TUTORIAL QUESTIONS WORK ENERGY POWER 2

Question 1

A block is free to slide without friction on a horizontal table. William exerts a constant force of 5 N on the block. The direction of the force is 37° with respect to the horizontal. William keeps applying the force on the block as it moves a distance of 10 m on the table top.

a) How much work was done by the William's force?

b) How much work was done by the force of gravity?

Question 2

Eddie has made a long gun. The bullet has a mass of 10 grams. A force of 3 N pushes the bullet down the barrel, but the barrel has a frictional force of 1 N in the opposite direction. The barrel is 5 meters long and the bullet starts off at rest.

What is the final speed of the bullet as it leaves the barrel?

Question 3

Stella is sitting on top of a big slide. The slide has a vertical drop of 10 m. If there is no friction between her and the slide, what is her speed at the bottom of the slide?

Now, Stella tries out the slide again and measures her speed at the bottom. She finds that her speed is only 8 ms^{-1}. How much work was done by the force of friction? Stella's mass is 30 kg.

Question 4

An absent-minded professor does the "pendulum-of-death" demonstration. He takes a bowling ball of mass 3 kg and ties it to a long rope. For the demonstration he is supposed to let the ball go at his nose with no speed. The ball swings across the room and returns stopping at his nose. However, he forgets and gives the ball an initial speed of 1 ms^{-1}. He is lucky however. There is a lot of air friction and the ball still returns just in front of his nose. How much work was done against air friction?

Question 5

Lance, 80 kg, rides his bike up a steep hill at a constant speed. The hill makes an angle of 10° with the horizontal. If he rides a distance of 12 km up the incline find:

a) Gain in potential energy.

b) The work done against gravity.

c) If Lance can complete the 12 km in one hour, what is his power output?

Question 6

There is a metal sphere of mass 10 kg, moving with a speed of 1 ms^{-1}, and another of mass 1 kg, moving at a speed of 6 ms^{-1}. You apply a force of 2 N to both of them. Show quantitatively
a) which one will stop in the shortest time?
b) which one will stop in the shortest distance?

Question 7

Jane thinks that Tarzan has been gaining too much mass; however, he doesn't want to tell her what he weighs. One day Tarzan is swinging in the forest. He starts (from rest) from one side at an angle of 53° from the vertical. He swings down and grabs Jane at the bottom of the swing. They swing together on the other side up to a maximum angle of 37°. Jane knows that her mass is 50 Kg. What is Tarzans's mass?
(Assuming there is no air friction or external forces during the collision)

Question 8

A block of mass m starts from rest on a frictionless incline. It is initially a height h_1 above the ground. The block slides down the incline and collides with another block of mass 4m. After the collision, the 4m block travels forward up an incline plane, and the m block slides backwards up the incline from which it started. They both slide up their inclines to the same height h_2 above the ground. All surfaces are frictionless and there is no external force during the collision. Determine what the height h_2 is in terms of h_1.

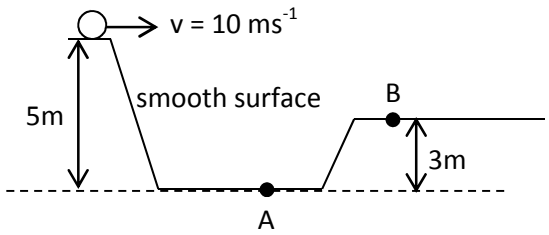
Question 9

One way to measure the speed of a bullet is to use a "ballistic pendulum". The ballistic pendulum consists of a block of wood suspended by a string. The bullet is shot into the wood. The wood and bullet swing up to a maximum height h. Let m be the mass of the bullet and M be the mass of the wood. What is the speed v_0 of the bullet in terms of h, m, M and g?

Question 10

A small electric motor is used to raise a weight of 2.0 N through a vertical height of 80 cm in 4 s. The efficiency of the motor is 20%. What is the electrical power supplied to the motor?

Question 11

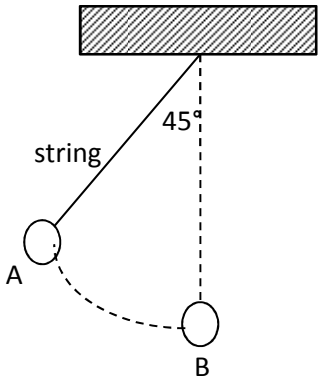


Referring to diagram on the left, assuming the surface is smooth and negligible air resistance, determine the speed of object when it reaches:
a.) point A
b.) point B

Question 12

An object of mass 1.6 kg is thrown vertically upwards with speed 25 ms^{-1}. It reaches a maximum height of 20 m. Determine the energy loss due to air resistance.

Question 13



The mass of the bob and length of the string of a simple pendulum are 0.10 kg and 1.0 m respectively. The string makes an angle of 45° with the vertical, as shown on the left. The bob, initially at rest, is released and when it reaches the lowest position it has a speed of 2.2 ms^{-1}. Determine the loss in energy of the system due to air resistance.

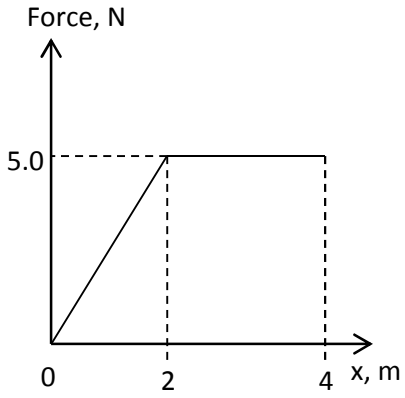
Question 14

An object is exerted by a force. It then moves along a straight line. Figure on the right shows how the magnitude of the force varies with displacement x of the object. The time taken to travel from x = 0 to x =2.0 m is 1.5 s and from x = 2.0 m to x = 4.0 m is 2.0 s. Determine the average power received by the object when it moves from

a.) x = 0 to x = 2.0 m,

b.) x = 2.0 m to x = 4.0 m,

c.) x = 0 to x = 4.0 m



Question 15

a.) The power of the engine of a car of mass 950 kg is 3.5 kW when the car moves at constant speed 20 ms^{-1} along a straight road. Determine the total resistance (air & friction) against the car at this speed.

b.) Then the car moves up a road which is inclined 30° at constant speed 20 ms^{-1}. If the resistance (air & friction) remains the same, determine the new power produced by the engine.

Question 16

A stationary car of mass 900 kg starts to accelerate with constant acceleration 1.5 ms^{-2}. The resistance force which acts on the car is of constant magnitude 500 N. Determine the power of the car engine at time t = 5.0 s.