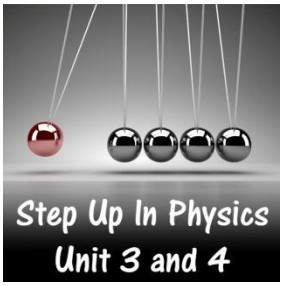
Forces on an Inclined Plane

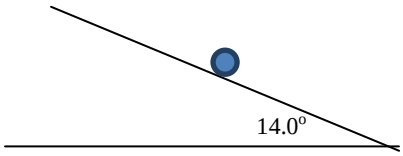
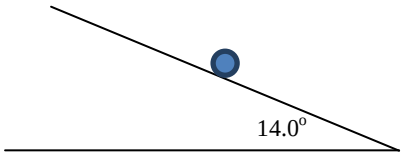
Problems Worksheet



1. A ball rolling down a smooth ramp at a constant **acceleration** is shown in a diagram below.
   a. Draw and label a free body diagram showing all the forces acting on the ball.

   b. Draw and label a vector diagram showing the relationship between all these forces. Include at least one angle.

   c. Draw and label the components of the ball's weight which acts parallel and perpendicular to the slope.

Free body diagram	Vector diagram	Weight components
		

   d. Describe the relationship between the perpendicular component of the weight force and the normal force acting on the ball.

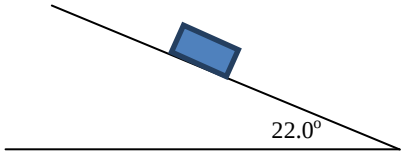
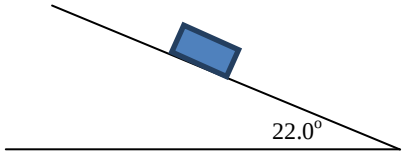
   e. Describe the relationship between the parallel component of the weight force and the acceleration of the ball.

   f. The ball has a mass of 200 g. Calculate the acceleration of the ball as it rolls down the ramp.

2. A box sliding down a ramp at a constant **velocity** is shown in a diagram below.
    a. Draw and label a free body diagram showing all the forces acting on the box.

    b. Draw and label a vector diagram showing the relationship between all these forces. Include at least one angle.

    c. Draw and label the components of the box's weight which acts parallel and perpendicular to the slope.

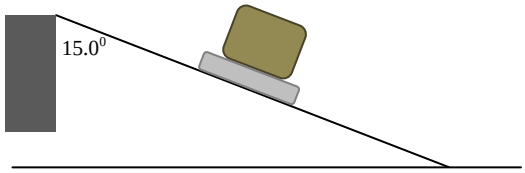
Free body diagram	Vector diagram	Weight components
		

    d. Describe the relationship between the friction acting on the box and the component of the weight force acting parallel with the slope.

    e. The box has a mass of 1.20 kg. Calculate the magnitude of the frictional force acting on the box.

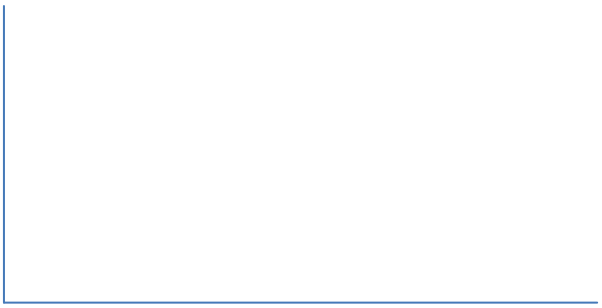
3. Determine the angle required for a frictionless ramp to cause a ball to accelerate down the ramp at 25.0% of what gravity would cause if the ball was in free fall.

4. Susan is moving house, placing her belongings into a removalist truck. While packing up her bathroom, she places a set of bathroom scales on the ramp leading to the truck. On top of this she places a 12.0 kg box. What is the apparent mass of the box, shown by the bathroom scales?



5. At a bowling alley, young children use a ramp to help get the ball down the lane. The 2.40 kg ball, initially at rest, rolls down from the end of a 1.50 m long ramp which is inclined 30.0^0 above the ground. The ball takes 0.800 s to reach the bottom of the ramp. Calculate the average frictional force acting between the ball and the ramp.

6. Make a sketch of the magnitude of the acceleration a ball rolling down a frictionless ramp would experience as the angle of incline of the ramp is increased from 0^0 to 90^0. Include key numbers on both axes.



7. Paul forgets to put the handbrake on in his 1200 kg car when parked on a hill. The hill has an incline of 16.0^0. The tyres of Paul's car provide 648 N of frictional force but are unable to stop the car from rolling away. How much time passes before Paul's car hits another parked car which is located 10.0 m downhill?