Physics Fall 2013 Final Review Problems

1D Kinematics

1. If a truck traveling 35.0 km/hr uniformly accelerates up to 50.0 km/hr, what is its average speed in the process?
42.5m/s

2. An elevator accelerates upward from rest at 0.98 m/s^2. A) What was its initial speed? B) How fast is it moving after 7 seconds? C) How high has it risen in those 7 seconds? A) $V_i = 0$ B) 6.86m/s C) 24.0m

3. The speed of a car is increased at a constant rate. If the speed is increased by 74 m/s over a 6 second period, what is the acceleration? 12.33 m/s^2

4. A car traveling 20 m/s is accelerated uniformly at the rate of 7.1 m/s^2 for 3.8 s. What is the car's final speed? 47 m/s

5. An electron initially at rest, leaves a cathode and is uniformly accelerated in a straight line toward an anode. It reaches the anode in 0.02 s traveling at a speed of 1500 m/s. what is its acceleration? 75000 m/s^2

6. A supersonic jet flying at 200 m/s is accelerated uniformly at the rate of 23.1 m/s^2 for 34 s. What is its final speed?
985 m/s

Vectors and Projectiles Review Problems

1. Claire de Iles is shopping. She walks 16 m to the end of an aisle. She then makes a right hand turn and walks 21 m down the end aisle. Determine the magnitude of Claire's resultant displacement. 26m

2. Jim Nazium is walking from lunch to his PE class. He exits the lunchroom and walks 43 m west. He then turns and walks 72 m north down the hallway leading to the locker room. Determine the magnitude and direction of Jim's resultant displacement. 84m 59° N of W

3. In an effort to create a cannonball-style splash, eight-year old Matthew runs off the edge of the board of the high dive at 4.6 m/s and falls 2.3 m to the water below.

a. Determine the time for Matthew to fall the 2.3 m to the water. 0.69s
b. What horizontal distance from the edge of the board will Matthew plunge into the water? 3.2 m
c. With what speed does Matthew enter the water? 6.76m/s

4. Ima Peode wishes to throw a 2.8-kg pumpkin horizontally off the top of the school roof in order to hit Mr. H's car. The car is parked a distance of 13.4 m away from the base of the building below the point where Ima is standing. The building's roof is 10.4 m high. Assuming no air resistance, with what horizontal speed must Ima toss the pumpkin in order to hit Mr. H's car. 9.2m/s

5. A guy at the top of a building gets bad news on his cell phone and in a fit of rage throws it horizontally over the side of a building with a velocity of 4 m/s. The phone lands and breaks apart 16 m away from the building. According to the way we work calculations, which of the following is NOT true:

a. The air resistance is negligible.
b. The acceleration in the x direction is 9.8 m/s^2
c. The initial velocity in the y direction is 0 m/s
d. The acceleration in the y direction is gravity.

Forces Review Problems

1. For each collection of listed forces, determine the vector sum or the net force.

Set A
58 N, right
42 N, left
98 N, up
98 N, down
16N right

Set B
14 N, left
16 N, up
16 N, down
14N left

Set C
12 N, up
8 N, down
4N up

2. An African elephant can reach heights of 13 feet and possess a mass of as much as 6000 kg. Determine the weight of an African elephant in Newtons and in pounds. (Given: 1.00 N = .225 pounds)
58800N, 13230 lb

3. With fuel prices for combustible engine automobiles increasing, researchers and manufacturers have given more attention to the concept of an ultralight car. Using carbon composites, lighter steels and plastics, a fuel-efficient car can be manufactured at 540 kg. How much less does an ultralight car weigh compared to a 1450-kg Honda Accord (2007)?

8918N

4. According to the National Center for Health Statistics, the average mass of an adult American male is 86 kg. Determine the mass and the weight of an 86-kg man on the moon where the gravitational field is one-sixth that of the Earth.

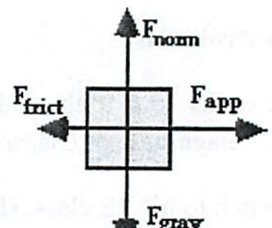
Weight= 140.5N mass = 86kg

5. Captain John Stapp of the U.S. Air Force tested the human limits of acceleration by riding on a rocket sled of his own design. His rocket sled, known as the Gee Whiz, had a mass of about 82 kg. What net force would be required to accelerate the Gee Whiz and 82-kg Stapp at 450 m/s/s (the highest acceleration tested by Stapp)?

