Work & Energy

Work

- Work = (Force **in direction of motion**)*distance
- W, Joule (J) = N-m
- 1 J is work done in lifting 1 N (weight of average apple) at a constant speed, vertically 1 m

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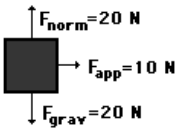
No Work

- person holding sign is doing no work
- waiter carrying tray is doing no work
- Person pushing stationary car is doing no work

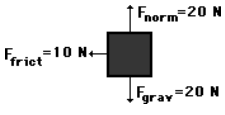
Work Question 1

- A 10 N horizontal force is applied to push a block across a frictionless, horizontal surface through a distance of 5.0 m to the right. What is the work done on the block by each of the forces shown?



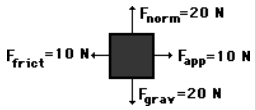
Work Question 2

- A frictional force slows a moving block to a stop through a distance of 5.0 m to the right. What is the work done on the block by each of the forces shown?



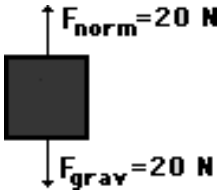
Work Question 3

- A 10 N horizontal force is applied to push a block across a frictional surface at constant speed through a displacement of 5.0 m to the right. What is the work done on the block by each of the forces shown?



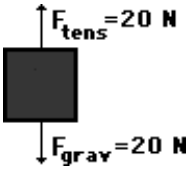
Work Question 4

- A 2 kg object slides at a constant speed across a horizontal, frictionless surface through a distance of 5.0 m to the right. What is the work done on the block by each of the forces shown?



Work Question 5

- A 2 kg object is pulled upward at a constant speed by a 20 N force through a distance of 5 m. What is the work done on the block by each of the forces shown?



Power

- Power = Work/time
- P, J/s = Watt
- 1 horsepower = 746 Watts

Power Question

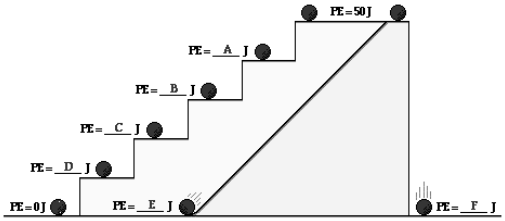
- A 60 kg student climbs a 5 m high flight of stairs at a constant speed in 3 seconds. What is the student's power rating?

Gravitational Potential Energy

- Energy of position
- Gravitational Potential Energy
- PE = mgh
- PE is the work done against the field to move an object to a certain position
- Lifting apple 1 m – 1 J of PE
- PE is the work that the object can do
  - Stored energy

Potential Energy Question

- Use the fact that the PE of the ball at the top of the stairs is 50 J to determine the PE at the other locations.



Elastic Potential Energy

- Energy stored by compressing or stretching a spring
- $PE = 0.5\ k\ x^2$
- K is the spring constant – a measure of the stiffness of the spring

Kinetic Energy

- KE is energy of motion
- $KE = 0.5\ mv^2$
- Apple (0.10 kg) thrown at 5 m/s
- $KE = (0.5)(0.10\ kg)(5\ m/s)^2 = 1.25\ J$

Kinetic Energy Question

- What is the kinetic energy of my 1000 kg car when it is traveling at 25 m/s?

Work = ΔEnergy

- Work produces a change in energy
- Work done by friction in stopping a car is equal to the change in kinetic energy experienced by the car
- $F*d = -0.5mv^2$
- How does doubling a car's speed, affect the stopping distance?

Stopping Distance

- Given that F is a fixed value for given road/tire conditions, the stopping distance is proportional to the KE
- How does doubling the speed affect the KE?

Stopping Distance

- Given that F is a fixed value for given road/tire conditions, the stopping distance is proportional to the KE
- How does doubling the speed affect the KE?
- $(2v)^2 = 4v^2$
- 4X the KE, thus, 4X the stopping distance

Stopping Distance

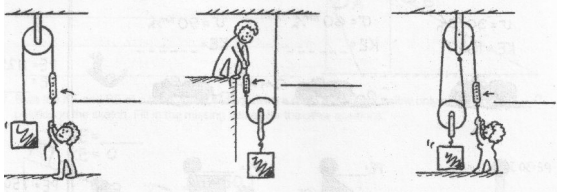
- How does tripling the speed affect the stopping distance?

Stopping Distance

- How does tripling the speed affect the stopping distance?
- $(3v)^2 = 9v^2$
- 9X KE means 9X the stopping distance

Pulleys and Force

2. The woman supports a 100-N load with the friction-free pulley systems shown below. Fill in the spring-scale readings that show how much force she must exert.



Pulleys and Work

3. A 600-N block is lifted by the friction-free pulley system shown.

a. How many strands of rope support the 600-N weight?

_____

b. What is the tension in each strand?

_____

c. What is the tension in the end held by the man?

_____

d. If the man pulls his end down 60 cm, how many cm will the weight rise?

_____

e. If the man does 60 joules of work, what will be the increase of PE of the 600-N weight?

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