PHYSICAL SCIENCES
Grade 12

WORK ENERGY POWER

01 JULY 2014

Check List

Make sure you ….

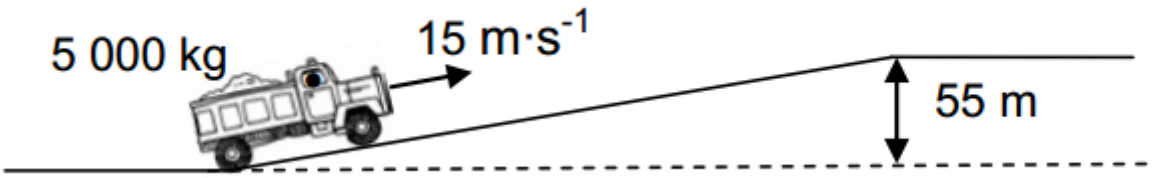
- Are able to define work and apply the definition to solve problems
- Revise how draw free body diagrams to find the components of forces
- Can state and apply the work energy theorem
- Are able to state and apply the principle of conservation of mechanical energy
- Can solve conservation of energy problems where non-conservative forces are present
- Can define power and use the definition to calculate power when work is done
- Are able to use the equation $P_{ave} = Fv_{ave}$ for various situations

Exam Questions

Question 1

(Adapted from DBE Feb 2014 Paper 1 Question 5)

A loaded truck with a total mass of 5 000 kg travels up a straight incline at a constant velocity of 15 m·s^{-1}. At the top of the incline, the truck is at a height of 55 m above its starting point. The work done by frictional forces is 8,5 x 10^{4}J. (Ignore the rotational effects of the wheels of the truck.)



1.1 Define power in words. (2)

1.2 Draw a labelled free-body diagram showing ALL the forces acting on the truck as it moves up the incline. (4)

1.3 Use the WORK-ENERGY THEOREM to calculate the work done by the engine of the truck to get it to the top of the incline. (5)

1.4 Calculate the average power delivered by the engine of the truck if the truck takes 60 s to reach the top of the incline. (3)

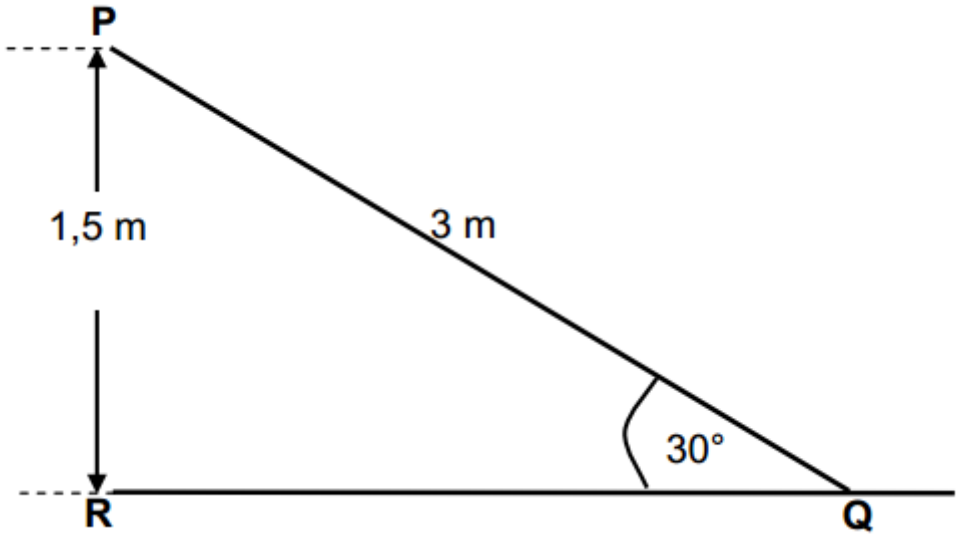
The truck now returns down the same incline with a constant velocity of 15 m·s^{-1}

1.5 How will the work done by the engine of the truck on reaching the bottom of the incline compare to that calculated in QUESTION 1.3?
Write down GREATER THAN, SMALLER THAN or EQUAL TO.
Give a reason for the answer. (2)

