelling at 33 m/s due East collides head-on with an 1800 kg car travelling at 17 m/s in the opposite direction. The two cars stick together after the collision. What is the resultant velocity of the combined masses immediately after the collision?
6. A 24 kg car is initially held at the top of a 12 m high hill. The car is released and allowed to move down the hill and collide with stationary 18 kg car at the bottom of the hill. The two cars stick together (Inelastic collision) and begin to move off up another hill. What maximum height, h, up this second hill do the combined masses reach?

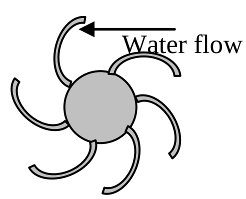



7. In the early days of water wheels the wheel was simply placed in the river and the flow of the river turned the wheel.
    a. Then one ingenious person allowed the water to flow over top of the wheel as show below. Explain why this would be more efficient.
    b. In modern water turbines used to generate electricity the turbine blades are curved as shown below instead of being straight. Explain using momentum why this is a more efficient design.

More efficient water wheel

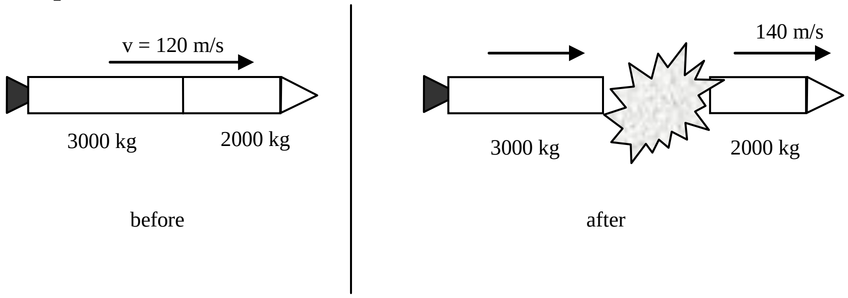



Old in-efficient turbine design

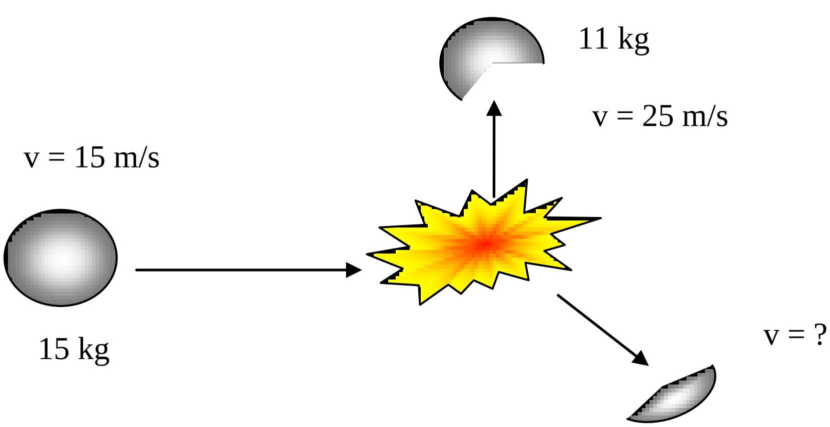



More modern efficient turbine design

8. A 2000 kg car travelling at 15 m/s rear ends another car of mass 1000 kg which was moving at 6.0 m/s in the same direction as the first car. What is their common velocity after the collision if they lock together during the impact?
9. A 5000 kg space vehicle consists of a 3000 kg main capsule and a 2000 kg probe. The space vehicle is travelling 120 m/s when an explosion occurs between the capsule and the probe. As a result, the probe moves forward at 140 m/s, as shown below.

