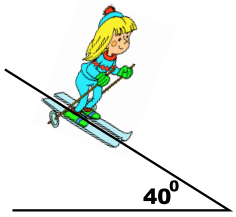
2 Worksheet: Work, energy and power

QUESTION 1

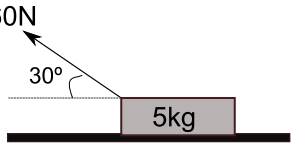
1.1 A girl with mass 60 kg slides 3 m down an inclined plane as shown in the picture.



a. Calculate the work done on the girl by gravity.

b. Calculate the work done on the girl by the normal force.

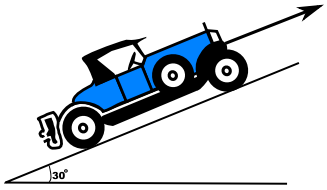
1.2 A block (5 kg) is pulled by a force of 60 N at an angle of 30° to the ground. The block moves 3,25 m.



a. Calculate the work done on the block by gravity.

b. Calculate the work done on the block by the applied force.

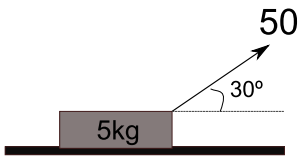
1.3 A 1200 kg car is pulled 3 m up an incline (30° with the ground) by a rope exerting a force of 8000 N on the car. The car experiences a 20 N frictional force.



a. Draw a labelled free body diagram of all the forces acting on the car.

b. Calculate the net work done on the car.

1.4

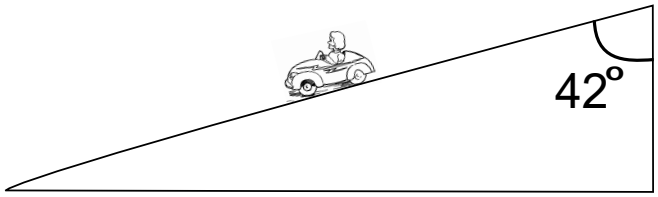


A block (5 kg) is pulled by a 50 N at an angle of 30° to the ground. The block experiences a 4,2 N frictional force and moves 2,60 m. The block starts from rest. Use the work-energy principle to calculate the speed of the block after the 2,60 m.

1.5 A film star in a car (together 720 kg) drives 4,8 m down an inclined plane as indicated in the picture. She starts from rest. The car experiences a frictional force of 23 N. and the engine exerts a force of 200 N.

a. Calculate the work done on the car by the engine.

b. Calculate the velocity of the car after moving 4,8 m.



QUESTION 2

(The rest of the questions focus on study material covered in Video 3 and 4)

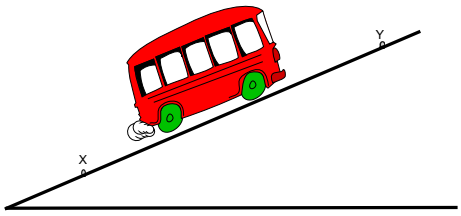
2.1

a. State the principle of conservation of mechanical energy.

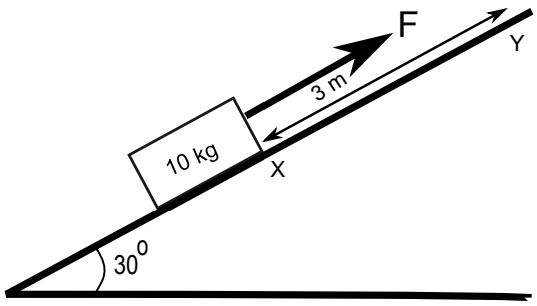
b. A girl slides down a slide. She begins 2 m above the ground from rest and experiences no friction. Use the principle of conservation of mechanical energy to calculate her speed when she is 50 cm above the ground.

QUESTION 3

3.1 A Bus (2000 kg) is driving up an inclined plane. The engine exert a force of 20 000 N on the bus and the bus experiences a 1 200 N frictional force. The bus travels at X with a speed of 3 $m{\cdot}s^{-1}$ and at Y with a speed of 3,1 $m{\cdot}s^{-1}$. The distance between X and Y is 4 m. Calculate the difference in height between X and Y.



3.2 A man pulls a wood block up an inclined plane. The mass of the block is 10 kg and the kinetic friction coefficient between the block and the surface is 0,18. The block accelerates from 2 $m{\cdot}s^{-1}$ to 3 $m{\cdot}s^{-1}$ while travelling a distance of 3 m.

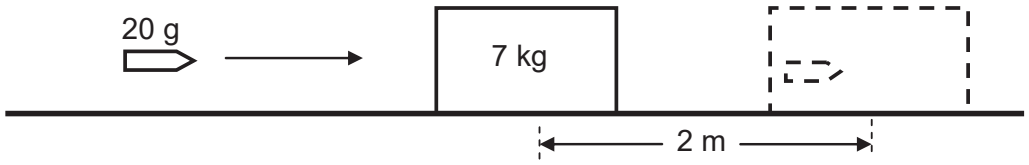


a. Use energy principles to calculate the magnitude of the applied force.

b. Calculate the power dissipated by the man.

QUESTION 4 (DBE Mar 2015)

The diagram below shows a bullet of mass 20 g that is travelling horizontally. The bullet strikes a stationary 7 kg block and becomes embedded in it. The bullet and block together travel on a rough horizontal surface a distance of 2 m before coming to a stop.



4.1 Use the work-energy theorem to calculate the magnitude of the velocity of the bullet-block system immediately after the bullet strikes the block, given that the frictional force between the block and surface is 10 N. (5)

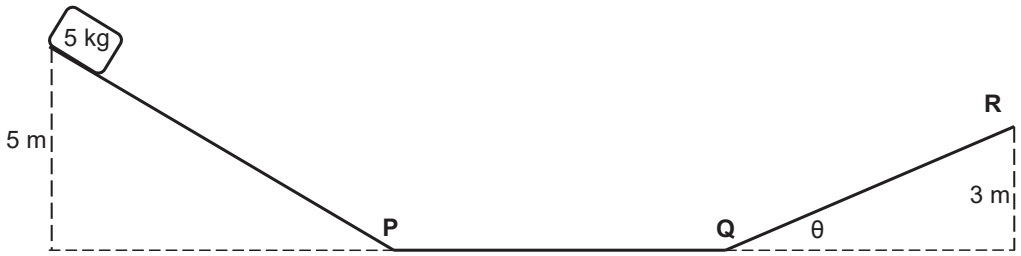
4.2 State the *principle of conservation of linear momentum* in words. (2)

4.3 Calculate the magnitude of the velocity with which the bullet hits the block. (4)

[11]

QUESTION 5 (DBE Mar 2015)

A 5 kg block is released from rest from a height of 5 m and slides down a frictionless incline to point **P** as shown in the diagram below. It then moves along a frictionless horizontal portion **PQ** and finally moves up a second rough inclined plane. It comes to a stop at point **R** which is 3 m above the horizontal.



The frictional force, which is a non-conservative force, between the surface and the block is 18 N.

5.1 Using ENERGY PRINCIPLES only, calculate the speed of the block at point **P**. (4)

5.2 Explain why the kinetic energy at point **P** is the same as that at point **Q**. (2)

5.3 Explain the term *non-conservative force.* (2)

5.4 Calculate the angle (θ) of the slope **QR**. (7)

[15]