

Semester #1 Physics Final Review [Key]

- 1) B. scalar no direction
- 2) A. vector direction (east)
- 3) A. vector direction (south)
- 4) B. scalar no direction

5)

$$a^2 + b^2 = c^2$$

$$(39)^2 + (35)^2 = c^2$$

$$1,521 + 1,225 = c^2$$

$$\sqrt{2,746} \text{ km} = \sqrt{c^2}$$

D. 52.4 km SW = c

6)

$$a^2 + b^2 = c^2$$

$$(20)^2 + (60^2) = c^2$$

$$400 + 3,600 = c^2$$

$$\sqrt{4,000} = \sqrt{c^2}$$

C. 63.2 km SW = c

7)

So, Net force = 0N!

$$F = ma$$

$$0 = \frac{(5 \text{ kg})a}{5}$$

$$0 = a$$

d. 0 m/s² = a

$F = 0 \text{ N}$
 $m = 5 \text{ kg}$
 $a = \cancel{?}$

8) Weight is a force that depends on gravity!

$$F = ma$$

↑ weight ↑ acceleration
due to gravity.
It is 9.81 m/s^2
on Earth!

$$F = 45 \text{ N} \text{ (weight)}$$

$$m = 15 \text{ kg}$$

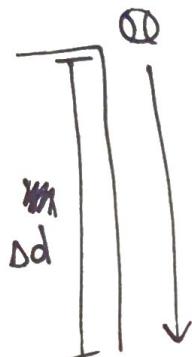
$$a = ?$$

$$F = ma$$

$$\frac{45 \text{ N}}{15 \text{ kg}} = \frac{(15 \text{ kg}) a}{15 \text{ kg}}$$

$$(b) \boxed{3 \text{ m/s}^2 = a}$$

9)



Freefall: Initial velocity is 0 m/s
Acceleration due to gravity is 9.8 m/s^2
only vertical motion

$$\Delta d = v_i \Delta t + \frac{1}{2} a t^2$$

$$\Delta d = (0)(3.1) + \frac{1}{2}(9.8)(3.1)^2$$

$$\Delta d = 0 + 47.1$$

$$(b) \boxed{\Delta d = 47.1 \text{ m}}$$

$\Delta d = ?$ ← how tall the building is
 $v_i = 0 \text{ m/s}$
 $\Delta t = 3.1 \text{ s}$
 $a = 9.8 \text{ m/s}^2$

10)



So F_{net} (net force) is 10 N !

$$F = 10 \text{ N}$$

$$a = 2 \text{ m/s}^2$$

$$m = ?$$

$$F = ma$$

$$\frac{10 \text{ N}}{2 \text{ m/s}^2} = \frac{m (2 \text{ m/s}^2)}{2 \text{ m/s}^2}$$

$$(c) \boxed{5 \text{ kg} = m}$$

11) The gravitational potential energy depends on height

$$PE_g = mgh$$

↑ height

So, it depends on $\boxed{(b) \text{ position}}$

12)



The law of conservation of energy states that energy is never gained or destroyed, and total mechanical energy stays THE SAME!

$$ME = KE + PE$$

C

stays the same!

13) $m = 70 \text{ kg}$

$$P = 210 \text{ W}$$

$$v = 7 \text{ m/s}$$

* a constant velocity means no speeding up ~~or~~ slowing down, so it means NO ACCELERATION!

$$a = 0 \text{ m/s}^2$$

$$F = ?$$

$$F = ma$$

$$F = (70 \text{ kg})(0 \text{ m/s})$$

(d) $F = 0 \text{ N}$

* The power is unnecessary information

14) $m = 60 \text{ kg}$
 $v = 20 \text{ m/s}$
 $t = 0.50 \text{ s}$
 $F = ?$

$$\begin{matrix} F = ma \\ ? & 60 \text{ kg} & \frac{v}{t} \\ ① & a = \frac{v}{t} & \end{matrix}$$

$$a = \frac{20 \text{ m/s}}{0.50 \text{ s}}$$

$$a = 40 \text{ m/s}^2$$

$$\begin{matrix} ② F = ma \\ F = (60 \text{ kg})(40 \text{ m/s}^2) \end{matrix}$$

