Physics H.W

Problem 1.

A train covers 60 miles between 2 p.m. and 4 p.m. How fast was it going at 3 p.m.?

Problem 2.

Is it possible that the car could have accelerated to 55mph within 268 meters if the car can only accelerate from 0 to 60 mph in 15 seconds?

Problem 3.

A car travels up a hill at a constant speed of 37 km/h and returns down the hill at a constant speed of 66 km/h. Calculate the average speed for the whole trip.

Problem 4.

An archer shoots an arrow with a velocity of 30 m/s at an angle of 20 degrees with respect to the horizontal. An assistant standing on the level ground 30 m downrange from the launch point throws an apple straight up with the minimum initial speed necessary to meet the path of the arrow. What is the initial speed of the apple and at what time after the arrow is launched should the apple be thrown so that the arrow hits the apple?

Problem 5.

A box sits on a horizontal wooden board. The coefficient of static friction between the box and the board is 0.5. You grab one end of the board and lift it up, keeping the other end of the board on the ground. What is the angle between the board and the horizontal direction when the box begins to slide down the board?

Problem 6.

A 8 kg block is at rest on a horizontal floor. If you push horizontally on the 8 kg block with a force of 20 N, it just starts to move.

(a) What is the coefficient of static friction?

(b) A 10.0 kg block is stacked on top of the 8 kg block. What is the magnitude F of the force, acting horizontally on the 8 kg block as before, that is required to make the two blocks start to move?

Problem 7.

A car is accelerating at $12 m/s^2$. Find its acceleration in km/h^2.

Problem 8.

We drive a distance of 1 km at 16 km/h. Then we drive an additional distance of 1 km at 32 km/h. What is our average speed?

Problem 9.

An airliner reaches its takeoff speed of 163 mph in 36.2 s. What is the magnitude of its average acceleration.

Problem 10.

A car is initially traveling due north at 23 m/s.
(a) Find the velocity of the car after 4 s if its acceleration is $2\,m/s^2$ due north.
(b) Find the velocity of the car after 4 s if its acceleration is instead $2\,m/s^2$ due south.

Problem 1.

If an object weighs 30 N on Earth, how much would it weigh on the moon?

Problem 2.

A child throws a ball downward from a tall building. Note that the ball is thrown, not dropped and disregard air resistance. What is the acceleration of the ball immediately after it leaves the child's hand?

Problem 3.

You are driving along an empty straight road at a constant speed u. At some point you notice a tall wall at a distance D in front of you. Would it require a larger force to (a) continue moving straight and decelerate to a full stop before the wall, or (b) turn left or right to avoid the wall? (to make the calculation easier assume that the turn is done at a constant speed along a circular path).

Problem 4.

How fast should the earth spin in order for a 150 lb human not to be able to walk on the ground?

Problem 5.

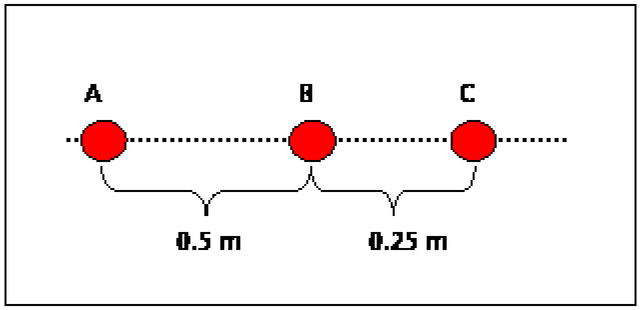
In the film 2001: A Space Odyssey, a wheel like space station achieves artificial gravity by spinning around its axis. If the station had a size of 2 km, how fast should it be spinning for the people inside to feel the same gravitational acceleration as on earth?

Problem 6.

A boy of mass 40 kg wishes to play on pivoted seesaw with his dog of mass 15 kg. When the dog sits at 3 m from the pivot, where must the boy sit if the 6.5 me long board is to be balanced horizontally?

