PHYS 211 Exam 3 - Practice Test - Solutions

1E

This one's a little tricky. A lot of information is provided, but once they ask for net work and tell us that velocity is constant, we know that $\Delta K = 0$ and since there is no change in height, the net work done must be zero, since $\Delta K = W_{Net}$.

2D

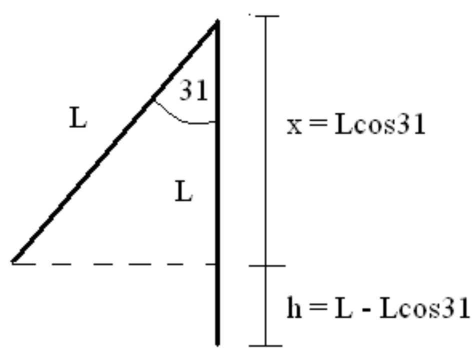
The net force acting on the object will be given by the eqn:

Fnet = 100 – f = ma = 3.1 x 20

From that we can solve for the force of friction, f = 38 N

Lastly, Work, W = -f x d = -38 x 20 = -760 J

3C



This questions really deals with conservation of energy, $\Delta K + \Delta U = 0$.

The main problem is determining the initial height, h, of the man just as he starts to swing.

The diagram above shows how the length of the rope, L, can be split into L = x + h, and how we can solve for the height using trig.

So we get the following equation:

$$\left(\tfrac{1}{2}mv_f^{\,2} - \tfrac{1}{2}mv_i^{\,2}\right) + (0 - mgh) = 0$$
$$v_f = 6.77 m/s$$

4E
This is another conservation of energy question, though this time we have friction, so we get
$\Delta K + \Delta U = Wnc$

This breaks down to $\frac{1}{2} m v_f^2 - mgh = -\mu mg \cos 40(6.22)$, where 6.22 is the distance the block travels down the incline given by (h/sin40).

From this the mass cancels out and v = 6.03 m/s

5D
From the first compression: $\frac{1}{2}kx^2 = 120$, so k = 24000 N/m

For the second we just plug in the new k value and solve for x = 0.1207 m

6B

We know that Wnet = ΔK…so if we can get the initial and final velocities we can solve for work.

To do this we must take the derivative of the position function to get v(t).

Now we can calculate the v at t=0 and t=3

v(0) = 1 ms, v(3) = 10 m/s

And so: W = ΔK = ½(6)(99) = 297 J

7C
For this we imagine a number line with the girl at the origin (since the question asks for distance relative to her) at the boy at a distance of 10 m.

To calculate center of mass: $\frac{(40 \times 0) + (60 \times 10)}{100} = 6$

So we conclude that the center of mass is 6 m from the origin, or 6 m from the girl.

8B
We know that $\Delta K = W_{net}$

So we re-write Work into its components, $W_{net} = Fd + -\mu mgd$

We then solve for F, and get F = 9.96 N

9C
Power, P is Work/Time. In this question the dog does work by lifting his own weight up the height of the stairs.

So we get: $P = \frac{W}{t} = \frac{mg(15 \times 0.25)}{11} = 83.5W$

10B

When each child throws the ball he/she gives the ball momentum, p = (0.35)(4.5) = 1.575 kg m/s

Since momentum must be conserved, the child also gets 1.575 kg m/s of momentum, just in the other direction.

Furthermore, after catching the ball, the child picks up another 1.575 kg m/s of momentum.

This means in total each child gets 3.15 kg m/s of momentum.

From this we can calculate the velocity, $v = \Delta p/m$ = 0.063 m/s, where the mass is 490/9.8

11A

Since after the collision the object is now at some angle relative to its initial motion, we have to deal with conservation of momentum in each axis (x and y).

For the x-axis we get: 10m = (2.5cos20)m + (v_x)2m, which gives us v_x = 3.825 m/s

For the y-axis we get: 0 = (2.5sin20)m + (v_y)2m, which gives us v_y = -0.428 m/s

Note that the masses cancel out in both eqns.

Finally we combine the two velocity vectors to get the resultant velocity,

$$v = \sqrt{v_x^{\;2} + v_y^{\;2}} = 3.85 m/s$$

12B

Another case of conservation of energy:

(-½mv^2) + (½kx^2 – mgh) = 0, where h = 6sin30 = 3 m

From that we can solve for initial speed, v = 6.1 m/s

13B

This question is a real pain!

It deals with conservation of energy but this time there are two non-conservative forces that do work on the object.

So ΔK +ΔU = Wnc becomes:

(-½mv^2) + (½kx^2) = -Fcos60(d + x) + -μn(d + x)

Note that we use (d + x) for distance when calculating work done because the object is still moving as it compresses the spring.

Also, to calculate normal force, n, we use the free body diagram for the y-axis which shows:
Fsin60 + n = mg….and so we get n = mg – Fsin60 = 11.4 N

Lastly we solve for μ and get 0.64.

14A

The easiest way to do this is to recognize that the two momentums are at right angles and thus their vectors can be combined using Pythagorean theory.

Since momentum is conserved p(initial) = p(final) and we can write: $(p_x)^2 + (p_y)^2 = p^2$

This becomes $(3m)^2 + (4m)^2 = (v2m)^2$

And then $25m^2 = 4m^2v^2$, and we get v = 2.5 m/s after the masses cancel out.

15A

The net force acting on the spring on the block is given by F = -kx. Since net force is always equal to mass x acc as well, we can set them equal to each other:

$-kx = ma$

All we have to do now is solve for a:

$a = -kx / m = 1.4 \text{ m/s}^2$