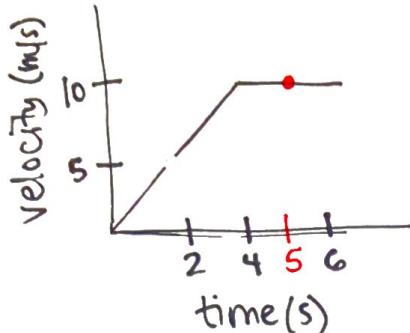
(d) $F = 2,400 \text{ N}$

15) $W = ?$
 $P = 6,000 \text{ W}$
 $t = 10 \text{ s}$

$$\begin{matrix} P = \frac{W}{t} \\ 10 \text{ s} \times 6,000 \text{ W} = \frac{W}{10 \text{ s}} \end{matrix}$$

(d) $60,000 \text{ J} = W$

16)



The slope on a velocity vs. time graph gives you the acceleration.

at $t = 5.0\text{s}$, the slope is 0!

$$(a) 0.0 \text{ m/s}^2$$

The car has a ^{constant} velocity, so is not accelerating.

17) ① Find a from $t = 0\text{s}$ to $t = 4\text{s}$ and use this to find distance.

$$a = \frac{v_f - v_i}{\Delta t}$$

$$\begin{aligned} v_f &= 10 \text{ m/s} \\ v_i &= 0 \text{ m/s} \\ \Delta t &= 4 \text{ s} \end{aligned}$$

$$a = \frac{10 - 0}{4}$$

$$a = 2.5 \text{ m/s}^2$$

$$\Delta d = v_i t + \frac{1}{2} a t^2$$

$$\Delta d = 0 + \frac{1}{2}(2.5)(4)^2$$

$$\underline{\Delta d = 20 \text{ m}}$$

② Find distance from $t = 4\text{s}$ to $t = 6\text{s}$

$$v = \frac{d}{t}$$

$$25 \cancel{10} = \frac{d}{2\cancel{s}} \times 25$$

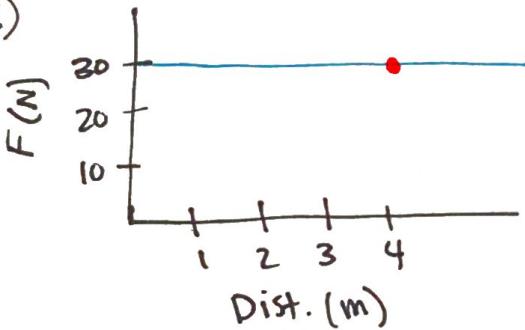
$$\underline{20 \text{ m} = d}$$

③ Add the two distances together

$$20 \text{ m} + 20 \text{ m}$$

$$\boxed{d = 40 \text{ m}}$$

18)



$$W = Fd$$

$$\uparrow \\ W = (30 \text{ N})(4 \text{ m})$$

$$(b) \boxed{W = 120 \text{ J}}$$

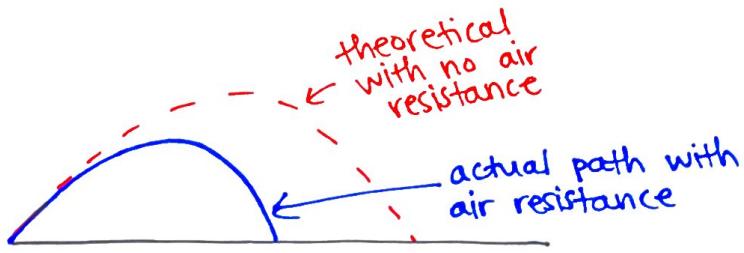
19) (a) velocity is a vector quantity & has direction associated with it.

Vectors: magnitude and direction. Ex: displacement, velocity, force, acceleration

Scalars: magnitude. Ex: distance, speed

20) (a) lower and shorter

Air resistance slows objects down, depending on the object's body shape.



