1. Calculate the kinetic energy of a proton mass \(1.67 \times 10^{-27}\) kg, traveling at \(5.20 \times 10^7\) m/s.
\[2.26 \times 10^{-12} \text{ J}\]

2. What is the kinetic energy of a 3.2 kg pike swimming at 2.7 km/h? \(0.75 \text{ m/s therefore } 0.90 \text{ J}\)

3. A force of 30.0 N pushes a 1.5 kg cart, initially at rest, a distance of 2.8 m along a frictionless surface.
   a. Find the work done on the cart. \(84 \text{ J}\)
   b. What is its change in kinetic energy? \(84 \text{ J}\)
   c. What is the cart's final velocity? \(10.6 \text{ m/s}\)

4. A bike and rider, 82.0 kg combined mass, are traveling at 4.2 m/s. A constant force of \(-140\) N is applied by the brakes in stopping the bike. What braking distance is needed? \(W = \Delta E_k; 5.2 \text{ m}\)

5. A 712 kg car is traveling at 5.6 m/s when a force acts on it for 8.4 s, changing its velocity to 10.2 m/s.
   a. What is the change in kinetic energy of the car? \(25 874 \text{ J}\)
   b. How far did the car move while the force acted? \(a = 0.548 \text{ m/s}^2; 66.3 \text{ m}\)
   c. How large is the force? \(390 \text{ N}\)

6. Five identical 0.85 kg books of 2.50 cm thickness are each laying flat on a table. Calculate the gain in potential energy of the system if they are stacked one on top of the other.
   \(\text{ind } E_p\text{ of each and sum them up; } 0 \text{ J} + 0.21 \text{ J} + 0.42 \text{ J} + 0.62 \text{ J} + 0.83 \text{ J} = 2.08 \text{ J}\)

7. Each step of a ladder increases one’s vertical height 40. cm. If a 90.0 kg painter climbs 8 steps of the ladder, what is the increase in potential energy? \(2800 \text{ J}\)

8. A 0.25 kg ball is dropped from a height of 3.2 m and bounces to a height of 2.4 m.
   What is its loss in potential energy? \(\Delta E_p = 7.84 \text{ J} – 5.88 \text{ J} = 1.96 \text{ J}\)

9. A 0.18 kg ball is placed on a compressed spring on the floor. The spring exerts an average force of 2.8 N through a distance of 15 cm as it shoots the ball upward. How high will the ball travel above the release spring? \(W = 0.42 \text{ J} ; W = \Delta E_p\text{ therefore } h = 0.23 \text{ m}\)

10. A force of 14.0 N is applied to a 1.5 kg cart as it travels 2.6 m along an inclined plane. What is the angle of inclination of the plane? \(\text{Work done on ramp is } 36.4 \text{ J, same work would be required to lift straight up, therefore } E_p = 36.4 \text{ J and } h = 2.48 \text{ m. using trig, angle } = 72.5^\circ.\)

11. A 15.0 kg model plane flies horizontally at a constant speed of 12.5 m/s.
   a. Calculate its kinetic energy. \(1170 \text{ J}\)
   b. The plane goes into a dive and levels off 20.4 m closer to Earth. How much, potential energy does it lose during the dive? Assume no additional drag. \(E_p = 3000 \text{ J}\)
   c. How much kinetic energy does the plane gain during the dive? \(E_k = 3000 \text{ J (total}\)
energy is conserved so a loss of potential must equal a gain in kinetic energy)

d. What is its new kinetic energy? \( E_{k_{\text{old}}} + E_{k_{\text{new}}} = 1172 + 3000 \text{ J} = 4172 \text{ J} \)
e. What is its new horizontal velocity? \( v_{\text{new}} = 23.63 \text{ m/s} \)

12. A 1200 kg car starts from rest and accelerates to 72 km/h (20. m/s) in 20.0 s. Friction exerts an average force of 450 N on the car during this time;

a. What is the net work done on the car?
   \[ W_{\text{net}} = \Delta E_k = E_{k_{\text{final}}} - E_{k_{\text{initial}}} = 240000 \text{ J} - 0 \text{ J} = 240000 \text{ J} \]
b. How far does the car move during its acceleration?
   Use kinematics; \( a = 1.0 \text{ m/s}^2 \) then \( d = 200 \text{ m} \)
c. What is the net force exerted on the car during this time?
   \[ W_{\text{net}} = F_{\text{net}} \times d \text{ so } F_{\text{net}} = W_{\text{net}}/d = 1200 \text{ N} \]
d. What is the forward force exerted on the car as a result of the engine, power train, and wheels pushing backward on the road? \( F_{\text{net}} = F_{\text{applied}} - F_{\text{fr}} \); \( F_{\text{applied}} = 1650 \text{ N} \)

13. In an electronics factory, small cabinets slide down a 30.0° incline a distance of 16.0 m to reach the next assembly stage. The cabinets have a mass of 10.0 kg each

a. Calculate the speed each cabinet would acquire if the incline were frictionless.
   Find height using trig. which is 8.0 m. Then \( E_p = 784 \text{ J} \), as this cabinet slides down all the PE is converted to KE. Therefore, \( E_k = 784 \text{ J} \) and the speed is 12.5 m/s.

b. What kinetic energy would a cabinet have under such circumstances? \( E_k = 784 \text{ J} \)

14. An average force of 8.2 N is used to pull a 0.40 kg rock, stretching a sling shot 43 cm. The rock is shot downward from a bridge 18 m above a stream. What will be the velocity of the rock just before it enters the water? \( \text{DALP. The kinetic energy the sum of the KE supplied by the slingshot (equal to work done on the slingshot) and the KE supplied by gravity (as gravitational PE is converted to KE). } \)
   \( E_k = 3.5 \text{ J} + 70.6 \text{ J} = 74.1 \text{ J} \); this relates to a velocity of 19.2 m/s