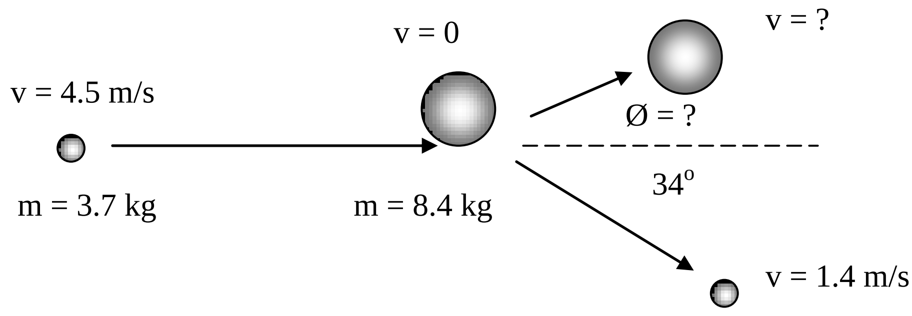



    a. What is the speed pf the main capsule after the explosion?
    b. Define impulse and briefly explain why the impulse on the probe is equal in magnitude to the impulse on the main capsule.
    c. What is the magnitude of the impulse given to the probe?
10. A 1500000 kg railcar contains a cannon that shoots a 150 kg shell with an initial speed of 256 m/s at angle of $33^o$ above the horizontal. With what initial speed does the railcar move off at?
*11.* An object is traveling along at some constant velocity and is then hit with an impulse of 12 N•s due east. As a result of this impulse the object obtains a final momentum of 42 kg•m/s in the direction of $43^o$ N of E. What was the magnitude of the momentum of the object before the impulse was applied? (*Hint: Draw a vector diagram of the momentum.)*
12. A 3500 kg car travelling at 16 m/s dues south collides and sticks to (*inelastic collision*) a second car of mass 2200 kg traveling at 12 m/s due west. With what initial velocity (magnitude and direction) will the combined mass move at?
13. A toy car moving due North at 12 m/s strikes a stationary toy car of equal mass. The first car moves off after the collision at an angle of $30^o$ East of North with a speed of 8.0 m/s. What is the velocity (magnitude and direction) of the struck car after the collision?
14. A 15 kg object moving initially East at 15 m/s explodes into two unequal fragments as shown. After the explosion an 11 kg fragment moves North at 25 m/s.

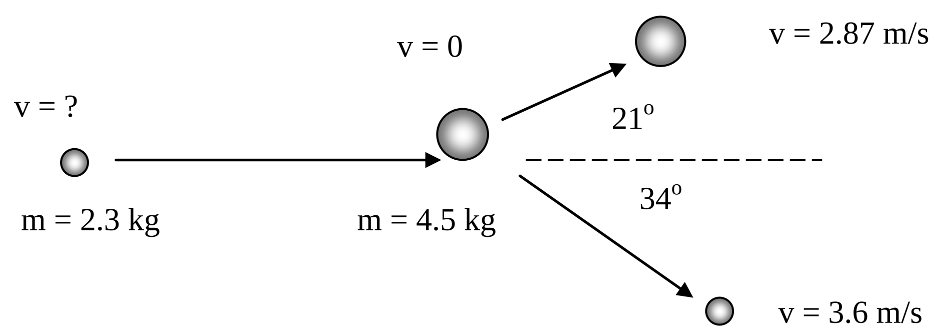



What is the velocity (magnitude and direction) of the remaining piece after the collision?

15. A 3.7 kg steel ball travelling at 4.5 m/s due east collides obliquely with an 8.4 kg aluminium ball initially at rest. The steel ball after the collision travels at 1.4 m/s at an angle of 34o South of East. What is the velocity (magnitude and direction) of the aluminium ball?




16. A 2.3 kg steel ball collides with a stationary 4.5 kg steel ball. As a result of this collision the two balls travel as shown.




What was the original velocity of the 2.3 kg ball?

Answers:

1. 0.0030 kgm/s  2. a) 538 kgm/s  b) -538 Ns  c) -448 N
4. 5.3 m/s  5. 3.0 m/s  6. 7.8 m  8. 12 m/s (in same direction)
9. a) 107 m/s  c) 40000 Ns  10. 0.0215 m/s  11. 34 kgm/s
12. 10.9 m/s at $65^{o}$ S of W  13.6.5 m/s at $38^{o}$ W of N  14.89 m/s at $51^{o}$ S of E
15.1.5 m/s at $13^{o}$ N of E  16. 8.22 m/s due East