21)

$$a = \frac{v_f - v_i}{\Delta t}$$

$$v_f = 8 \text{ m/s}$$

$$v_i = 28 \text{ m/s}$$

$$\Delta t = 10 \text{ s}$$

$$a = \frac{v_f - v_i}{\Delta t}$$

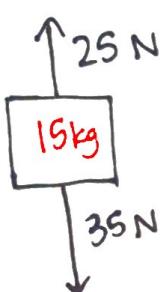
$$a = \frac{8 - 28}{10}$$

$$a = -\frac{20}{10}$$

$$a = -2 \text{ m/s}^2$$

(b)

22)



$$F_{\text{net}} = 10 \text{ N}$$

$$F_{\text{net}} = ma$$

$$10 \text{ N} = (15 \text{ kg})a$$

$$(a)$$

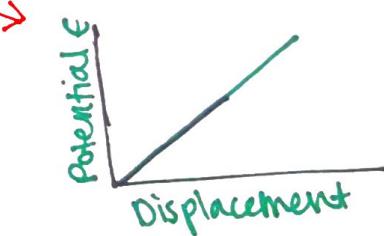
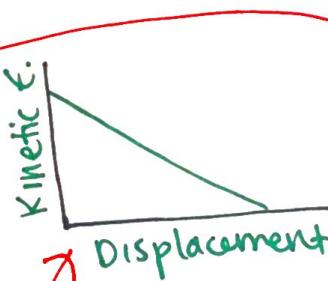
$$a = 0.67 \text{ m/s}^2$$

23) (b) increases and KE remains the same.

- The question states that there is a constant velocity, so the kinetic energy is not increasing or decreasing.
- Gravitational potential energy increases when height increases.

24)

Potential energy increases with height.
Kinetic energy decreases because the object slows down as it goes up. (It slows down because gravity acts against it.)



(1)

25) (d) B and C

$$KE = \frac{1}{2}mv^2$$

object

A. $KE = \frac{1}{2}(1)(4)^2$ $m = 1\text{kg}$
 $KE = 8\text{J}$ $v = 4\text{m/s}$

B. $KE = \frac{1}{2}(2)(2)^2$ $m = 2\text{kg}$
 $KE = 4\text{J}$ $v = 2\text{m/s}$

C. $KE = \frac{1}{2}(0.5)(4)^2$ $m = 0.5\text{kg}$
 $KE = 4\text{J}$ $v = 4\text{m/s}$

D. $KE = \frac{1}{2}(4)(1)^2$ $m = 4\text{kg}$
 $KE = 2\text{J}$ $v = 1\text{m/s}$

27) (d) quadrupled

$m = 5\text{kg}$ if doubled, $m = 5\text{kg}$
 $v = 3\text{m/s}$ $v = 6\text{m/s}$

$$KE = \frac{1}{2}mv^2$$

$$KE = \frac{1}{2}(5)(3)^2$$

$$KE = 22.5\text{J}$$

$\times 4$
quadrupled

$$KE = \frac{1}{2}mv^2$$

$$KE = \frac{1}{2}(5)(6)^2$$

$$KE = 90\text{J}$$

26) $F = 1.81 \times 10^4\text{N}$

$$d = 12\text{m}$$

$$t = 22.5\text{s}$$

$$P = ?$$

$$P = \frac{W}{t}$$

$$P = \frac{Fd}{t}$$

$$P = \frac{(1.81 \times 10^4\text{N})(12\text{m})}{22.5\text{s}}$$

$$P = 9653\text{W}$$

(c) $9.65 \times 10^3\text{W}$

28) $F = 10\text{N}$ weight is a force that depends on gravity
 $d = 40\text{m} - 4\text{m} = 36\text{m}$

$$W = ?$$

$$W = Fd$$

$$W = (10\text{N})(36\text{m})$$

$W = 360\text{J}$

29) (d) a boy jumping down from a tree.
decreasing height, so decreasing potential energy

