LES10A020 Engineering Physics / Mid-Term Examination

Please submit the answers to the corresponding exam submission location on Moodle.

The submission of examination answers is due October 28th, at 15:30. Each task below is worth 10 points.

Task 1. A car has been driven for a while and the driver checks the tire pressure. It is 2.5 bar, 0.3 bars above the recommended pressure. The driver lowers the pressure to 2.2 bars and completes his drive. Ambient temperature is -5℃ and in that temperature the wheel volume is 93 liters. **A)** After the car has cooled down, what is the wheel pressure if the wheel temperature at the time of pressure measurement was 43℃? Assume that the wheel volume remained constant. **B)** What was the tier pressure at the beginning of the drive, if the ambient temperature was -7℃ then? **C)** What volume does the air released from the wheel to the atmosphere take after it cools down to -5 ℃, when the outside air pressure is 0.98 bar?

Task 2. Consider 833-liter junk of ice that floats on water. Assume both the ice and water are at the freezing temperature. **A)** Show with three significant numbers how large percentage of the ice is floating above the water, if the weight of the junk of ice 777 kg. The density of zero-degree water is 999.87 kg/m^3. **B)** The ice is lighter than normal because bubbles of air have been trapped inside the ice. How many liters of extra air is locked inside the ice cube, if the density of pure ice is 917 kg/m^3? Use three significant numbers. **C)** Assume the junk of ice is lifted from the water and frozen to -15℃. Using two significant figures, estimate how many percentages the volume of the junk of ice has decreased after the freezing, when the linear coefficient of expansion for ice is 55·10^{-6} 1/K. You can assume that the air bubbles do not influence the change of volume in freezing.

Task 3. Point charges Q = 15,0 nC are on the two sharp tips of an isosceles triangle. The third angle of the triangle is right-angle. If a -10,0 nC charge is placed on the right angle, how large force is influences each of the charges? Draw a graph and inform the direction of the forces with 0.1 rad accuracy. The equal sides of the triangle are 5.0 cm long. Find the strength of the forces with two significant figure accuracy. Use the value k = 9.0·109 Nm^2/C^2 as a constant.

Task 4. Mass of 2kg is connected to a horizontal spring. The mass is displaced 2.2 meters from the spring equilibrium. The friction coefficient between the mass and ground is 0.32. **A)** What is the minimum needed spring coefficient that would force the mass to slide? **B)** Assume the spring constant is k = 5.2 N/m. How many meters does the mass slide?

Task 5. An object is performing a harmonic oscillation with a frequency of 0.52 Hz. The mass of the object is 1.2 kg and the amplitude of the oscillation is 24 cm. When the mass has a displacement of 0.1 meters, define the following values: velocity, acceleration, and kinetic energy of the mass.

Task 6. Solve the voltage source E$_1$ from the circuit below (figure on another page), when R$_1$ = 12 Ω, R$_2$ = 8 Ω, R$_3$ = 15 Ω, R$_4$ = 5 Ω, R$_5$ = 20 Ω, R$_6$ = 5 Ω, R$_7$ = 22 Ω, and E$_2$ = 12 V. In addition, it is known that the current over the resistor R6 is 1.7A.

Circuit in Task 6.