19.

v_0	v_f	a	d	t
X	15.0 m/s	9.80 m/s^2	10.0 m	?

Note: All equations require v_0 ; therefore, we must find v_0 first

$$v_f^2 = v_0^2 + 2ad$$
$$(15 \text{ m/s})^2 = v_0^2 + 2(9.80 \text{ m/s}^2)(10.0 \text{ m})$$
$$v_0 = 5.39 \text{ m/s}$$

Now use any equation that you like to find t

$$a = \frac{v_f - v_0}{t}$$
$$9.80 \text{ m/s}^2 = \frac{15.0 \text{ m/s} - 5.39 \text{ m/s}}{t}$$
$$t = 0.981 \text{ s}$$

20.

v_0	v_f	a	d	t
X	?	9.80 m/s^2	9.2 m	0.85 s

Find v_0 first

$$d = v_0 t + \frac{1}{2}at^2$$
$$9.2 \text{ m} = v_0(0.85 \text{ s}) + \frac{1}{2}(9.80 \text{ m/s}^2)(0.85 \text{ s})^2$$
$$v_0 = \frac{9.2 \text{ m} - \frac{1}{2}(9.80 \text{ m/s}^2)(0.85 \text{ s})^2}{0.85 \text{ s}}$$
$$= 6.66 \text{ m/s}$$

Now find v_f

$$a = \frac{v_f - v_0}{t}$$
$$9.80 \text{ m/s}^2 = \frac{v_f - 6.66 \text{ m/s}}{0.85 \text{ s}}$$
$$v_f = 15 \text{ m/s}$$

21.

v_0	v_f	a	d	t
0	60.0 m/s	?	40.0 m	X

$$v_f^2 = v_0^2 + 2ad$$
$$(60.0 \text{ m/s})^2 = 2(a)(40.0 \text{ m})$$
$$a = 45.0 \text{ m/s}^2$$

22. Average velocity during the 2nd second

$$v_{average} = \frac{d}{t}$$
$$= \frac{5.00 \text{ m}}{1.00 \text{ s}}$$
$$= 5.00 \text{ m/s}$$

This is the instantaneous velocity at 1.00 s + 0.50 s = 1.50 s

v_0	v_f	a	d	t
0	5.0 m/s	?	X	1.50 s

$$a = \frac{v_f - v_0}{t}$$
$$= \frac{5.00 \text{ m/s} - 0}{1.50 \text{ s}}$$
$$= 3.33 \text{ m/s}^2$$

Lesson 4: Graphical Analysis

1. Velocity = slope of position-time graph -- we must draw a tangent line and find slope

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

a) $$\text{slope} = \frac{(10.0 - 1.0) \text{ m}}{(6.2 - 0) \text{ s}}$$
$$= 1.5 \text{ m/s}$$
$$= 1.5 \text{ m/s up}$$

b) $$\text{slope} = \frac{(5.0 - 14) \text{ m}}{(10.2 - 4.0) \text{ s}}$$
$$= -1.5 \text{ m/s}$$
$$= 1.5 \text{ m/s down}$$

2. Acceleration = slope of velocity-time graph.

Slope is constant; therefore, acceleration at 4.0 s and 10.0 s are equal.

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{(0 - 18.0) \text{ m/s}}{(12.0 - 2.0) \text{ s}}$$
$$= -1.8 \text{ m/s}^2$$

3.a) Displacement is read from graph
= 14.0 m north

b) Velocity = slope of position-time graph

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{(7.0 - 0) \text{ m}}{(7.0 - 0) \text{ s}}$$
$$= 1.0 \text{ m/s north}$$