30) $m = 60\text{kg}$

$$d = 4\text{m}$$

$$t = 8\text{s}$$

$$W = ?$$

$$a = 9.8\text{m/s}^2$$

$$W = Fd$$

$$W = (ma)d$$

$$W = (60 \times 9.8)4$$

$W = 2,352\text{J}$

$F = ma$

(a)

$$31) W = ?$$

$$P = 6,000 \text{ W}$$

$$t = 10 \text{ s}$$

$$P = \frac{W}{t}$$

$$10 \text{ s} \times 6,000 \text{ W} = \frac{W}{10 \text{ s}} \times 10 \text{ s}$$

$$\boxed{60,000 \text{ J} = W}$$

32) Student A

$$F = 50 \text{ N}$$

$$d = 0.40 \text{ m}$$

$$t = 2 \text{ s}$$

$$W = Fd$$

$$= (50)(0.40)$$

$$\boxed{W = 20 \text{ J}}$$

$$P = \frac{W}{t}$$

$$P = \frac{20 \text{ J}}{2 \text{ s}}$$

$$\boxed{P = 10 \text{ W}}$$

Student B

$$F = 40 \text{ N}$$

$$d = 0.50 \text{ m}$$

$$t = 1.0 \text{ s}$$

$$P = \frac{W}{t}$$

$$P = \frac{20 \text{ J}}{1 \text{ s}}$$

$$\boxed{P = 20 \text{ W}}$$

$$W = Fd$$

$$(40)(0.50)$$

$$\boxed{W = 20 \text{ J}}$$

(A)
Same work, but
Student B develops
more power!

$$33) m = 55 \text{ kg}$$

$$h = 370 \text{ m}$$

$$g = 9.8 \text{ m/s}^2$$

$$PE = ?$$

$$PE = mgh$$

$$PE = (55)(9.8)(370)$$

$$PE = 199,430 \text{ J}$$

$$\boxed{(d) 200,000 \text{ J}}$$

$$34) W = 40 \text{ J}$$

$$m = 0.10 \text{ kg}$$

$$a = 9.8 \text{ m/s}^2 \leftarrow \text{due to gravity}$$

$$d = ?$$



$$W = \frac{Fd}{ma}$$

$$F = ma$$

$$40 \text{ J} = (0.10 \times 9.8)d$$

$$\frac{40 \text{ J}}{0.98} = \frac{(0.98)d}{0.98}$$

$$\boxed{40.8 \text{ m} = d}$$

35) $m = 2 \text{ kg}$
 $F = 19.6 \text{ N}$
 $a = 9.8 \text{ m/s}^2$

} on Earth

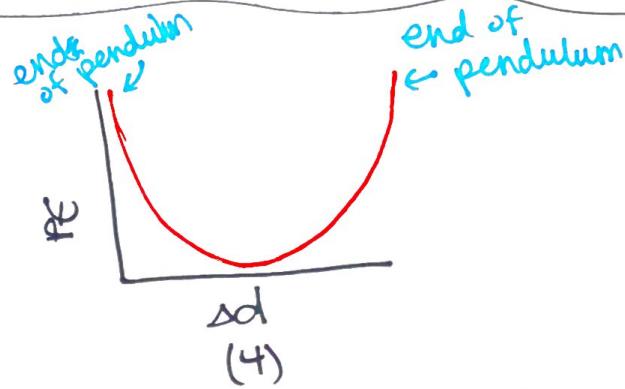
Mass should stay the same on both planets!

(c) 2 kg

$m = ?$
 $F =$
 $a = 3.71 \text{ m/s}^2$

} on Mars

36)



