1. This was Question 8 on HW 0. Just convert from piculs to kg

$$32.1\ piculs \times \frac{100\ gins}{1\ picul} \times \frac{16\ tahils}{1\ gin} \times \frac{10\ chees}{1\ tahil} \times \frac{10\ hoons}{1\ chee} \times \frac{0.3779\ g}{1\ hoon} \times \frac{1\ kg}{1000\ g} \cong 1941\ kg$$

2. This was Question 2 on HW 1. Differentiating gives the velocity $v = 29 - 24t^2$. Setting this to zero gives $t = \sqrt{29/24} \cong 1.1s$.

3. This was Question 4 on HW 1. If the building has height $H = 38.3\ m$ and the initial speed of the ball is s then the position and velocity of the ball are

$$y(t) = H - st - \tfrac{1}{2}gt^2 \qquad \text{and} \qquad v(t) = -s - gt$$

If the window is at height $h = 15.5\ m$ at time $t = 2.00\ s$ then we find the initial speed by

$$h = H - st - \tfrac{1}{2}gt^2 \quad \Rightarrow \quad s = \tfrac{H-h}{t} - \tfrac{1}{2}gt = 1.6\ \tfrac{m}{s}$$

The velocity at this time is

$$v = -s - gt = -21.2\ \tfrac{m}{s}$$

The speed is just the absolute value of this.

4. This was Question 10 on HW 1. Because $\sin(45^\circ) = \cos(45^\circ) = {}^{1}/_{\sqrt{2}}$ the vector displacements of the three puts are

$$\vec{p}_1 = 0 \cdot \hat{\imath} + 3.32 \cdot \hat{\jmath} \quad , \quad \vec{p}_2 = +\frac{1.57}{\sqrt{2}} \cdot \hat{\imath} - \frac{1.57}{\sqrt{2}} \cdot \hat{\jmath} \quad , \quad \vec{p}_3 = -\frac{0.718}{\sqrt{2}} \cdot \hat{\imath} - \frac{0.718}{\sqrt{2}} \cdot \hat{\jmath}$$

The vector sum is $\vec{p}_1 + \vec{p}_2 + \vec{p}_3 \approx 0.60 \cdot \hat{\imath} + 1.70 \cdot \hat{\jmath}$. This is the displacement needed to sink the hole in a single put. Its magnitude is $\sqrt{(0.60)^2 + (1.70)^2} \cong 1.8\ m$.

5. This was Question 1 on HW 2. The dot product is $\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y \cong 26.7$.

6. This was Question 6 on HW 2. The x and y components of the position and velocity are

$$x(t) = 1.30\ t - \tfrac{3.35}{2} t^2 \qquad v_x(t) = 1.30 - 3.35\ t$$

$$y(t) = -\tfrac{4.17}{2} t^2 \qquad v_y(t) = -4.17\ t$$

When the x component is maximized $v_x = 0$. This happens at $t = \frac{1.30}{3.35} \cong 0.388\ s$. At that time $v_y \cong -1.62\ m/s$. The particle's speed is the absolute value of this.

7. This was Question 9 on HW 2. The horizontal distance the balloon drifts is $\sqrt{(9.14\ km)^2 + (19.6\ km)^2} \cong 21.6\ km$. The angle it makes with the horizontal is $\theta = \tan^{-1}\left(\frac{2.16}{21.6}\right) \cong 5.7^\circ$.

8. This was Question 1 on HW 3. In spite of its horizontal motion, the block's vertical motion is just free fall from rest, $\Delta y(t) = -\frac{1}{2}gt^2$. So at $t = 0.19\ s$ it has fallen $\frac{1}{2}\left(980\ \frac{cm}{s^2}\right)(0.19\ s)^2 \cong 18\ cm$.

9. This was Question 3 on HW 3. The ball's horizontal position is $x(t) = v_0 \cos(\theta)\ t$ so it hits the wall at time $t = \frac{d}{v_0 \cos(\theta)} \cong 0.786\ s$. At that time its height is $y(t) = v_0 \sin(\theta)\ t - \frac{1}{2}gt^2 \cong 14.8\ m$.

10. This was Question 6 from HW 3. The radius of the circle is $r = \frac{v^2}{a_c} \cong 3.64\ m$. Because the centripetal acceleration points towards the center of the circle the y coordinate of the center is $4.10\ m + 3.64\ m = 7.74\ m$.