Question 2

(Adapted from DBE Feb 2013 Paper 1 Question 5)

The simplified diagram below shows a slide PQ at a playground. The slide is 3 m long and 1,5 m high. A boy of mass 40 kg and a girl of mass 22 kg stand at the top of the slide at P. The girl accelerates uniformly from rest down the slide. She experiences a constant frictional force of 1,9 N. The boy falls vertically down from the top of the slide through the height PR of 1,5 m. Ignore the effects of air friction



2.1 Write down the principle of conservation of mechanical energy in words. (2)

2.2 Draw a labelled free-body diagram to show ALL the forces acting on the:

2.2.1 Boy while falling vertically downwards (1)

2.2.2 Girl as she slides down the slide (3)

2.3 Use the principle of CONSERVATION OF MECHANICAL ENERGY to calculate the speed of the boy when he reaches the ground at R. (4)

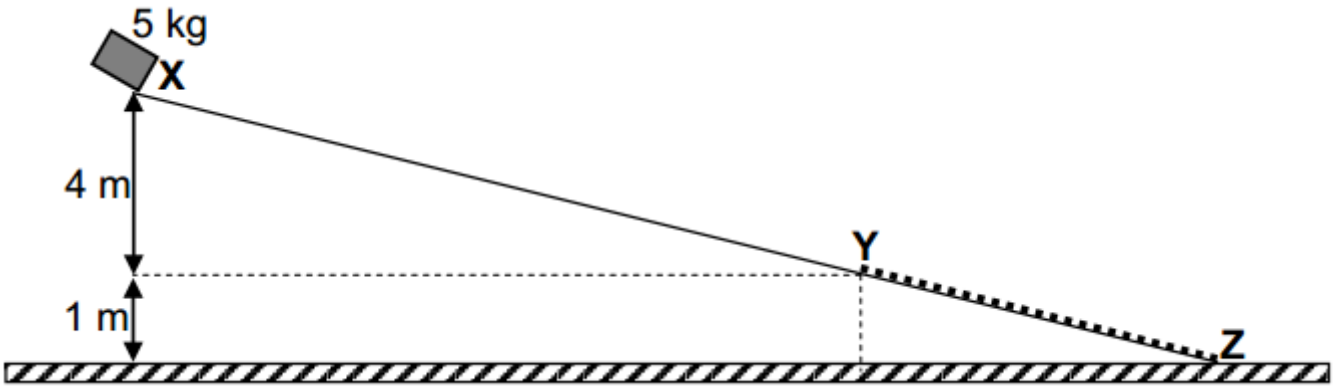
2.4 Use the WORK-ENERGY THEOREM to calculate the speed of the girl when she reaches the end of the slide at Q. (5)

2.5 How would the velocity of the girl at Q compare to that of the boy at R if the slide exerts no frictional force on the girl? Write down only GREATER THAN, LESS THAN or EQUAL TO. (1)

Question 3

(Adapted from DBE Nov 2013 Paper 1 Question 5)

A 5 kg rigid crate moves from rest down path XYZ as shown below (diagram not drawn to scale). Section XY of the path is frictionless. Assume that the crate moves in a straight line down the path.



3.1 Use the principle of the conservation of mechanical energy to calculate the speed of the crate when it reaches point Y. (4)

On reaching point Y, the crate continues to move down section YZ of the path. It experiences an average frictional force of 10 N and reaches point Z at a speed of 4 $m \cdot s^{-1}$

3.2 APART FROM FRICTION, write down the names of TWO other forces that act on the crate while it moves down section YZ. (2)

3.3 In which direction does the net force act on the crate as it moves down section YZ? Write down only from 'Y to Z' or from 'Z to Y'. (1)

3.4 Use the WORK-ENERGY THEOREM to calculate the length of section YZ. (5)

Another crate of mass 10 kg now moves from point X down path XYZ.

3.5 How will the velocity of this 10 kg crate at point Y compare to that of the 5 kg crate at Y? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)