

PHYSICS 117 – HOMEWORK SET 6

- Q 1** The momentum is not ‘hidden’; there was no initial momentum. Presumably, the identical cars had the same magnitude of individual momentum, but since they traveled in opposite directions, the sum of the momentum vectors was zero.
- Q 3** Well, momentum is always conserved, while kinetic energy is not. So go figure.
- Q 12** The momentum is a vector, and as the direction of the plane’s velocity changes, so does the direction of the momentum. The magnitude of momentum and the kinetic energy just depend on the magnitude of the velocity, so if it does not change, then neither do they.
- Q 15** The amount of work Sally actually does on the bags depends on the manner in which she transports them across the floor. Perhaps she is pushing them. Also, her body must be doing some work to move itself around. I support Sally’s claim.
- Q 19** The teams apply the same force over the same distance so do the same work. Thus, the change in kinetic energy must be the same. The smaller mass of the lighter sled means that it has a greater acceleration and faster final velocity. This means that it travels the five meters faster, so is pushed for a shorter amount of time. In turn, that implies that the applied impulse is less, so the change in momentum is less for the lighter sled. As stated, though, its final velocity is greater.
- Q 21** The answer depends on the direction of the velocity with respect to the direction of the force, and the force always points towards the center. At point A, velocity is mostly towards the earth, the work is positive, and the velocity is increasing. At point B, it looks to me that the velocity is perpendicular to the force, so there is no work and no change in velocity. At point C, the satellite is moving away from the planet, the work is negative, and the velocity decreases.
- Q 22** Other forces like friction and air resistance slow the trailer down.
- Q 23** The answer depends on the component of force in the direction of motion. It appears to me that force **A** has a smaller component, so it does less work.

- 46** All objects will have the same acceleration, so they will all have the same final speed. Since the masses are different, they have different kinetic energy, potential energy, and momentum. Since they have different momenta, each will require a different force to stop it.
- E 1** $KE = \frac{1}{2}mv^2 = 3.75 \times 10^5 \text{ J}$.
- E 3** $p_i = 4 \cdot 6 - 1 \cdot 6 = 18 \text{ kg m/s}$; $p_f = 18 \text{ kg m/s}$, so \vec{p} is conserved. $KE_i = 90 \text{ J}$; $KE_f = 58 \text{ J}$, so kinetic energy is not conserved.
- E 4** Now, $p_f = 24 \text{ kg m/s}$, and $KE_f = 90 \text{ J}$. Since momentum is not conserved, the collision probably did not actually happen.
- E 5** $KE_i = \frac{1}{2}m_1v_1^2 = 50 \text{ J}$. $KE_f = \frac{1}{2}(m_1 + m_2)v_f^2 = 40 \text{ J}$, so the change is -10 J .
- E 8** 15 N over 1 m means 15 J of work. However, the force applied by the hand equals the force of gravity, so zero total work is done on the object—it's kinetic energy does not change from 5 J .
- E 17** Grav. PE is equal, and we could define it to be zero. KE is the same, and equal to the change in Grav. PE $= mgh = 80 \text{ J}$. The speed is the same, $v = \sqrt{\frac{2KE}{m}} = 8.94 \text{ m/s}$. The magnitude of momentum is the same, $p = mv = 17.9 \text{ kg m/s}$, but the direction of the momentum vector differs.
- E 20** If we define Grav. PE to be zero at ground level, then when released, the ball has $PE = mgh = 5 \text{ J}$ and when hitting the ground it has $PE = 0$. The KE at the sidewalk equals the change in PE plus the initial KE, $KE_f = KE_i + \Delta PE = 9 \text{ J}$. Since KE does not depend on the direction of velocity, the previous answer would not change if the ball were thrown straight down.
- E 21** $\Delta W = 1200 \text{ lb ft}$; $P = \frac{\Delta W}{\Delta t} = 1500 \text{ ft lb/s} = 2.73 \text{ hp}$.
- E 22** $\Delta W = \Delta KE = \frac{1}{2}mv_{final}^2 = 3000 \text{ J}$; $P = \frac{\Delta W}{\Delta t} = 1000 \text{ W}$.