37) $F = 600 \text{ N}$

$v = 3 \text{ m/s}$

$t = 5.0 \text{ s}$

$PE = ?$

$g = 9.8 \text{ m/s}^2$

$PE = mgh$

① Since $F = ma \rightarrow m = \frac{F}{a}$

$PE = \left(\frac{F}{a}\right)(9.8 \text{ m/s}^2)h$

② To find h , use $v = \frac{d}{t}$

$5+3 = \frac{d}{5} \times 5$

$15 \text{ m} = d$

③ Solve to find PE

$PE = \left(\frac{600}{9.8}\right)(9.8)(15)$

PE = 9,000 J

38) (c) it remains the same

Mechanical energy stays the same:
 Total ME is conserved (saved) throughout

39) $m = 1500 \text{ kg}$

$KE = 300,000 \text{ J}$

$v = ?$

$$KE = \frac{1}{2} mv^2$$

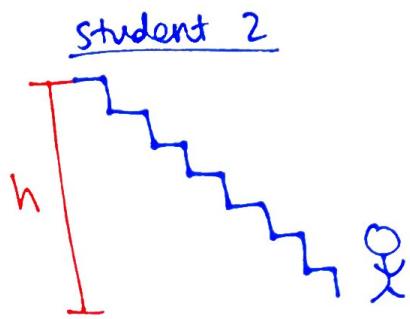
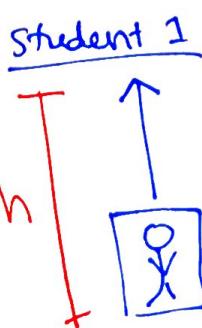
$$300,000 \text{ J} = \frac{1}{2}(1500 \text{ kg})v^2$$

$$\frac{300,000 \text{ J}}{750} = \frac{750 v^2}{750}$$

$$\sqrt{400} = \sqrt{v^2}$$

(b) $20 \text{ m/s} = v$

40) (c) the same

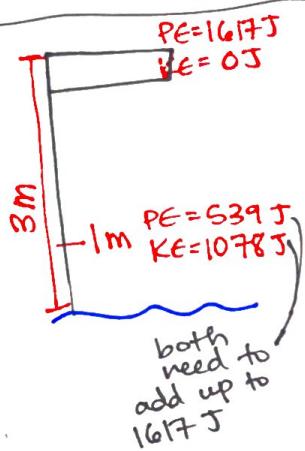


gained the same PE because they ended at the same height (h).

$$41) m = 55 \text{ kg}$$

$$h = 3 \text{ m}$$

$$g = 9.8 \text{ m/s}^2$$



$$(d) PE = 540 \text{ J}$$

$$KE = 1080 \text{ J}$$

$$\frac{PE \text{ at } 3 \text{ m}}{PE = mgh}$$

$$PE = (55)(9.8)(3)$$

$$PE = 1617 \text{ J}$$

$$\frac{KE \text{ at } 3 \text{ m}}{KE = 0 \text{ J}}$$

$$\frac{ME \text{ at } 3 \text{ m}}{ME = KE + PE}$$

$$ME = 1617 + 0$$

$$ME = 1617 \text{ J}$$

has ↑
to be the
same at every
point!

