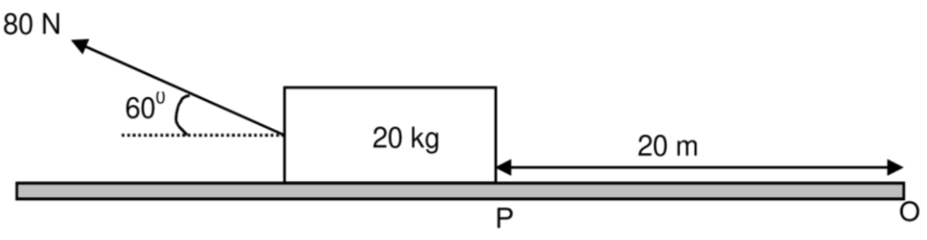
WORK, ENERGY & POWER: WORKSHEETS

ACTIVITY 1

A worker pulls a crate of mass 20 kg from rest along a horizontal floor by applying a constant force of magnitude 80 N at an angle of 60° to the horizontal. A frictional force of magnitude 10 N acts on the crate whilst moving along the floor.



1.1 Draw a labelled free-body diagram to show ALL the forces acting on the crate during its motion.

1.2 Give a reason why each of the vertical forces acting on the crate does NO WORK on the crate.

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1.3 Calculate the net work done on the crate as it reaches point P, 20 m from the starting point O.

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1.4 Use the WORK-ENERGY THEOREM to calculate the speed of the crate at the instant it reaches point P.

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1.5 The worker now applies a force of the same magnitude, but at a SMALLER ANGLE to the horizontal, on the crate.

How does the work done by the worker now compare to the work done by the worker in QUESTION 1.3? Write down only GREATER THAN, SMALLER

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ACTIVITY 2

The diagram below, not drawn to scale, shows a vehicle with a mass of 1 500 kg starting from rest at point **A** at the bottom of a rough incline. Point **B** is 200 m vertically above the horizontal.

The total work done by force F that moves the vehicle from point A to point B in 90 s is 4,80 x 106 J.

2.1 Define the term non-conservative force. (2)

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2.2 Is force F a conservative force? Choose from: YES or NO. (1)

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2.3 Calculate the average power generated by force F. (3)

The speed of the vehicle when it reaches point B is 25 m·s-1.

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2.4 State the work-energy theorem in words. (2)

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2.5 Use **energy principles** to calculate the total work done on the vehicle by the frictional forces. (5)

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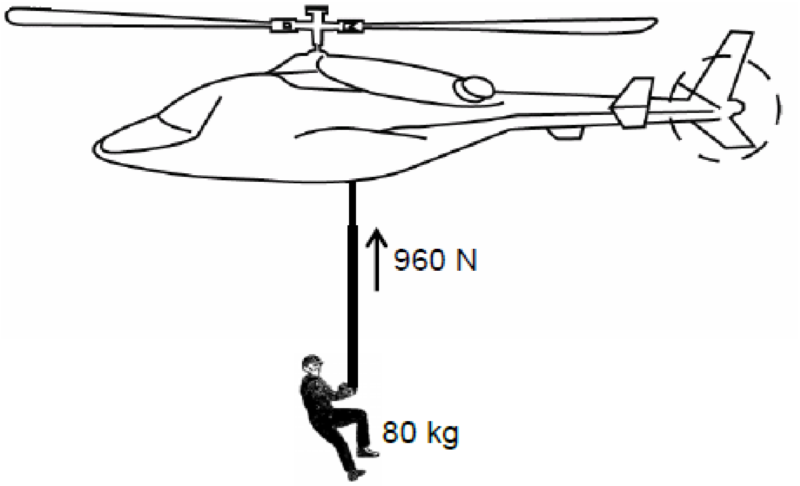
ACTIVITY 3

A rescue helicopter is stationary (hovers) above a soldier. The soldier of mass 80 kg is lifted vertically upwards through a height of 20 m by a cable at a CONSTANT SPEED of 4 $m \cdot s^{-1}$. The tension in the cable is 960 N. Assume that there is no sideways motion during the lift. Air friction is not to be ignored.