11. This was presented on page 17 of Lecture #8 on Sept. 9. It takes you $t = \frac{60\ m}{4\ m/s} = 15\ s$ to cross the river. During this time the current pulls you down stream a distance $\left(3\frac{m}{s}\right)(15\ s) = 45\ m$.

12. Constant velocity means zero net force. Therefore the three forces must add (as vectors) to zero. F_1 and F_2 are at right angles to each other, so we have ourselves a right angle triangle with short sides 6 and 8, so the hypotenuse is length 10N.

13. This looks tricky and is a variant of the example discussed in class on 9/16. It in fact becomes much easier if you realize that the friction does not matter but here is the complete solution. To find the contact force of m on M, first realize that it is the same as the force of contact M on m (Newton's Third Law). So let's solve for the latter. Then the acceleration from: F_{NET} = ma.

    F_{NET} = F-μ(m+M)g = (m+M)a and so a=F/(m+M) - μg
    The total force on mass m is this F_{NETonm} = mF/(m+M) - mμg
    (contact force on m) = F_{NETonm} + mμg = mF/(m+M) - mμg + mμg (so friction disappears!)
    So, = (contact force on m) = mF/(m+M) = 40/5 = 8 N = (contact force of m on M)

14. Discussed in class on 9/13. It is going down but with decreasing speed. That means the acceleration is up. That means the scale will read high. Formally, with up is positive, F_{NORMAL} – mg = ma where a is positive. Therefore F_{NORMAL} > mg and the scale reads high.

15. Again, we have uniform speed, so the net force is zero, with the diagram from HW4, Q3. I would redraw the diagram making it clear that the angle is not 45^0. I would then draw the normal force, put my axes as horizontal and vertical and add up the forces in the y-direction. This gives $F_N\cos(\vartheta)$ = mg and so $F_N = mg/\cos(\vartheta)$. Now look at the horizontal direction and we find that $F_N\sin(\vartheta)$ = F. So, mg = Fcos(ϑ)/sin(ϑ) and m=20*0.8/(0.6*9.8) = 2.7 kg

16. This is similar to the example in class on 9/11. The action reaction pair is the gravitational force of the earth pulling the ball and the force of the ball pulling up the earth. Remember that an "action-reaction pair" MUST be acting on different objects, otherwise nothing would ever accelerate! Note that not all equal and opposite forces are "action-reaction" pairs. For instance, the rope is pulling the ball with an equal and opposite force to that with which gravity pulls the ball. This is not an action-reaction pair. If the rope pulling the ball is the "action" then the "reaction" to that is the ball pulling the rope. If the rope is pulled up from above so that the ball accelerates up, the force of the rope on the ball is not equal in magnitude to the gravitational force on the ball – but Newton's Third Law still holds!

17. We discussed this situation in class on 9/18. The force of friction is the only horizontal force on the smaller(upper) block. So let's see what it is assuming that it stays on the lower block, and then we will check that it doesn't slip off.

    For the two blocks together F = ma so a = 30/(10+5) = 2 m/s^2

    Now we know the acceleration, that tells us the net force on the upper block (F=ma) is 10 N

    That was easy, now just to check that friction can produce that, let's note the maximum possible static friction is given by 0.6 x 5 x g = 29.4 N, so it is not even close to slipping.

18. This is a simple "Atwood's Machine" which was covered in class on 9/13. The two masses are balanced, so there will be no acceleration. The constant velocity is not relevant and the force on each of the masses is zero. Therefore T=mg for each, so T=19.6 N

19. This is similar to HW4, Question 4. We need to overcome the force of static friction, and the maximum static friction force is given by $\mu_s F_N$ = 0.4(mg-$F_{vertical}$) . Therefore 10 = 0.4(5.1*9.8– $F_{vertical}$) and the numbers work out well, so

    10 = 20 – 0.4 $F_{vertical}$ and $F_{vertical}$ = 25 N

20. A similar problem was discussed in class on 9/16. After 5 seconds it is rising with 10 m/s. Then, immediately after being released it has this initial velocity of 10 m/s and an acceleration (down) of g. Therefore one second later is still rising but with (10-9.8) m/s = 0.2 m/s