Physics 12 Year End Review

Kinematics

1. What is the acceleration of a ball that bounces off a wall in 0.30 s if its incoming velocity is 60. m/s and its recoil velocity is 50. m/s? **∆v = vf – vi = 110. m/s therefore a = ∆v/∆t = 110/0.3 = 367 m/s2**
2. A car is traveling at 100 km/h **(27.8 m/s)**, due northwest. The driver puts on the brakes and turns the corner. Four seconds later, he is heading east at 50 km/h **(13.9 m/s)**. What is the average acceleration?

3. A boat can travel 4.30 m/s in still water. If the boat heads directly across a river with a current of 6.50 m/s:

1. What is the velocity of the boat relative to the shore? **2.75 m/s**
2. At what angle compared to straight across is it traveling? **θ = 33.1°**

How far from its point of origin is the boat after 8.0 s?

1. A seagull flying with an air speed of 10 km/h is flying north but suddenly encounters a wind of 5 km/h at 20° south of east. What will be the new direction and airspeed of the seagull? **9.53 m/s 60.5˚ N of E**

A pilot wishes to reach a city 600.0 km away in a direction of 15° S of W in two hours. **(v = 300 km/h at this same direction - this is the resultant vector in the vector diagram!)** If there is a wind of 70 km/h blowing at 10° W of S. What must be the heading and air speed of the plane

1. A plane heading due north with an air speed of 250 km/h is blown off course by a wind blowing at 50 km/h to the NE. What will be the ground speed and direction of the plane? **288 km/h at 7.1˚ E of N**
2. A boat capable of 10.5 knots in still water wishes to cross a narrows at a bearing of 23° N of E. If the current in the narrows is at 3.7 knots at 8° E of S. What must be the heading of the boat and what will be its chart speed? **The trick is to draw the resultant vector then the two vectors that will add to this. Must use the sin law first to find the angle between the vectors (I found all three angles). The angle between the two vectors is 105˚. The velocity is 8.9 knots at 43˚ N of E.**

4. A rescue pilot wishes to drop a package of emergency supplies so that it lands as close as possible to a target. If the plane travels with a velocity of 81 m/s and is flying 125 m above the target, how far away (horizontally) from the target must the rescue pilot drop the package? **It will take 5.05 s to fall 125 m (use d = vit+1/2at2), therefore the package must be dropped 5.05 s before the plane flies over its target. Hence, the distance away is d = vxt = 81 x 5.05 = 409 m**

5. An archer standing on the back of a pickup truck moving at 28 m/s fires an arrow straight up at a duck flying directly overhead. The archer misses the duck! The arrow was fired with an initial velocity of 49 m/s relative to the truck.

1. For how long will the arrow be in the air? **Only the vy matters … 10.0 s**
2. How far will the truck travel while the arrow is in the air? **280 m**

Where, in relation to the "duckless" archer, will the arrow come down? Will the archer have to 'duck'

11. A diver takes off with a speed of 8.0 m/s from a 3.0 m high diving board at 30˚ above the horizontal. How much later does she strike the water? **Use d = vit+1/2at2, the displacement is –3.0 m and vy = +4.0 m/s, solve the quadratic equation using quad formula to find t = 1.29 s**

12. A pilot cuts loose two fuel tanks in an effort to gain altitude. At the time of release, the plane was 120 m above the ground and traveling upward at 30˚ to the horizontal, with a speed of 84 m/s. For how long did the tanks fall and with what speed did they hit the ground?

**The tanks would have vx = 72.7 m/s and vy =42.0 m/s, use d = vit+1/2at2 to find t (solve the quadratic). Time is 10.8 s. Since the viy = 42 m/s, find vfy = 63.8 m/s using vf = vi +at. The resultant velocity is 96.7 m/s.**



33. A 0.75 kg ball is thrown at 32° above the horizontal at 29 m/s from the hot air balloon when the balloon is 25 m above the ground. **The balloon is traveling upwards at a constant velocity of 4.5 m/s**.

