# 2015-16 Lab Physics Final Exam Topics List

- Bring your own calculator and pencil.  Calculators may not be shared during the exam.
- Bring a #2 pencil for the multiple choice section of the exam
- Bring your 4" x 6" note card.  This card will be handed in with your exam.
- Bring your complete review problems.
- The exam consists of the review problems (25%), 30 multiple choice questions (20%), and 10 problems with multiple parts (55%)

*The following is a list of topics covered during the course of the school year.  The list will include the major points only. Do not just study off of this list.  Review your notes and textbook.*

1. General Stuff
   - Know the metric system and the meaning and values of the prefixes
   - Be able to convert metric units
   - Know the units of every measure that we have talked about this year- velocity, acceleration, force, distance, mass, energy, power, current, momentum, charge, voltage, resistance, frequency, period

2. Motion
   - Constant acceleration situations for objects moving horizontally.  Calculate $\Delta x$, $t$, $a$, $v_f$, and $v_i$
   - Free fall situations
   - Object thrown straight up in the air- calculate maximum height, hang time, time up or down

3. Projectile Motion
   - Be able to break a vector into its components
   - Be able to add vectors together.  (ex. Boat crossing a river problem) SOH CAH TOA and Pythagorean theorem
   - Understand the concepts associated with projectile motion

4. Newton's Law of Motion and Forces
   - Know and understand the laws.  Be able to apply the laws to a situation – like force and acceleration of a bug going splat on the windshield (equal and opposite forces, etc.)
   - Apply Newton's 2$^{nd}$ Law to calculate acceleration and $F_{net}$.  Apply the equation when there is a constant velocity (equilibrium) to find the force of friction.
   - Calculate $F_a$, $F_f$, $F_g$, $F_f$, $\mu$ for objects that have a constant acceleration (non-equilibrium)
   - Understand where friction comes from and the differences between static and kinetic friction

5. Work and Energy
   - Calculate the work done on an object.  Know when work is performed and when it is not.
   - Perform various calculations using the law of conservation of energy (pendulum, rollercoaster, free fall)
   - KE and PE, know how to calculate them and when they exist
   - Define and calculate power.
   - Understand the concept of the work-energy theorem and use it to calculate force, coefficient of friction, distance, or velocity.

6. Impulse and Momentum
   - Understand impulse and how it relates to momentum; how are F and Δt related?
   - Solve problems involving the impulse-momentum theorem including stopping distance.
   - Perform calculations using conservation of momentum as it applies to collisions (elastic and inelastic) and recoil (explosions).
   - Understand what the law of conservation of momentum states and how it applies to collisions.

7. Circular Motion
   - Perform calculations for period, frequency, and liner speed.  Understand the meaning of each measure.
   - Understand the concept of a centripetal force and acceleration.  What would happen to the motion of an object if the centripetal force is removed?
   - Calculate the centripetal force and acceleration.
   - Understand the conversion from linear measurements to angular measurements.
   - Solve various problem types where the centripetal force is caused by a specific force- friction, gravity
   - Understand and be able to calculate the force of gravity that exists between masses
   - Understand the factors that affect and be able to calculate the acceleration due to gravity anywhere in the universe

8. Electrostatics
   - Know and understand how the methods of charging work
   - Be able to calculate the number of electrons involved with a specific charge or vice versa
   - Calculate the electric force that exists between two charges using Coulomb's Law
   - Apply the superposition principle to Coulomb's Law to determine the net force acting on a charge

9. Electricity
   - Define current and be able to calculate it from the number of electrons passing a point in a wire
   - Understand resistance, where it comes from and the factors that affect it
   - Solve problems dealing with the resistance of a wire
   - Apply Ohm's law to solve for current, resistance, or voltage
   - Calculate electrical power and be able to determine the cost of running electrical devices
   - Distinguish between series and parallel circuits.