$$\frac{PE \text{ at } 1 \text{ m}}{PE = mgh}$$

$$PE = (55)(9.8)(1)$$

$$PE = 539 \text{ J}$$

$$\frac{KE \text{ at } 1 \text{ m}}{ME = KE + PE}$$

$$1617 \text{ J} = KE + 539 \text{ J}$$

$$- 539 \text{ J}$$

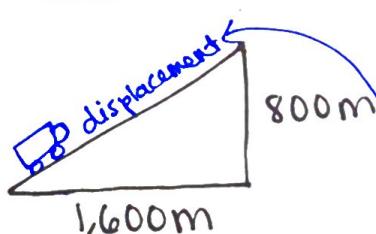
$$1078 \text{ J} = KE$$

$$42) F = 30,000 \text{ N}$$

$$d_x = 1,600 \text{ m}$$

$$d_y = 800 \text{ m}$$

$$t = 480 \text{ s}$$



$$a^2 + b^2 = c^2$$

$$(800)^2 + (1,600)^2 = c^2$$

$$\sqrt{320,000} = \sqrt{c^2}$$

$$1,788.9 \text{ m} = c$$

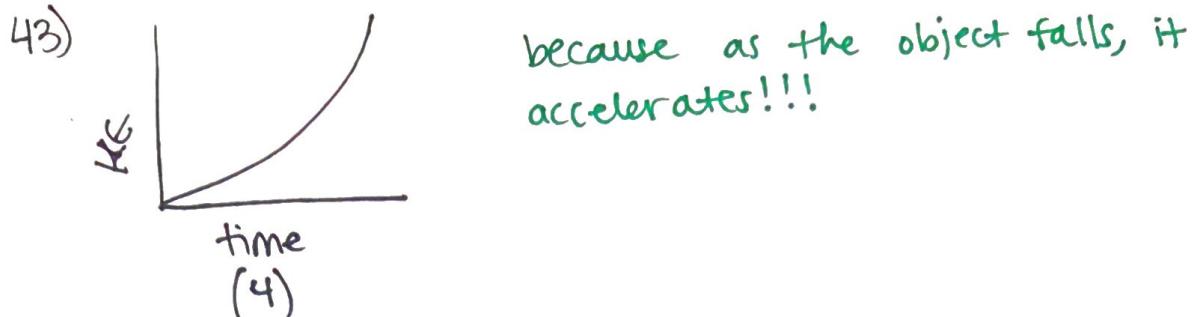
$$P = \frac{W}{t} \quad W = Fd$$

$$P = \frac{Fd}{t}$$

$$P = \frac{(30,000)(1,788.9)}{480}$$

$$(c) 1.0 \times 10^5 \text{ W}$$

$$P = 111806 \text{ W}$$



44) $W = Fd$

$$W = (600\text{N})(3\text{m})$$

$$W = 1800 \text{ J}$$

$$PE = mgh$$

$$PE = (50)(9.8)(3)$$

$$PE = 1470 \text{ J}$$

$$F = 600 \text{ N}$$

$$d \text{ or } h = 3 \text{ m}$$

$$g = 9.8 \text{ m/s}^2$$

$$\begin{array}{r} 1800 \text{ J} \\ - 1470 \text{ J} \\ \hline 330 \text{ J} \end{array}$$

(c) 330 J less

45) $m = 75 \text{ kg}$

$$h = 3 \text{ m}$$

$$g = 9.8 \text{ m/s}^2$$

$$PE = mgh$$

$$PE = (75)(9.8)(3)$$

(c) $\boxed{PE = 2205 \text{ J}}$

46) $m = 60 \text{ kg}$

$$KE = 1920 \text{ J}$$

$$v = ?$$

$$KE = \frac{1}{2}mv^2$$

$$1920 \text{ J} = \frac{1}{2}(60 \text{ kg})v^2$$

$$\frac{1920}{30} = \frac{30v^2}{30}$$

$$\sqrt{64} = \sqrt{v^2}$$

(c) $\boxed{8 \text{ m/s} = v}$

47) $P = 120 \text{ W}$

$$F = 15 \text{ N}$$

$$t = 5 \text{ s}$$

$$d = ?$$

$$P = \frac{W}{t}$$

$$W = \boxed{Fd}$$

$$P = \frac{Fd}{t}$$

$$5 \times 120 = \frac{(15)d}{5} \times 5$$

$$\frac{600}{15} = \frac{15d}{15}$$

(b) $\boxed{40 \text{ m} = d}$

48) $m_1 = 45 \text{ kg}$ ← mass of boy
 $m_2 = 15 \text{ kg}$ ← mass of bicycle
 $v = 8 \text{ m/s}$ ← boy & bicycle have the same speed
 $KE = ?$

$② KE = \frac{1}{2}mv^2$
 $KE = \frac{1}{2}(60 \text{ kg})(8)^2$
 $KE = 1920 \text{ J}$

① $45 \text{ kg} + 15 \text{ kg} = 60 \text{ kg} = m_{\text{total}}$

49) (c) remains the same Mechanical energy never changes in a system!

50) $P = ?$

$m = 400 \text{ kg}$

$d = 10 \text{ m}$

$t = 8 \text{ s}$

$a = 9.8 \text{ m/s}^2$

because it is being lifted against gravity

$P = \frac{W}{t}$ $\circlearrowleft W = Fd$

$P = \frac{Fd}{t}$ $\circlearrowleft F = ma$

$P = \frac{(ma)d}{t}$

$P = \frac{(400 \text{ kg} \times 9.8 \text{ m/s}^2)(10 \text{ m})}{(8 \text{ s})}$

$P = 4,900 \text{ W}$

51) $h = 0.22 \text{ m}$

$F = 15 \text{ N}$

$PE = ?$

$a = 9.8 \text{ m/s}^2$

1. $F = ma$ ← acceleration due to gravity (9.8 m/s^2) because weight is a force that depends on gravity.

