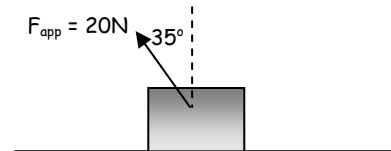


WORK, ENERGY, AND MOMENTUM

In-Class Example Problems

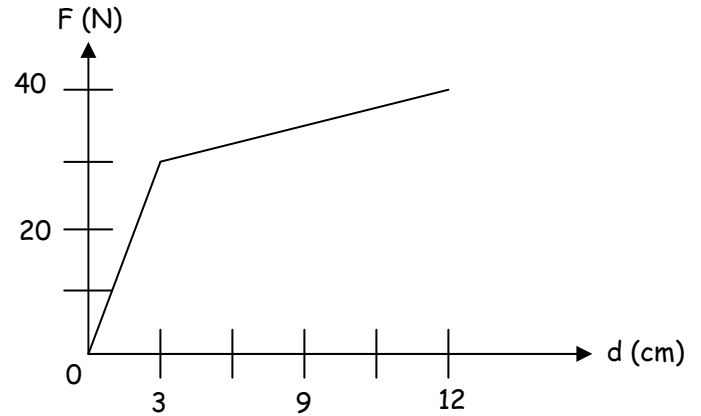
WORK:

1. A 3kg block is sliding across a frictionless surface when a 20N applied force begins to act, as shown in the diagram. If the force acts as the block moves 3m to the right, calculate the work done by the applied force during the slide.



2. A 20kg block slides down a 30° incline at a constant velocity. Calculate the following, as the block slides through a distance of 2.1m down the incline.
 - a. Work done by gravity.
 - b. Work done by the normal force.
 - c. Work done by friction.
 - d. Net work done on the block.

3. The given graph shows force versus distance compressed for a pillow exerting a force on an egg in bringing it to a stop. Use the graph to calculate the work done by the pillow during the entire 12cm stopping distance.



WORK AND KINETIC ENERGY:

4. A 6kg block is initially sliding at 5m/s, and is later moving at 8m/s.
- Calculate the initial kinetic energy of the block.
 - Calculate the work done on the block to cause its increase in speed.
5. A 1200kg car is traveling at 18m/s when it locks applies its brakes. If the brakes allow friction to exert a 2000N force on the car, and the brakes are applied for 50m, how fast is the car moving when the brakes are released?

POTENTIAL ENERGY:

6. A 30kg mass is hung from a spring ($k=200\text{N/m}$), which has the effect of stretching the spring down a distance of 1.47m.
- Calculate the increase in the elastic potential energy of the spring.
 - Calculate the decrease in the gravitational potential energy of the mass.

ENERGY CONSERVATION BASICS:

7. A box is given a push up a frictionless incline, such that its initial speed is 8.6m/s. What is the maximum height that the box reaches above the incline's base?
8. A ball is launched upward from ground level with a speed of 15m/s. At what height is the ball moving at 3m/s?

SPRING ENERGY CONSERVATION:

9. A 230g block is attached to the end of a horizontal spring of negligible mass and spring constant 1900N/m. The spring is stretched back from equilibrium by a distance of 35cm and released from rest. What is the speed of the block when it has crossed through equilibrium and is now 10cm past equilibrium?
10. A 3kg block sits atop a vertically-oriented spring ($k=2000\text{N/m}$), compressing it 20cm below its equilibrium position. If the spring is released to 'launch' the block, calculate the launch speed of the block.

PENDULUM ENERGY CONSERVATION:

11. A 2.0m-long pendulum is released from rest when the support string is at an angle of 25° with the vertical. What is the speed of the pendulum bob at the bottom of its swing?

ENERGY CONSERVATION WITH FRICTION:

12. A certain 3kg object is dropped from a height of 4.2 meters. If it strikes the ground with a speed of 6.5m/s, how much work is done by air resistance during the object's fall?
13. A 5kg box is pressed against a horizontal spring ($k=5000\text{N/m}$), compressing it 40cm from equilibrium. The spring is released from rest, pushing the box across a flat surface. If the speed of the box 4 meters from the point of release is measured to be 8.3m/s, what is the average force of friction acting on the box?

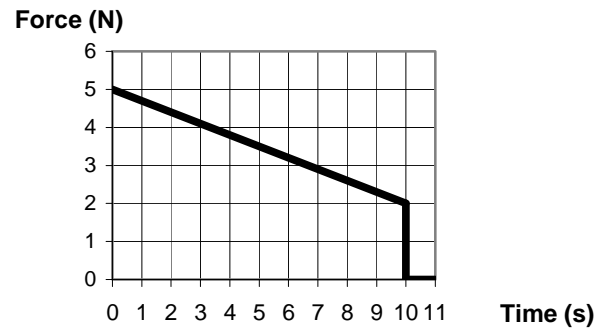
FRICTION & INCLINES & E-CONSERVATION!

14. A boy on a sled, with a combined mass of 80kg, slides down a 34° hill that is 25m long. If the coefficient of friction between the sled and hill is 0.15, calculate the sled's speed when it reaches the base of the hill.

MOMENTUM & IMPULSE:

15. A 2kg object is initially moving at 5m/s in the positive direction, and 3 seconds later it is moving at 7m/s in the negative direction.
- Calculate the initial momentum of the object.
 - Use the impulse-momentum theorem to calculate the average force that acted on the object during the 3s interval.

16. The only force acting on a 3kg object varies over time as shown in the given graph. Find the impulse given to the object, and then determine the speed of the object at the end of 10s, assuming the object started from rest at $t=0$ s.



BASIC MOMENTUM CONSERVATION:

17. A 75kg man, initially at rest, throws a 750g baseball to the right at 22m/s. What is the man's velocity (speed and direction) after he throws the ball?

18. A 3g marble, moving to the right at 8m/s, collides with a larger 5g marble, initially at rest. If the 3g marble is moving back to the left at 2m/s after the collision, what is the final velocity (speed and direction) of the 5g marble after the collision?

ELASTIC COLLISIONS:

19. A 3kg block moving to the right at 20m/s undergoes an elastic collision with a 4kg block moving to the left at 13m/s. Determine the velocity of each block after the collision.

MULTIPLE STEPS W/ENERGY AND MOMENTUM!

20. A 6.2g bullet is fired into a 3.1kg ballistic pendulum, where the block rises to a maximum angle of 62° from the vertical. If the length of the pendulum is 23cm, find the initial speed of the bullet.
21. A 3kg box is slid across a frictionless surface, traveling at 5.7m/s when it strikes a 7kg box, initially at rest. After the collision, the 7kg block slides up a frictionless incline. Assuming that the collision was elastic, what is the maximum height to which the 7kg block rises as it slides up the incline?