**Dynamics**

2) A 0.10 g spider is descending on a strand of web which supports it with a force of 5.6 x 10-4 N. What is the acceleration of the spider? ( - 4.2 m/s2 or 4.2 m/s2 downward)

3) A 75 kg criminal wants to escape from the 5th storey window of the jail, 24 m above the ground. He has a rope but it can only support a tension force of 650 N.

a. What is the minimum acceleration he can have as he lowers himself? (1.1 m/s2)

b. How fast is he traveling when he hits the ground below? (7.3 m/s)

1.0 kg

1.5 kg

13) A 1.0kg box on a frictionless surface is attached to a 1.5 kg box as shown. What is the acceleration of the 1.0 kg box? (5.9 m/s2)

1.5

2.0

14) Two masses are hung from a frictionless pulley as shown. What is the acceleration of:

a. the 1.5 kg block? (1.4 m/s2 up)

b. the 2.0 kg block? (1.4 m/s2 down)

4) A pack of five Artic wolves are exerting five different forces upon the carcass of a 500-kg dead polar bear. A top view showing the magnitude and direction of each of the five individual forces is shown in the diagram at the right.

20 N 90o

30 N 45o

25 N 0o

50 N 270o

20 N 225o

What is the resultant force?

(39.4 N 324o)

2) A 7.6 kg object is pulled up an inclined plane. If the plane makes an angle with the horizontal of 33o and the coefficient of friction is 0.20, what is the force of friction?

(12 N)

3) A 16.2 kg object slides down an inclined plane at a constant velocity. If the plane makes an angle of 25o, what is the normal force acting on the object? (144 N)

1) Two blocks are tied together with a string as shown.

m2 = 1.0 kg

m1 =

2.0 kg

30o

If both the pulley and incline are frictionless find

1. the direction and magnitude of acceleration on
the 1.0 kg mass.

(4.9m/s2 up the ramp)

1. the tension in the string joining the blocks.

(9.8 N)

2) If the ramp and block in question 1 have a coefficient of friction of 0.135, what will be the block’s acceleration? (4.5 m/s2)





b) If 0.150 kg of mass is transferred from the box to the hanger, what is the acceleration of the system? (7 marks)

**WEP and Mo**

9. A 25.0 kg pickle is accelerated from rest through a distance of 6.0 m in 4.0 s across a level floor. If the friction force between the pickle and the floor is 3.8 N, what is the work done to move the object?

9) 140 J 10) -1.4x105 J

10. A 1165 kg car traveling at 55 km/h is brought to a stop while skidding 38 m. Calculate the work done on the car by the friction forces.

8. A roller coaster car starts from rest at point A. What is its speed at point C if the track is frictionless?

12.0 m

2.0 m

4.0 m

A

B

C

9. A 2.5 kg object is dropped from a height of 10.0 m above the ground. Calculate the speed of the object as it hits the ground.

10. An 80.0 kg student running at 3.5 m/s grabs a rope that is hanging vertically. How high will the student swing?

6) A 5.00 x 102 W electric motor lifts a 20.0 kg object 5.00 m in 3.50 s. What is the efficiency of the motor? (56%)

7) If a 1.00 x 102 kW motor has an efficiency of 82%, how long will it take to lift a 50.0 kg object to a height of 8.00 m? (0.048 s)

6. A pendulum is dropped from the position shown, 0.25 m above its equilibrium position. What is the speed of the pendulum bob as it passes through its equilibrium position?

1.00 m

0.25 m

30o

12.0 m

7. A box slides down a frictionless incline as shown. If the box starts from rest, what is its speed at the bottom?

10. A 25 kg turkey is fired from a 1.1 x 103 kg turkey launcher. If the horizontal velocity of the turkey is 325 m/s east, what is the recoil velocity of the launcher? (7.4 m/s west)

11. A vehicle with a rocket engine is being tested on a smooth track. Starting from rest the engine is fired for a short period of time, releasing 4.5 x 102 kg of gases. It is estimated that the average velocity of the gases is 1.4 x 103 m/s to the right, and that the maximum velocity of the vehicle is 45 m/s left. What is the mass of the vehicle? (1.4x104 kg)

5. A 5.00 kg object accelerates uniformly from rest to a velocity of 15.0 m/s east. What is the change in momentum on the object?

6. An average net force caused an 11.0 kg object to accelerate uniformly from rest. If this object travels 26.3 m west in 3.20 s, what is the change in momentum of the object?

