Kinetic Energy and Work

QUIZ Check your understanding:

An electron moves in a straight line toward the east with a constant speed of $8*10^7$m/s. It has electric, magnetic, and gravitational forces acting on it. During a 1 m displacement, the total work done on the electron is (i) positive; (ii) negative; (iii) zero; (iv) not enough information is given.

$\vec{F}_{net} = 0 \Rightarrow W = 0$

QUIZ Check your understanding:

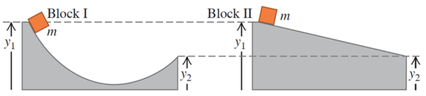
Rank the following objects in order of their kinetic energy, from least to greatest.
(i) A 2.0 kg object moving at 5.0 m/s; (ii) a 1.0 kg object that initially was at rest and then had 30 J of work done on it; (iii) a 1.0 kg object that initially was moving at 4.0 m/s and then had 20 J of work done on it; (iv) a 2.0 kg object that initially was moving at 10 m/s and then did 80 J of work on another object.

(iv), (i), (iii), (ii)

Conservation of Mechanical Energy

QUIZ Check your understanding:

The figure shows two frictionless ramps. The heights y_1 and y_2 are the same for both ramps. If a block of mass m is released from rest at the left-hand end of each ramp, which block arrives at the right-hand end with the greater speed?
(i) Block I; (ii) block II; (iii) the speed is the same for both blocks.



(iii)

$mgy_1 = mgy_2 + K_2$

Force and Potential Energy in 3-D

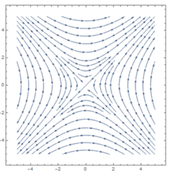
EXERCISE

Task #2: Derive the force from the given potential energy

$$U(x, y) = -\alpha xy$$

Solution:

$$\vec{F} = -\left(\frac{\partial U}{\partial x}\vec{i} + \frac{\partial U}{\partial y}\vec{j}\right) = \alpha(y\vec{i} + x\vec{j})$$



QUIZ Check your understanding:

A particle moving along the *x*-axis is acted on by a conservative force F_x. *At a certain point, the force is zero. (a) Which of the following* statements about the value of the potential-energy function *U*(*x*) at that point is correct? (i) $U = 0$; (ii) $U > 0$; (iii) $U < 0$; (iv) not enough information is given to decide.
(b) Which of the following statements about the value of the derivative of *U(x) at that point is* correct? (i) $dU/dx = 0$; (ii) $dU/dx > 0$; (iii) $dU/dx < 0$; (iv) not enough information is given to decide.

a) (iv)
b) (i)

Conservation of Total Energy

QUIZ Check your understanding:

In a hydroelectric generating station, falling water is used to drive turbines ("water wheels"), which in turn run electric generators. Compared to the amount of gravita-tional potential energy released by the falling water, how much electrical energy is produced? (i) The same; (ii) more; (iii) less.

friction in turbines reduces the amount of mechanical energy

Systems with Varying Mass

QUIZ Check your understanding:

(a) If a rocket in gravity-free outer space has the same thrust at all times, is its acceleration constant, increasing, or decreasing? (b) If the rocket has the same acceleration at all times, is the thrust constant, increasing, or decreasing?

thrust $\rightarrow \frac{dm}{dt}\vec{u}$

free outer space $\rightarrow \vec{F} = 0$

a) Increasing
b) decreasing