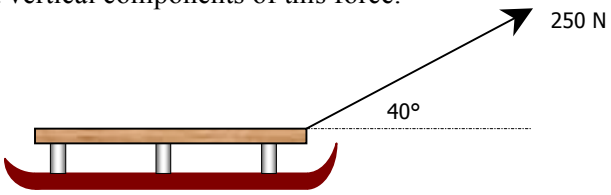
FORMAL HOMEWORK EXERCISE
Mechanics & Properties of Matter

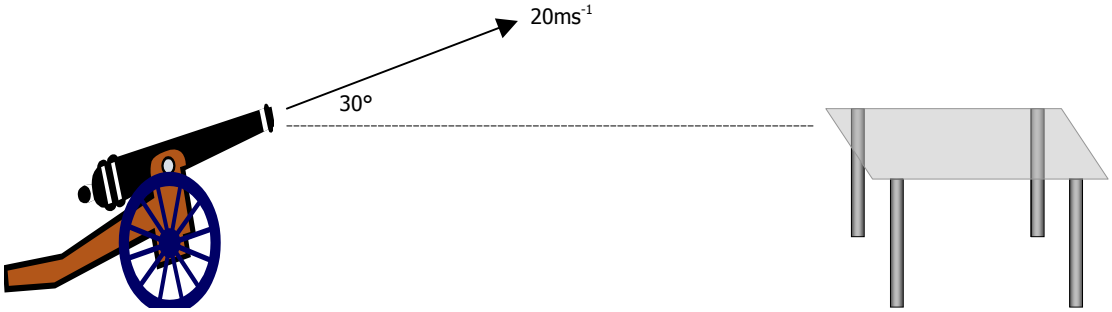
Higher Homework for Tuesday 20th September

1. A boy using a force of 250 N pulls a sledge across the snow as shown in the diagram below. Calculate the horizontal and vertical components of this force.



2. A workman on the scaffolding outside one of the science classrooms drops a wrench. A physics student, bored with the lesson, times it as it falls past the classroom window. She found that it took 0.6s to fall past the 2m tall window. Calculate the spanner's **initial** velocity as it appears at the top of the window.

3. A human cannonball at a circus is fired from the cannon with a muzzle velocity of 20 ms^{-1} at 30° to the ground, and (hopefully) lands in a safety net that is at the same height as the mouth of the cannon.



(a) Calculate the horizontal and vertical components of the performer's velocity.
(b) How high above the net was he at his highest point?
(c) How far from the cannon should the net have been placed to safely catch the performer?
(d) In practice, this distance would have to be slightly shorter. Why?

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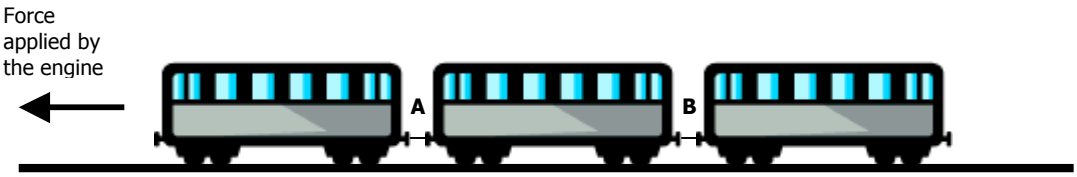
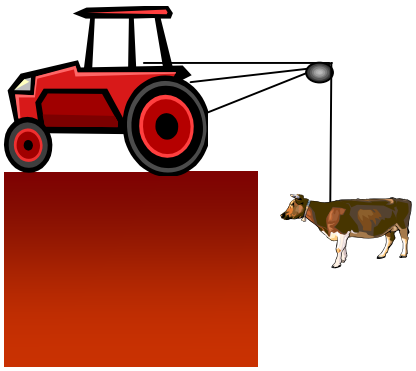
4. A train made up of 3 carriages is pulled along a level track by a force of 16 500 N. Each of the carriages has a mass of 8 000 kg, and each experiences 1500 N of resistive forces.



(a) Calculate the acceleration of the train.
(b) Work out the tension in link **B**.

5. A cow has fallen over a cliff and cannot get back up to the field. The farmer has to rescue it by attaching a rope and harness, and lifting it using a pulley and his tractor (as shown in the diagram).



The tractor has a mass of 1500 kg, and the cow has a mass of 500 kg. The tractor's engine can apply a force of 6000 N. Ignore friction between the tractor and the ground.

(a) Calculate the initial acceleration of the tractor as it lifts the cow.
(b) Draw a free body diagram showing the forces acting on the cow as it is being lifted.
(c) Calculate the tension in the rope lifting the cow.