Name: _____    Period: _____

2016 Lab Physics FINAL REVIEW                    Date: _____

*Print out the following Review and complete all the problems. Show ALL work including givens, formulas, units, etc. This is to be completed and reviewed **before** the final and **must be handed in on the day of the final exam.***

**THIS REVIEW WILL BE WORTH 25% OF YOUR FINAL EXAM GRADE. LATE SUBMISSIONS OF THIS REVIEW WILL NOT BE ACCEPTED. NO EXCEPTIONS.**

1.  Henry pulls a 0.45 kg toy train with a horizontal applied force of 3.2 N. The car is moving with a constant velocity. Draw a force vector diagram including $F_A$, $F_f$, $F_g$, and $F_N$.

    a.  What is the net force in the y-direction? WHY?

    b.  Calculate the normal force. *(Ans: 4.41N)*

    c.  What is the net force in the x-direction? WHY?

    d.  Calculate the force of friction. *(Ans: 3.2 N)*

    e.  Calculate the coefficient of friction between the car tires and the floor. Is this the coefficient of static or kinetic friction? *(Ans: 0.72)*

2.  Harry and Henry are riding in the bumper cars at Great Adventure. Henry and his car have a mass of 300.0 kg, while Harry and his car have a mass of 315.0 kg.  Henry is moving at 2.5 m/s towards the right and hits Harry, who was stationary.  After the collision Harry moves to the right with a speed of 1.75 m/s.

    a.  What type of collision is this? _____

    b.  What is Henry's speed after the collision? *(Ans: 0.66 m/s right)*

3.  If Harry and Henry's cars stick together after the collision described in #2, what is their velocity after the collision?  What type of collision is this? *(Ans: 1.22 m/s right)*

4.  An electric motor operates a ski-lift of mass 200kg and lifts it to the top of a 1000m high hill. If the trip to the top takes 4 minutes, find the work done by the motor and its power. Assuming that the motor is connected to a 240V power supply, find the current drawn by the motor and its resistance. *(Ans: 1.96X10⁶J, 8167 W, 34 A, 7.1Ω)*
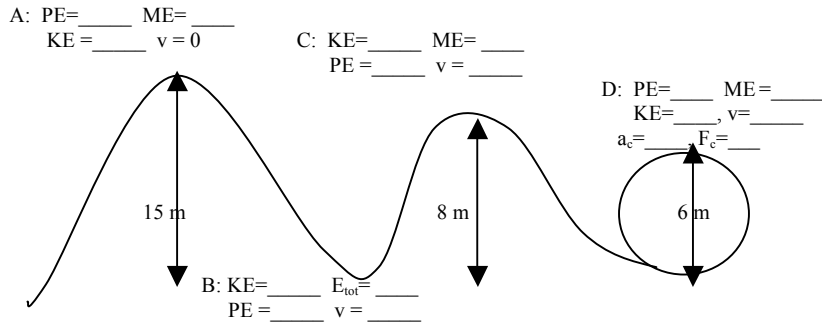
5. Michael, a 65 kg basketball player, attempts a jump shot. If his initial vertical velocity is 7.75 m/s,
    a. How high does he jump? *(Ans: 3.06 m)*

    b. What is his hang time? *(Ans: 1.58 s)*

    c. What is his velocity as he returns to the ground? *(Ans: -7.75 m/s)*

6. Two charges are placed next to each other. A +2 μC charge is placed +1.0m from a + 4 μC charge. Draw a diagram showing all the distances and the force vectors for each of the charges. Find the net electric force on the + 4 μC charge. *(Ans:0.072N)*

7. A 1200 kg car moving at 12.4 m/s coasts down the road slowing to 10.1 m/s due to friction. The car travels 12 m while coasting.
    a. What is the force of friction acting on the car? *(Ans: 2587.5N)*

    b. What is the coefficient of friction between the road and tires? *(Ans: 0.22)*

    c. What is the acceleration of the car? *(Ans: -2.156 m/s$^2$)*

    d. How long will it take the car to stop if it continues at this acceleration? *(Ans: 5.75s)*

8. A force of 2500N is applied for 1.5 seconds to slow down a 1000 kg lawn mower that is moving with a velocity of 5.0m/s.

   a. What is the velocity of the lawn mower at the end of this time?*(1.25 m/s)*

   b. How far does the mower move during this time?*(4.69 m)*

9. What is the change in PE (work done by battery) of 10C of charge moving through a potential difference of 240 V? (*Ans:2400 J*)

10. a. If a heating coil with a resistance of 20Ω is connected to a power supply with a voltage of 240V, how much current does it draw? (*Ans:12 A*)

   b. How much charge flows through the coil per minute? (*Ans: 720 C*)

   c. How many electrons flow through a cross-section of the coil per minute?*(Ans: 4.5X10²¹ electrons)*

11. A 0.0025 kg penny is placed on the turntable of a record player 0.070 meters from the rotational axis. The penny begins to slip off of the turntable when it is completing 15 revolutions in 11 seconds.

