

6. A river flows due east at 1.5 m/s. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of 10 m/s due north relative to the water. Draw a vector diagram and find the resultant velocity of the boat (magnitude and direction - include angle). (*Ans. 10.1 m/s at 8.5° East of North or 81.5° N of East*)
7. A rock is thrown horizontally from a 100m high cliff. It strikes level ground 90m from the base of the cliff. At what speed was it thrown? (19.9m/s)
8. A scared kangaroo once cleared a fence by jumping with a speed of 8.42m/s at an angle of 55.2° with respect to the ground.
- If the jump lasted 1.4s, how high was the fence? (2.4m)
 - What was the kangaroo's horizontal displacement? (6.7m)

Newton's Laws and Forces

9. Andrew pulls a 0.75 kg toy car with a horizontal applied force of 4.3 N. The car is moving with a constant velocity.

a. Draw a free-body diagram including F_A , F_f , F_g , and F_N .

b. Calculate the force of friction. (*Ans. 4.3 N*)

c. Calculate the coefficient of friction between the car tires and the floor. Is this the coefficient of static or kinetic friction? (*Ans. 0.58*)

d. If Andrew pulls the car for 2.3 m, how much work does he do on the car? (*Ans. 9.9J*)

10. Amber pushes a 1.35 kg book across the desk accelerating it at a constant rate. The coefficient of friction between the book and the desk is 0.088. If she is applying a constant horizontal force of 6.40 N,

a. Draw a free-body diagram and calculate the force of friction. (*Ans. 1.17 N*)

b. Calculate the horizontal net force. (Hint: Write an equation for the net horizontal force on the book using the force of friction and the horizontal applied force.) (*Ans. 5.23 N*)

c. Calculate the horizontal acceleration of the book. (*Ans. 3.9 m/s²*)

Circular Motion and Universal Gravitation

11. A 5kg dog is attached to a leash that is 6m long. He runs in circles chasing a squirrel while his owner applies a force of 15N.

a. What is the speed of the dog? (*Ans: 4.24 m/s*)

b. What is the dog's period? (*Ans: 8.9 s*)

c. What is the frequency of the dog? (*Ans: 0.11 Hz or 0.11 rev/s*)

12. A 20 kg car travels at 18 m/s around a curve with radius 100m. What minimum coefficient of friction between the tires and road will allow the car to round the curve safely? (*Ans: 0.33*)

13. The gravitational force between Dan and Carl is 4×10^{-7} N. If Dan has a mass of 45kg and Carl has a mass of 60 kg then how far apart are Dan and Carl? (*Ans: 0.67m*)

14. Planet X has a mass of 3×10^{26} kg and radius of 5.5×10^7 m.

a. What is the acceleration due to gravity on planet X? (*Ans: 6.61 m/s^2*)

b. What is the orbital velocity of a moon 7.5×10^8 m away from planet X? (*Ans: 5165 m/s*)

c. What is the orbital period of the moon? (*Ans: 912370 s*)