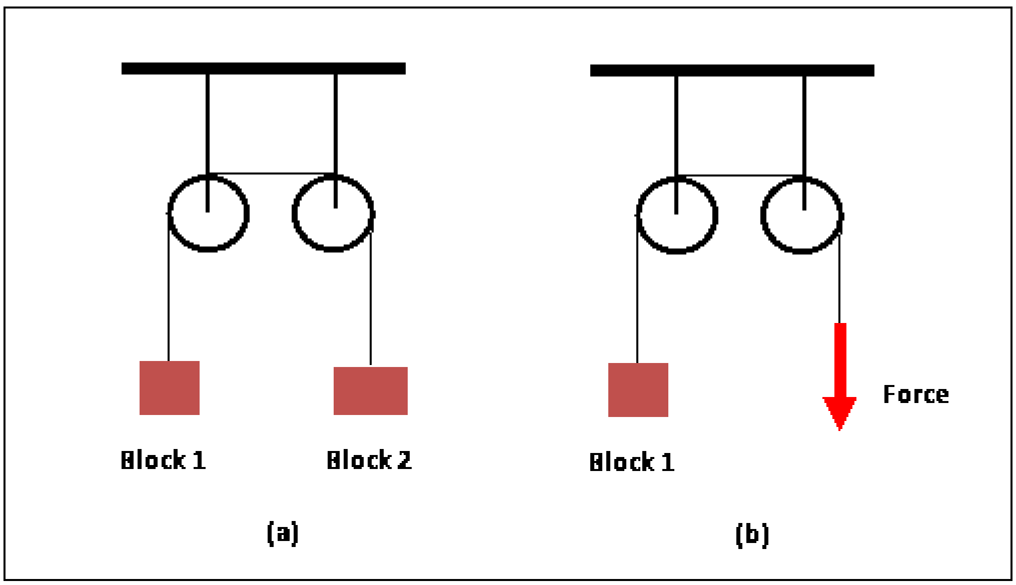
Problem 7.

The drawing shows three particles far away from any other objects and located on a straight line. The masses of these particles are: *partice A* = 400 kg, *particle B* = 500 kg, and *particle C* = 100 kg. Find the magnitude and direction of the net gravitational force acting on each of the three particles (the direction to the right is positive).



Problem 8.

As part *a* of the drawing shows, two blocks are connected by a rope that passes over a set of pulleys. The block 1 has a weight of 400 N, and the block 2 has a weight of 600 N. The rope and the pulleys are massless and there is no friction.

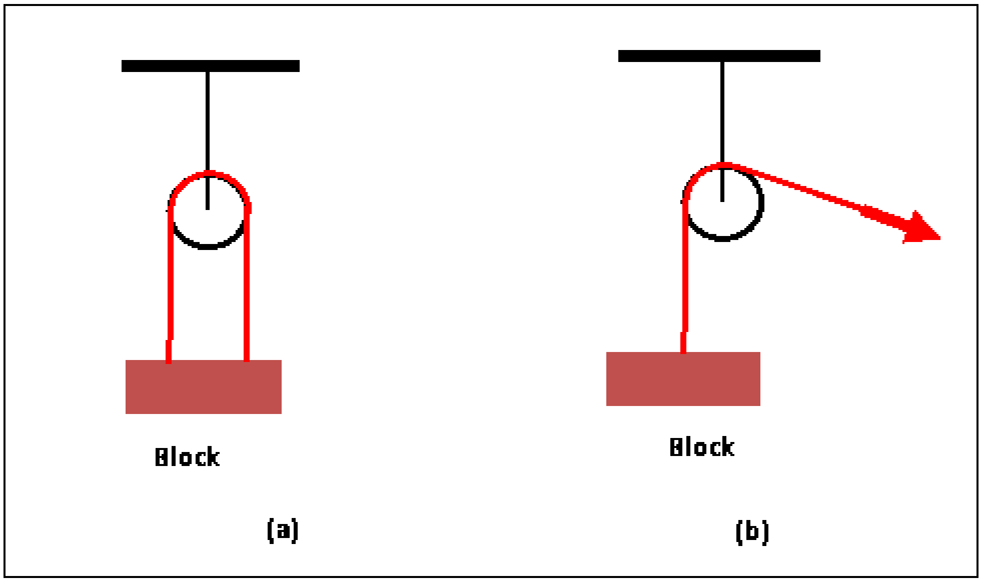


(a) What is the acceleration of the lighter block?

(b) Suppose that the heavier block is removed, and a downward force of 600 N is provided by someone pulling on the rope, as part *b* of the drawing shows. Find the acceleration of the remaining block.

Problem 9.

Part *a* of the drawing shows a block suspended from the pulley; the tension in the rope is 80 N. Part *b* shows the same block being pulled up at a constant velocity. What is the tension in the rope in part *b* ?



Problem 10.

A uniform, solid metal disk of mass 6.0 kg and diameter 2.0 cm hangs in a horizontal plane, supported at its center by a vertical metal wire. You find that it requires a horizontal force of 4 N tangent to the rim of the disk to turn it by 5 degrees, thus twisting the wire. You now remove this force and release the disk from rest.

(a) What is the torsion constant for the metal wire?

(b) Write the equation of motion for twist angle of the disk.

Problem 11.

A box is sliding up an incline that makes an angle of 20 degrees with respect to the horizontal. The coefficient of kinetic friction between the box and the surface of the incline is 0.2. The initial speed of the box at the bottom of the incline is 2 m/s. How far does the box travel along the incline before coming to rest?

Problem 12.

A block weighing 80 N rests on a plane inclined at 30 degrees to the horizontal. The coefficients of static and kinetic friction are 0.2 and 0.1 respectively. What is the minimum magnitude of the force F, parallel to the plane, that will prevent the block from slipping?

Problem 13.