36900 N

a. Determine the net force required to accelerate a 540-kg ultralight car from 0 to 27 m/s (60 mph) in 10.0 seconds.
b. Determine the net force required to accelerate a 2160-kg Ford Expedition from 0 to 27 m/s (60 mph) in 10.0 seconds.

a) 14288N
b) 57154N



For the free body diagram problems use the diagram as a reference:

6. Ethan is dragging a bag of grass from the garage to the street on the evening before garbage pick-up day. The diagram at the right is a free-body diagram. It uses arrows to represent the forces acting upon the bag. Each force is labeled according to type. The magnitude of the force is represented by the size of the arrow. Use the free body diagram to determine the net force acting upon the bag. The values of the individual forces are:

$F_{grav} = F_{norm} = 60.5$ N
$F_{app} = 40.2$ N
$F_{frict} = 5.7$ N.

$F_{net} = 34.5N$

7. Unfortunately for Vanessa, the wheels on her suitcase are not working. She pulls on the strap in an effort to budge it from rest and drag it to the curbside check-in desk. The free body diagram at the right depicts the forces acting upon the suitcase. Use force values to determine the net force, the mass and the acceleration of the suitcase. The values of the individual forces are:

$F_{grav} = F_{norm} = 207$ N
$F_{tens} = 182$ N
$F_{frict} = 166$ N.

$F_{net} = 16N$ $207N = mg$ $m = 21.1 kg$ $a = 0.76 m/s^2$

8. Nicholas, Brianna, Dylan and Chloe are practicing their hockey on frozen Bluebird Lake. As Dylan and Chloe chase after the 0.162 kg puck, it decelerates from 10.5 m/s to 8.8 m/s in 14 seconds.

a. Determine the acceleration of the puck. $-0.12 m/s^2$
b. Determine the force of friction experienced by the puck. $-0.02 N$

Circular Motion and Gravitation Review Problems

1. The tallest Ferris wheel in the world is located in Singapore. Standing 42 stories high and holding as many as 780 passengers, *the Ferris wheel has a diameter* of 150 meters and takes approximately 30 minutes to make a full circle. Determine the speed of riders (in m/s and mi/hr) on the Singapore Flyer. (**GIVEN**: 1.00 m/s= 2.24 mi/hr)

$V = \frac{2\pi(75)}{30(60)} = 0.26 m/s, 0.59 mi/hr$

2. Elmira, New York boasts of having the fastest carousel ride in the world. The merry-go-round at Eldridge Park takes riders on a spin at 18 mi/hr (8.0 m/s). The radius of the circle about which the outside riders move is approximately 7.4 m.

a. Determine the time for outside riders to make one complete circle. $T = 2\pi(7.4)/8 = 5.8$ s

b. Determine the acceleration of the riders. $a_c = \frac{8^2}{7.4} = 8.6$ m/s²

3. Determine the force of gravitational attraction between the Earth and the moon. Their masses are 5.98×10^{24} kg and 7.26×10^{22} kg, respectively. The average distance separating the Earth and the moon is 3.84×10^{8} m. $F_g = 1.96 \times 10^{20}$ N

4. Tyrone and Mia have masses of 84 kg and 59 kg respectively. They sit 1.0 m apart in the front center of Mr. H's Physics class. For some time, they each have been sensing a sort of electricity in their growing relationship. And now, six units into their Physics course, they have learned that they are gravitationally attracted to each other. Determine the magnitude of this force of gravitational attraction. 3.3×10^{-7} N

Work, Energy, and Power Review Problems

1. Renatta Gass is out with her friends. Misfortune occurs and Renatta and her friends find themselves getting a *work*out. They apply a cumulative force of 1080 N to push the car 218 m to the nearest fuel station. Determine the work done on the car. W = 235440 J

2. During the Powerhouse lab, Jerome runs up the stairs, elevating his 102 kg body a vertical distance of 2.29 meters in a time of 1.32 seconds at a constant speed.

a. Determine the work done by Jerome in climbing the stair case. 2289 J

b. Determine the power generated by Jerome. 1734 W

3. A bicycle has a kinetic energy of 124 J. What kinetic energy would the bicycle have if it had …

a. … twice the mass and was moving at the same speed? 2(124) = 248 J

b. … the same mass and was moving with twice the speed? 4(124) = 496 J

c. … the same mass and was moving with one-half the speed? $\frac{1}{4}(124) = 31$ J

4. A 78-kg skydiver has a speed of 62 m/s at an altitude of 870 m above the ground.

a. Determine the kinetic energy possessed by the skydiver. 149916 J

b. Determine the potential energy possessed by the skydiver. 665028 J

c. Determine the total mechanical energy possessed by the skydiver. 814944 J

5. Suzie Lavtaski (m=56 kg) is skiing at Bluebird Mountain. She is moving at 16 m/s across the crest of a ski hill located 34 m above ground level at the end of the run.