$15 \text{ N} = m(9.8 \text{ m/s}^2)$

$1.53 \text{ kg} = m$ ← you need to find mass first

2. $PE = mgh$

$PE = (1.53)(9.8)(0.22)$

$PE = 3.3 \text{ J}$

52) (b) increases

objects accelerate (increase in velocity) as they fall, so KE increases.

53) $m = 3 \text{ kg}$
 54) $d = 8 \text{ m}$
 $t = 2 \text{ s}$
 $F = 12 \text{ N}$

$$P = \frac{W}{t} \quad W = Fd$$

$$P = \frac{Fd}{t}$$

$$P = \frac{(12 \text{ N})(8 \text{ m})}{2 \text{ s}}$$

$$P = 48 \text{ W}$$

55) Before
 $m_1 = 5 \text{ kg}$
 $v_1 = 20 \text{ m/s}$
 $m_2 = ?$
 $v_2 = 10 \text{ m/s}$

After
 $m_1 = 5 \text{ kg}$
 $v_1 = 10 \text{ m/s}$
 $m_2 = ?$
 $v_2 = 15 \text{ m/s}$

elastic collision because the balls have different velocities after they collide! They do not move together.

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(5)(20) + (m_2)(10) = (5)(10) + (m_2)(15)$$

$$\cancel{100} + (m_2)(10) = \cancel{50} + (m_2)(15)$$

$$- \cancel{50} - m_2(10) = (m_2)(15) - m_2(10)$$

$$\frac{50}{5} = \frac{(m_2)(5)}{5}$$

$$10 \text{ kg} = m_2$$

57) $m = 0.40 \text{ kg}$
 $v_i = 0 \text{ m/s}$
 $v_f = 20 \text{ m/s}$
 $J = ?$

$$J = m\Delta v$$

$$J = (0.40)(20 - 0)$$

$$J = (0.40)(20)$$

$$J = 8 \text{ N}\cdot\text{s}$$

or
 $\text{kg}\cdot\text{m/s}$

58) $m = 60 \text{ kg}$
 $F = 10 \text{ N}$
 $\Delta t = 20 \text{ s}$
 $J = ?$

$$J = F\Delta t$$

$$J = (10 \text{ N})(0.20 \text{ s})$$

$$J = 2 \text{ N}\cdot\text{s}$$

59) Before

$m_1 = 100 \text{ kg}$
 $v_1 = 0 \text{ m/s}$

$m_2 = 500 \text{ kg}$
 $v_2 = 0 \text{ m/s}$

After

$m_1 = 100 \text{ kg}$
 $v_1 = 15 \text{ m/s}$

$m_2 = 500 \text{ kg}$
 $v_2 = ?$

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$
 $(100)(0) + (500)(0) = (100)(15) + (500)v_{2f}$
 $0 = 1500 + 500v_{2f}$
 $-1500 = -1500$
 $\frac{-1500}{500} = \frac{500v_{2f}}{500}$
 $-3 \text{ m/s} = v_{2f}$

60) $m = 0.45 \text{ kg}$
 $v_i = 22 \text{ m/s}$
 $v_f = 0 \text{ m/s}$
 $J = ?$

$J = m \Delta v$
 $J = (0.45 \text{ kg})(0 - 22 \text{ m/s})$
 $J = (0.45)(-22)$
 $J = 9.9 \text{ N}\cdot\text{s} \text{ or } 9.9 \text{ kg}\cdot\text{m/s}$ C

61) (c) the same

62) Before

After

Inelastic because they stick together!

$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$
 $(1)(.50) + (1)(0) = (1 + 1)(0.25)$
 $0.50 = 0.50$

$m_1 = 1 \text{ kg}$
 $v_1 = 0.50 \text{ m/s}$

$m_2 = 1 \text{ kg}$
 $v_2 = 0 \text{ m/s}$

(c) the same before and after the collision

63) $F = 6 \text{ N}$
 $J = 3 \text{ kg}\cdot\text{m/s}$
 $\Delta t = ?$

$J = F \Delta t$
 $\frac{3}{6} = \frac{6 \Delta t}{6}$
 $0.50 \text{ s} = \Delta t$