7. A 1.30 kg object is dropped from a height of 6.5 m. How far did the object fall when its momentum is 6.0 kgm/s?

8. An average net force of 16.0 N acts on an object for 2.00 x 10-1 s causing it to accelerate from rest to 3.50 m/s. What is the mass of the object? .91 kg

6. A watermelon explodes into three equal masses. One mass moves east at 15.0 m/s. If a second mass moves at a velocity of 10.0 m/s 45.0o S of E, what is the velocity of the third mass? (Hint: the total momentum is zero, so how will your vector arrows add up?)







**Equilibrium**

1) W1, W2 and W3 are the weights of three objects suspended by pulleys as shown. Assuming the pulleys in this system are frictionless and weightless and that W3 = 120 N, what are the values of W1 and W2?

**W1**

**W3**

**W2**

50o

24o

 (W1 = 80.0 N, W2 = 114 N)

25o

2) An object is suspended on a frictionless inclined plane by a rope parallel to the incline as shown. If the angle of the incline is 25o and the tension in the rope is 500 N, what is the weight of the object? (1.18 x 103 N)

7) Given the following diagram, find W and T2.

W = ?

60o

30o

T1 = 96 N

(110 N, 55 N)

8) A 675 N object is pulled horizontally by a force of 410 N as shown. What is the angle, ~~0~~, between the rope and the vertical?

**675 N**

F = 410 N

~~0~~

 (31.3o)

3) Two students sit on either end of a uniform teeter-totter. Student 1 sits 1.10 m from the pivot while Student 2 sits 0.85 m from the pivot. If Student 1 has a mass of 72 kg, what is the mass of Student 2? (93 kg)

**1.2 m**

**0.90 m**

4) A 0.75 kg bird stands on a uniform 1.0 kg stick as shown. The stick is attached to a wall with a hinge and to the ceiling with a rope of negligible mass. What is the tension in the rope? (10.4 N)

6) A 650 N student stands on a 250 N uniform beam that is supported by two supports as shown in the diagram. If the supports are 5.0 m apart and the student stands 1.5 m from the left support:

a) What is the force that the right support exerts on the beam? (320 N)

b) What is the force that the left support exerts on the beam? (580 N)

7) A uniform 400 N diving board is supported at two points as shown in the diagram. If a 75 kg diver stands at the end of the board, what are the forces acting on the each support?

 (left support = 2.61x103 N down , right support = 3.74x103 N up)

2.0 m

0.50 m

5) The diagram below shows the top view of a door that is 2 m wide. Two forces are applied to the door as indicated in the diagram. What is the net torque on the door with respect to the hinge?

 (8.66 Nm clockwise)

25o

**13 kg**

6) A 2.6 m uniform beam (mass of 9.0 kg) is attached to a wall by a hinge and supported by a rope. A 13 kg mass hangs from the beam 2.2 m from the hinge. Find the tension in the rope which is attached to the beam 1.1 m from the wall.

 (770 N)



b) What are the magnitude and direction of the force that the pin exerts on the beam?(7)



**Circular motion and Gravitation**

1) Calculate the centripetal force acting on a 925 kg car as it rounds an unbanked curve with a radius of 75 m at a speed of 22 m/s.

 (6.0x103 N)

2) A small plane makes a complete circle with a radius of 3282 m in 2.0 min. What is the centripetal acceleration of the plane?

 (9.0 m/s2)

5) A 2.2 kg object is whirled in a vertical circle whose radius is 1.0 m. If the time of one revolution is 0.97 s, what is the tension in the string (assume uniform speed)

a) at the top? (71 N)

b) at the bottom? (114 N)

5) What is the gravitational potential energy (relative to infinite) of a 5.00x103 kg satellite that is in orbit with a radius of 9.90x106 m around the Earth? (-2.0x1011 J)

6) How much work is done against gravity in lifting the satellite in problem #5 from Earth’s surface to its orbital height? (1.11x1011 J)

11) A 12500 kg satellite is in Earth orbit at an altitude of 3.60x106 m. What is its **total** energy?

HINT: Total Energy = Ep + Ek (-2.50x1011 J)

50.