a. Determine Suzie's kinetic energy. 7168 J

b. Determine Suzie's potential energy relative to the height of the ground at the end of the run. 18659 J

c. Determine Suzie's total mechanical energy at the crest of the hill. 25827 J

d. If no energy is lost or gained between the top of the hill and her initial arrival at the end of the run, then what will be Suzie's total mechanical energy at the end of the run? 25827 J

e. Determine Suzie's speed as she arrives at the end of the run and prior to braking to a stop. 30.4 m/s

6. Nicholas is at The Noah's Ark Amusement Park and preparing to ride on The Point of No Return racing slide. At the top of the slide, Nicholas (m=72.6 kg) is 28.5 m above the ground.

a. Determine Nicholas' potential energy at the top of the slide. 20277.2 J

b. Determine Nicholas's kinetic energy at the top of the slide. 0 J

c. Assuming negligible losses of energy between the top of the slide and his approach to the bottom of the slide (h=0 m), determine Nicholas's total mechanical energy as he arrives at the bottom of the slide. 20277.2 J

d. Determine Nicholas' potential energy as he arrives at the bottom of the slide. 0 J
e. Determine Nicholas' kinetic energy as he arrives at the bottom of the slide. 20277.2J
f. Determine Nicholas' speed as he arrives at the bottom of the slide. 23.6 m/s

7. Justin Thyme is traveling down Lake Avenue at 32.8 m/s in his 1510-kg 1992 Camaro. He spots a police car with a radar gun and quickly slows down to a legal speed of 20.1 m/s.

a. Determine the initial kinetic energy of the Camaro. 812259J
b. Determine the kinetic energy of the Camaro after slowing down. 305027.5J
c. Determine the amount of work done on the Camaro during the deceleration. -507231.6J

8. Nolan Ryan reportedly had the fastest pitch in baseball, *clocked* at 100.9 mi/hr (45.0 m/s) If such a pitch had been directed vertically upwards at this same speed, then to what height would it have traveled? $KE_{bottom} = PE_{top}$ $\frac{1}{2}mv^2 = mgh$ 103.3m

Momentum, Impulse and Collision Review Problems

1. Determine the momentum of …

a. … an electron (m= 9.1 x10^{-31} kg) moving at 2.18 x 10^6 m/s (as if it were in a Bohr orbit in the H atom). 1.98e-24 kgm/s
b. … a 0.45 Caliber bullet (m = 0.162 kg) leaving the muzzle of a gun at 860 m/s. 139.3kgm/s
c. … a 110-kg professional fullback running across the line at 9.2 m/s. 1012 kgm/s
d. … a 360,000-kg passenger plane taxiing down a runway at 1.5 m/s 540,000kgm/s

2. According to the Guinness Book of World Records, the fastest recorded baseball pitch was delivered by Nolan Ryan in 1974. The pitch was clocked at 100.9 mi/hr (45.0 m/s). Determine the impulse required to give a 0.145-kg baseball such a momentum. $I = \Delta p = 6.5$ Ns

3. Jerome plays middle linebacker for South's varsity football team. In a game against cross-town rival North, he delivered a hit to North's 82-kg running back, changing his eastward velocity of 5.6 m/s into a westward velocity of 2.5 m/s.

a. Determine the initial momentum of the running back. 459 kgm/s
b. Determine the final momentum of the running back. -205 kgm/s
c. Determine the momentum change of the running back. -664 kgm/s
d. Determine the impulse delivered to the running back. -664 kgm/s

4. Kara Less was applying her makeup when she drove into South's busy parking lot last Friday morning. Unaware that Lisa Ford was stopped in her lane 30 feet ahead, Kara rear-ended Lisa's rented Taurus. Kara's 1300-kg car was moving at 11 m/s and stopped in 0.14 seconds.

a. Determine the momentum change of Kara's car. 14300 kgm/s
b. Determine the impulse experienced by Kara's car. -14300 kgm/s
c. Determine the magnitude of the force experienced by Kara's car. $F\Delta t = \Delta p$ F = -102143 N

5. A candy-filled piñata is hung from a tree for Matthew's birthday. During an unsuccessful attempt to break the 4.4-kg piñata, Hayden cracks it with a 0.54-kg stick moving at 4.8 m/s. The stick stops and the piñata undergoes a gentle swinging motion. Determine the swing speed of the piñata immediately after being cracked by the stick. What type of collision is this?

6. The city police are in pursuit of Robin Banks after his recent holdup at the savings and loan. The high speed police chase ends at an intersection as a 2080-kg Ford Explorer (driven by Robin) traveling north at 32.6 m/s collides with a 18400-kg garbage truck moving east at 12.4 m/s. The Explorer and the garbage truck entangle together in the *middle* of the intersection and move as a single object. Determine the post-collision speed and direction of the two entangled vehicles. What type of collision is this?

-160352 = 20480V
~~10.7~~ m/s = V
-7.8 m/s

7.8 ~~10.7~~ m/s South