3.1 State the work-energy theorem in words. (2)

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3.2 Draw a labelled free-body diagram showing ALL the forces acting on the soldier while being lifted upwards. (3)

3.3 Write down the name of a non-contact force that acts on the soldier during the upward lift. (1)

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3.4 Use the WORK-ENERGY THEOREM to calculate the work done on the soldier by friction after moving through the height of 20 m. (5)

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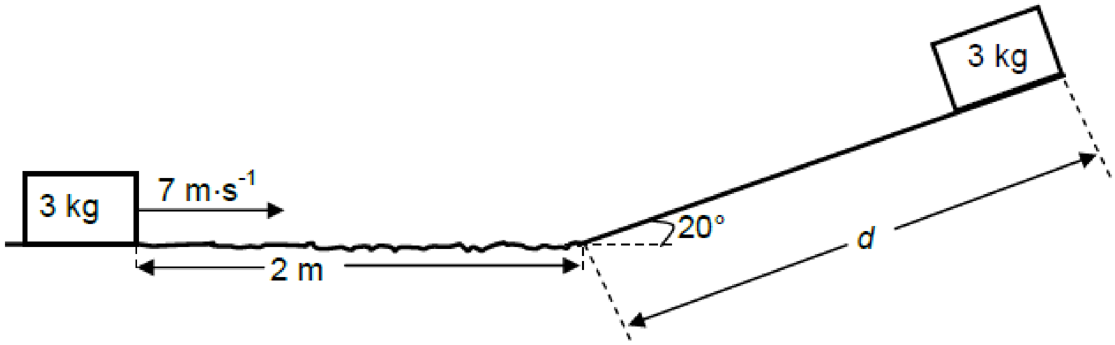
ACTIVITY 4

A 3 kg block slides at a constant velocity of 7 m·s^{-1} along a horizontal surface. It then strikes a rough surface, causing it to experience a constant frictional force of 30 N. The block slides 2 m under the influence of this frictional force before it moves up a frictionless ramp inclined at an angle of 20° to the horizontal, as shown in the diagram below.

The block moves a distance *d* up the ramp, before it comes to rest.



4.1 Show by calculation that the speed of the block at the bottom of the ramp is 3 m·s-1. (5)

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4.2 Draw a free-body diagram to show all the forces acting on the block in a direction parallel to the incline, whilst the block is sliding up the ramp. (2)

4.3 Calculate the distance, d, the block slides up the ramp. (5)

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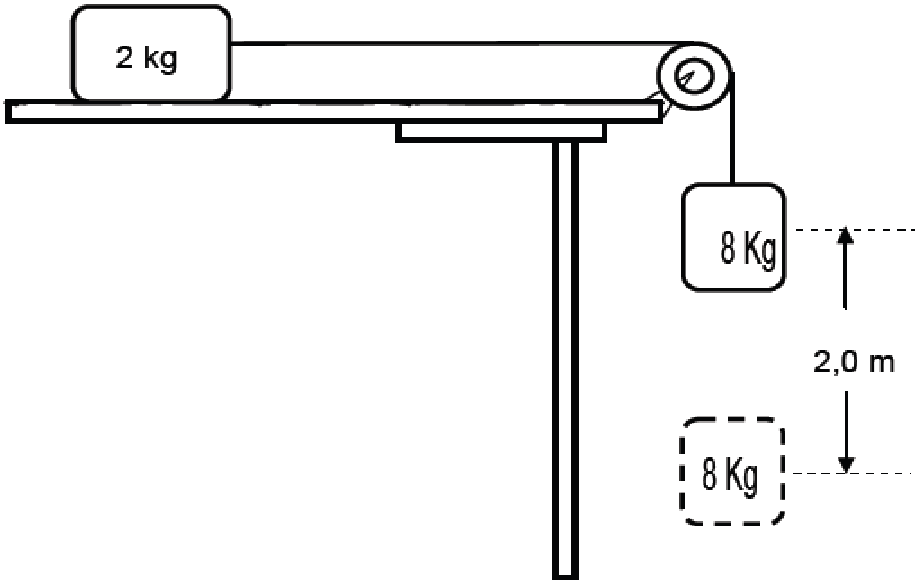
ACTIVITY 5

In the diagram below, a 2 kg block lying on a rough horizontal surface is connected to a 8 kg block by a light inextensible string passing over a light frictionless pulley.

Initially the blocks are HELD AT REST.



5.1 State the work-energy theorem in words. (2)

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When the blocks are released, the 8 kg block falls through a vertical distance

5.2 Draw a labelled free-body diagram for the 8 kg block. (2)

5.3 Calculate the work done by the gravitational force on the 8 kg block. (3)

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The coefficient of kinetic friction between the 2 kg block and the horizontal surface is 0,4. Ignore the effects of air resistance.

5. 4 Use **energy principles** to calculate the speed of the 8 kg block when it falls through 2,0 m while still attached to the 2 kg block.

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