   a. What are the period of revolution and the frequency of the turntable at this point? (ANS: .73 sec., 1.37 Hz)

   b. What is the linear speed of the penny before it slips off the turntable? (ANS: 0.60 m/s).

   c. What is the centripetal force experienced by the penny? (ANS: .013 N).

   d. What is the type of force that keeps the penny moving in a circle with the turntable?

   e. Calculate the coefficient of friction between the penny and the turntable. (ANS: 0.53)

12. Mark True or False.
      a. Polarization occurs when two charged objects come into contact with each other.
      b. When insulators are polarized the electrons in the insulator stay with their protons.
      c. Induction is the process of first polarizing an object then grounding it (adding or removing charge) with a 3rd object.
      d. A negative rod brought near a metal can will cause the can's electrons to move toward the rod.
      e. Rubbing fur on a plastic rod to charge the rod is called charging by induction.
      f. Charged plastic will attract neutral wood.
      g. Like charges attract each other.

13. If you ignore air resistance, state whether the following statements are true or false.
    The horizontal velocity of the projectile increases.
    The projectile's velocity at the top of its path is zero.
    The projectile's velocity and acceleration are both zero at the top of its path.
    Two projectiles launched horizontally from the top of a cliff with different velocities both land in the water below at the same time.

14. Find the gravitational force exerted by the earth on a 65kg man on the moon. The mass of the earth is $5.98 \times 10^{24}$ kg, and the distance between the moon and earth is 385000km. (Ans: .1749 N)

15. A plane flies due north with a velocity of 200 m/s. If there is a crosswind of 50m/s east, find the resultant velocity of the plane. Find the magnitude and angle of the resultant velocity.
      (Ans: 206.15m/s, @ $14^0$ East of North)

16. A 0.5 kg pendulum bob swings back and forth.  At the lowest point of the bob's swing its speed is 3.45m/s.
    a)    What kind of energy does the bob have at the bottom of the swing?

    b)    What is the total energy of the bob at the bottom of the swing? (Ans: 2.98 J)

    c)    What kind of energy does the bob have at the highest point of the swing?

    d)    What is the total energy of the bob at the highest point of the swing? (Ans: 2.98 J)

    e)    How high will the bob swing? (Ans: 0.61m)

17. You have three resistors. The values are 40Ω, 15Ω, & 65Ω. These resistors are connected to a 24V power supply.

    a.  Draw a circuit diagram for the resistors connected in a series circuit with the power supply.

    b.  The current measured through the power supply is.  What is the voltage across the 40Ω resistor connected in series?  What is the current passing through it? (*ANS:* 8V, 0.2A)

    c.  Draw a circuit diagram for the same three resistors connected in a parallel circuit with the power supply.

    d.  What is the current through the 40Ω resistor connected in parallel? What is the voltage across it? (*ANS:* 0.6A, 24 V)

18. In the movie *Indiana Jones and the Raiders of the Lost Ark*, a large boulder runs downhill after Dr. Jones. Let's assume that Dr. Jones and the boulder follow the path shown below. Fill in all of the missing information for the boulder in the drawing below. You may assume there is no friction and that the boulder starts at rest at the top of the 15.0 m hill (point A). Take the mass of the boulder to be 900 kg. The following answers are approximate. You will actually get 132,435 J for ME. (ANS: At A : PE=132,300 J, KE=0 J, ME = 132,300 J, v=0 m/s At C: PE=70,560 J, KE=61,740 J, ME= 132,300 J, v=11.7 m/s, At B: PE=0 J, KE=132,300 J, ME= 132,300 J, v=17.1 m/s, At D: PE=52920 J, KE = 79380 J, v=13.28m/s, $a_c$=58.8m/s$^2$, $F_c$= 52920 N )

A: PE=_____ ME=_____
    KE =_____ v = 0

C: KE=_____ ME=_____
    PE =_____ v = _____

D: PE=_____ ME =_____
    KE=_____ , v=_____
    $a_c$=_____ $F_c$=_____

15 m        8 m        6 m

B: KE=_____ $E_{tot}$=_____
    PE =_____ v = _____

b. If the movie crew used a crane to lift the boulder into place at point A, how much work does the crane do? (ANS: 132,300 J)

c. If the crane performs this task in 25 seconds, what is the power output of the crane? (ANS: 5292 W)