Physics 122

Exam Review: Problems

(May 2019)

Resultant

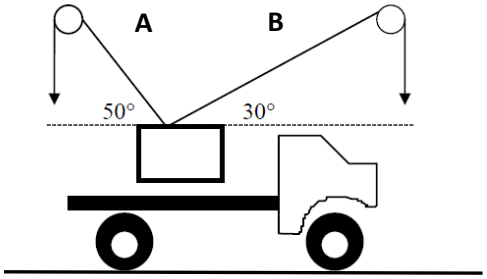
Three forces act simultaneously on point P. The first force is 87.4 N west. The second force is 51.9 N north. The third force is 45.8 N, 32.5° S of E. Find the resultant force. (**55.9 N, 29.2° N of W**)

Force Problem – Type I: Push/Pull

The handle of a 22 kg lawnmower makes a 35° angle with the horizontal. If a force of 342 N is required to push the mower at a constant velocity, what is the coefficient of friction between the lawnmower and the ground? Assume the force is applied along the handle. (**0.68**)

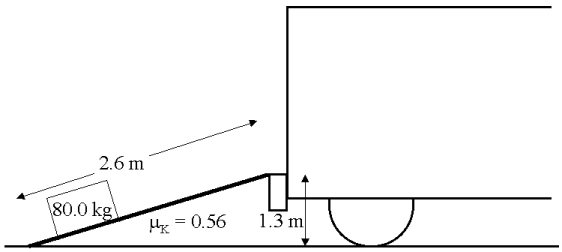
Suspended Object

What must the tension in each cable be in the diagram in order to support the cargo (m = 102 kg) in static equilibrium? (**8.8×10^2 N, 50° N of W and 6.5×10^2 N, 30° N of E**)



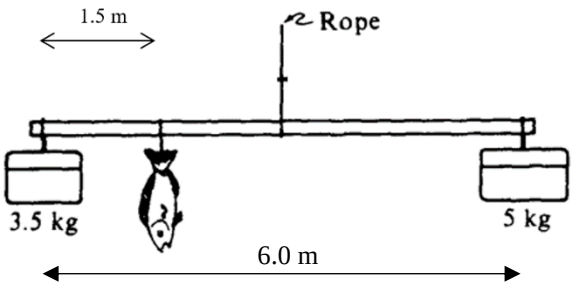
Force Problem – Type III: Inclined Plane

Crates of mass 80.0 kg are loaded onto a truck, a vertical lift of 1.3 m. To make the work easier, a 2.6 m long ramp is used and the crates are pushed along the ramp from the ground onto the truck. The coefficient of friction between the crates and the ramp is 0.56. Determine the minimum force required to push a crate along the ramp. **(7.7×10^2 N, up the ramp)**



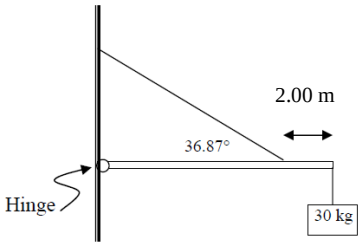
Static Torque #1

To weigh a fish, a person hangs a tackle box of mass 3.5 kg and a cooler of mass 5.0 kg from the ends of a 6.0 m uniform rigid pole that is suspended by a rope attached to its center. The system balances when the fish hangs at as shown. What is the mass of the fish? (**3.0 kg**)



Static Torque #2

Find the tension in the cable. The bar has a mass of 20.0 kg and it is 10 m long.
(**8.2 x 10^2 N, 37º N of W**)



Relative Velocity

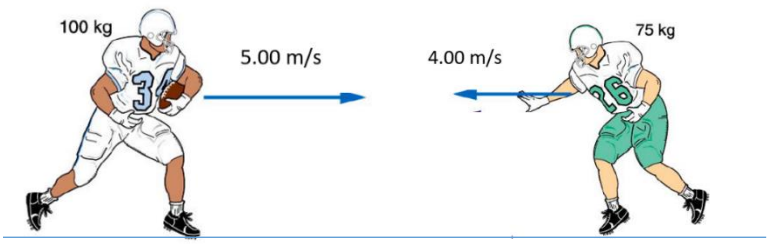
A woman can row a boat 1.79 m/s in still water. She decides to row her boat in a river where the velocity of the current is 0.894 m/s south. Imagine she starts on the western side of the river.