The tallest spot on Earth is Mt. Everest, which is 8857 m above sea level. If the radius of the Earth to sea level is 6369 km, how much does the magnitude of g change between sea level and the top of Mt. Everest?

Problem 14.

The value of g at the surface of the earth is 9.78 N/kg, and on the surface of Venus the magnitude of g is 8.6 N/kg. A cosmonaut has a mass of 60 kg on the surface of the earth. What will her weight be on the surface of Venus?

Problem 15.

A car (m=2000 kg) is parked on a road that rises 20 degrees above the horizontal. What are the magnitudes of (1) the normal force and (2) the static frictional force that the ground exerts on the tires?

Problem 16.

A rocket of mass $5 * 10^4$ kg is in flight. Its thrust is directed at an angle of 60 degrees above the horizontal and has a magnitude of $7 * 10^5\ N$. Find the magnitude and direction of the rockets acceleration. Give the direction as an angle above the horizontal.

Problem 17.

The speed of a bobsled is increasing because it has an acceleration of $3m/s^2$. At a given instant in time, the forces resisting the motion, including kinetic friction and air resistance, total 500 N. The mass of the bobsled and its riders is 300 kg.

(a) What is the magnitude of the force propelling the bobsled forward?

(b) What is the magnitude of the net force that acts on the bobsled?

Problem 18.

A person in a kayak starts paddling, and it accelerates from 0 to 0.8 miles/hour in a distance of 0.8 km. If the combined mass of the person and the kayak is 80 kg, what is the magnitude of the net force acting on the kayak?

Problem 19.

A dancer is standing on one leg on a drawbridge that is about to open. Before the drawbridge starts to open, it is perfectly level with the ground. The dancer is standing still on one leg. What is the x component (horizontal component) of the friction force?

Problem 20.

A block of mass 5 kg lies on a horizontal table. The block is at rest. The only forces acting on the block are the force due to gravity and the normal force from the table. What is the magnitude of the friction force?

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conservation laws

Problem 1.

If a 5 tons beam is raised 6 meters, what is it's potential energy? If it is raised another 8 meters in 6 seconds, what is the work done?

Problem 2.

(University Physics, 12th Edition, Young & Freedman 6.33) A 10-kg box moving at 5 m/s on a horizontal, frictionless surface runs into a light spring of force constant 100 N/cm. Use the work-energy theorem to find the maximum compression of the spring.

Problem 3.

A cat stuck up a tree and has 500 J gravitational potential energy. It then falls. Find the kinetic energy of the cat just before it is caught by the owner. Find the kinetic energy of the cat after it is caught by the owner. Find the wasted energy (after cat is caught by the owner).

Problem 4.

A 2000 kg truck is traveling east through an intersection at 2 m/s when it is hit simultaneously from the side and the rear. One car is a 1000 kg compact traveling north at 5 m/s. The other car is a 1500 kg midsize traveling east at 10 m/s. The three vehicles become entangled and slide at one body. What are their speeds and direction just after the collision?

Problem 5.

A small body of mass m is attached to a light thread which passes through a hole at the centre of a smooth table. The body is set into rotation in a circle of radius r_1, with a speed of v_1. The thread is then pulled down shortening the radius of the path to r_2. What will the new linear speed v_2 and the new angular speed ω_2 be?

Problem 6.

A metal surface is illuminated one by one by photons of energy ***2 eV*** and ***4 eV*** respectively. The work function of the metal is ***0.5 eV***. What is the ratio of the maximum speeds of electrons emitted in two cases?

Problem 7.

Ball **A**, with a mass of **2 kg**, moves with a velocity **5 m/s**. It collides with a stationary ball B, with a mass of **4 kg**. After the collision, ball **A** moves in a direction **60.0** degrees to the left of its original direction, while ball **B**moves in a direction **50.0** degrees to the right of ball **A**'s original direction. Calculate the velocities of each ball after the collision.

Problem 8.

A toy car **"1"** of mass 0.30 kg moves along a frictionless surface with a velocity of 0.20 m/s. It collides with another toy car **"2"**, with a mass of 0.40 kg and a speed of 0.10 m/s in the same direction. After the collision, toy car **"1"** continues to move in the same direction with a velocity of 0.15 m/s. Calculate the speed of toy car**"2"** after the collision.

Problem 9.

A skater of mass 80 kg initially at rest speeds up to a final speed of 10.0 m/s along a straight line and towards the East direction.

(a) Find the momentum of the skater while at rest.

(b) Find the momentum of the skater while traveling with its final speed.

(c) Find the change in momentum of the skater.

(d) Find the impulse acted on the skater.

(e) If that impulse exerted on the skater acts for 4 s, find the average force acting on the skater.

Problem 10.

A constant force of 80 N acts for 8 s on a box of mass 10 kg horizontally that initially rests on a horizontal frictionless surface.

(a) Find the change in the box's momentum.

(b) Calculate the final speed of the box after the 8 s have passed.