Solutions for all practice problems before Exam 1.

Practice questions Chs. 1, 2, 3, 4:

1) one soft drink every two days per person: each person consumes:

365/2=182.5 drinks per year.

In one year, 270 million Americans drink $270*10^6*182.5=4.93*10^{10}$ soft drinks.

Each can weighs 1/16 pound=1/16 pound*1/2000 ton/pound=1/32000 tons.

The total weight for the aluminum cans consumed in one year in America is:

$4.93*10^{10}$/32000 tons = 1.5*10^6 tons=1.5 million tons (answer B).

2) The answer is A:

The dimensions are: v=[L]/[T]; x=[L]; → v/x=[L]/[T]/[L]=1/[T].

3) Velocity is a vector. Subtracting two vectors still gives me a vector. Dimensionally, subtracting two velocities still gives me a velocity (Answer A).

4) We choose the y axis to point upward and we put the origin on the ground.

Use the equation of motion for an object under the influence of gravity:

$y=y_0+v_0t-1/2gt^2$.

In our case $y_0=0$ (the rocket starts from the ground) and y=0 (the object comes back to the ground). Also, $v_0=19.6$m/s (since it is thrown straight up, the velocity is positive because it is in the positive y direction). Therefore the equation reduces to:

$1/2gt^2-v_0t=0$ → $t(1/2gt-v_0)=0$ → the equation has two solutions: t=0 and $t=2v_0/g=2*19.6/9.81$ s= 4.0 s

Correct answer: A.

5) We first convert the final speed from km/h to m/s:

100 km/h = 100 km *1000 m/km *1/3600 h/s= 27.8 m/s.

The car accelerates from 0 to 27.8 m/s in 8 s. We calculate the average acceleration:

$a_{AV}=27.8/8\ m/s^2=3.48\ m/s^2$.

The speed of the car after 5 seconds is just given by the average acceleration times the time: $v_f=5s*3.48\ m/s^2=17.4\ m/s$ (Answer D).

6) y axis pointing upwards, origin on the ground. So, $y_i=30$ m; $y_f=0$.

We use the formula: $v^2=v_0^2+2a\Delta y$.

With $v_0=-14$ m/s, $a=-9.81\ m/s^2$ and $\Delta y=y_f-y_i=-30$ m we get: 28 m/s. (Answer B).

7) positive y axis pointing upwards. Origin at the hand of the lab partner.

Equation of motion: $y=-1/2gt^2$. So we find: y=-19.6m. So, the distance the ruler can fall before we catch it is 19.6 m (Answer D).

8) Vector 1: $50\,\hat{x}$; Vector 2: $-100\ Cos30\ \hat{x} + 100\ Sin30\ \hat{y} = -86.6\,\hat{x} + 50\,\hat{y}$

The sum is Vector 3: $-36.6\,\hat{x} + 50\,\hat{y}$.

The magnitude squared will be: 36.6^2+50^2. Taking the square root we get: 62.2.

The angle is given by $\tan^{-1}[50/(-36.6)]=54$ degrees north of west (Answer D).

9) It takes the ball 3 seconds to complete its trajectory. We know the time it takes the ball to go from initial to final position, both in the horizontal and vertical directions. I can find the horizontal displacement remembering that the projectile motion in the horizontal direction is a one-dimensional motion with constant velocity, given by the horizontal component of the initial velocity. Therefore:

$v_{0x}=29.4*Cos[30]m/s=25.46$ m/s.

The x displacement is simply given by: $x=v_{0x}t=76.4$m. (Answer A).

10) The vertical motion is a motion with constant acceleration. The general formula is:

$y=y_0+v_{0y}t+1/2at^2$.

We fix the origin of the axes at the bottom of a cliff, with positive y pointing upwards.

With this choice we have: v_{0y}=12*Sin[30]m/s=6m/s; a=-g; y=0 (the stone falls on the ground).

The unknown is y_0.

We get: $0=y_0+6*5.6m-1/2*9.81*5.6^2m \rightarrow y_0=1/2*9.81*5.6^2m-6*5.6m=120$ m (Answer C).