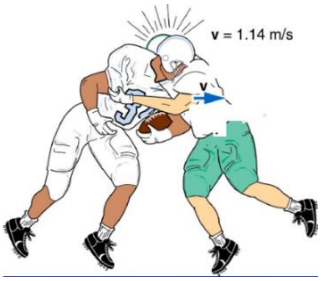
a) In what direction should she head if she wants to reach a point directly opposite her starting point? Draw a labelled sketch showing the three velocities involved. (**30.0º N of E**)

b) If the river is 6.44 km wide, how long will it take her to cross the river? (**4.15 x 10^3 s**)

1D Collision

A 100-kg fullback moving straight downfield collides with a 75-kg defensive back. The defensive back hangs on to the fullback, and the two players move together after the collision. What type of collision occurred? Justify your answer mathematically. (**inelastic, ΔE_k = -1.3 x 10^3 J**)





2D Explosion

A 0.042 kg firecracker is at rest when it explodes into three pieces. The first, with a mass 0.012 kg, moves east at 35 m/s. The second, with mass 0.021 kg, moves south at 29 m/s. Find the velocity of the third piece.
(**82 m/s, 55º N of W**)

2D Collision

A 1.3 kg object is moving east at 25 m/s. When the first object strikes a second, stationary 4.8 kg object, the 1.3 kg object moves at 9.0 m/s in a direction 53º north of west. What was the final velocity of the 4.8 kg object?
(**8.5 m/s, 13º S of E**)

Circular Motion

Brewster applies a force of 10.8 N to one end of a cord to keep a bag of rubber frogs tied to the other end moving with an acceleration of 1.33 m/s^2 in horizontal circle of radius 3.0 m.

a) What is the mass of the bag of rubber frogs? (**8.1 kg**)

b) What is the frequency of the circling bag of rubber frogs? (**0.11 Hz**)

Unbanked/Banked Curves

A car weighing 4000 N travels around a Dead Man's Curve (section of a road that has claimed lives because of numerous traffic accidents). If the maximum speed at which the car can safely travel around the curve is 73.1 km/h and the coefficient of friction between the tires and the highway is 0.70, what is the radius of the curve? (**60 m**)

Universal Law of Gravitation

The gravitational force between two electrons is 5.54×10^{-71} N when they are 100 cm apart. What is the mass of an electron? If you know the mass of an electron, you can state it, but you must justify your answer mathematically to obtain full value. (**9.11×10^{-31} kg**)

Orbital Period, Speed and Acceleration due to Gravity

The starship Enterprise discovers a small moon orbiting an unknown planet at a distance of 3.6×10^5 km with a period of 21 days.

a) What is the mass of the planet? (**8.5×10^{24} kg**)
b) If the starship Enterprise establishes a stable orbital radius of 8.0×10^7 m around the planet, what is the Enterprise's orbital speed? (**2.7×10^3 m/s**)
c) If the weight of the starship Enterprise at its location in (b) is 2.85×10^8 N, what is the mass of the Enterprise? (**3.2×10^9 kg**)

SHM

A 450 g mass on a spring is oscillating at 1.2 Hz. The total energy of the oscillation is 0.51 J. What is the maximum displacement of the mass from its equilibrium position? (**0.20 m**)

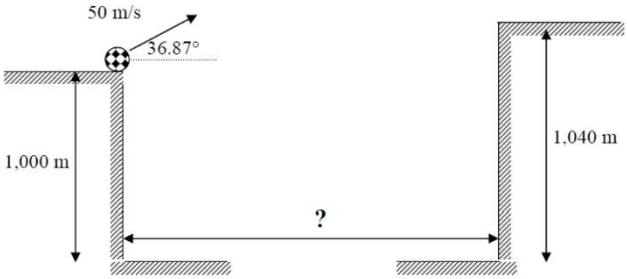
Projectile - Horizontal

An eagle is flying horizontally at a speed of 3.00 m/s when the fish in her talons wiggles loose and falls into the lake 5.00 m below.

a) Calculate the velocity of the fish when it is 3.00 m above the lake. (**6.94 m/s, 64.4° below the horizontal**)
b) How far forward did the fish travel after escaping the eagle? (**3.03 m**)

Projectile – Fired at an Angle

What is the distance between the two cliffs if the projectile is to hit the top edge of the right-hand cliff? (**No trajectory is given so two answers are possible: at t = 4.16 s, 1.7×10^2 m and at t = 196 s, 78 m**)



Coulomb's Law

A distance of 25 cm separates two neutral spheres. If 3.0×10^{13} electrons are removed from one sphere and placed on the other

a) what are the signs and magnitudes, in µC, on the spheres once the electrons have been transferred? (**+4.8 µC, -4.8 µC**)
b) what is the magnitude of the force that exists between the spheres? (**3.3 N**)

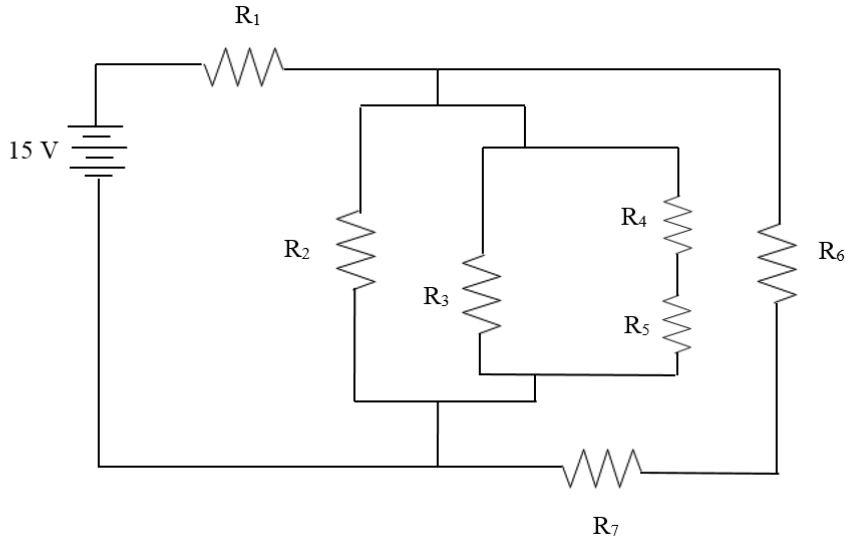
Electric Field Intensity

An electric field points due west with a magnitude of 2.95 x 10^3 N/C at a particular location. If a charge of -3.11 x 10^{-6} C is placed at this location, what will be the magnitude and the direction of the electric force it experiences? Include a labelled diagram showing the source charge, test charge, direction of electric field and direction of the electric force. (**9.17 x 10^{-3} N, east; negative source charge, negative test charge, E is west**)

Electric Circuit

Consider the circuit below. Complete the VIR chart for the circuit assuming R_1 = 1.0 Ω, R_2 = 2.0 Ω, R_3 = 3.0 Ω etc. Record all calculated values to three digits after the decimal point.

R_1



	V (V)	I (A)	R (Ω)
R_1	**7.580**	**7.580**	1.0
R_2	**7.420**	**3.710**	2.0
R_3	**7.420**	**2.473**	3.0
R_4	**3.300**	**0.825**	4.0
R_5	**4.125**	**0.825**	5.0
R_6	**3.432**	**0.572**	6.0
R_7	**4.004**	**0.572**	7.0
Total	15	**7.580**	**1.979**