The LNM Institute of Information Technology
End Sem. Exam: 2012
Physics I

- There are three parts namely section A, Section B and Section C.
- The part of section C which is separate from section A and Section B will be distributed and collected separately
- This 2 page document contains Section A and Section B
- Each Section carries 60marks.

Section A

Problem: 1

A 15.0-Kg bucket of water is suspended by a very light rope wrapped around a solid uniform cylinder 0.300m in diameter with mass 12.0 Kg. The cylinder pivots on a frictionless axle through its center. The bucket is released from rest at the top of a well and falls 10.0m to the water.

a. What is the tension in the rope while the bucket is falling? (12)
b. With what speed does the bucket strike the water? (05)
c. What is the time of fall? (05)
d. While the bucket is falling, what is the force exerted on the cylinder by the axle? (08)

Note: You can use that the moment of Inertia for a solid cylinder is I= (1/2) $M \times R^2$ and $g=9.80 m/s^2$

Problem: 2

Muons are unstable subatomic particles that decay to electrons with mean life time of $2.2\mu s$. They are produced when cosmic rays bombard the upper atmosphere about 10km above the earth's surface, and they travel very close to the speed of light. The problem we want to address is why we see any of them at the earth's surface.

a. What is the greatest distance a muon could travel during its $2.2\mu s$ lifetime? (06)
b. According to your answer in part (a), it would seem that muons could never make it to the ground. But the $2.2\mu s$ lifetime is measured in the frame of the muon, and muons are moving very fast. At a speed of 0.999c. What is the mean lifetime of a muon as measured by an observer at rest on the earth? How far would muon travel in this time? Does this result explain why we find muons in cosmic rays? (16)
c. From the point of view of the muon, it still lives for only $2.2\mu s$, so how does it make it to the ground? What is the thickness of the 10Km of atmosphere through which the muon must travel, as measured by the muon? It is now clear how the muon is able to reach the ground? (08)

Note: You can use that the speed of light, c= 3.00×10^8 m/s and $1\mu s$ is $10^{(-6)}$ s. (μs=*micro second*)

Section B

There will be no partial grading.
Each problem carries 12marks.

Problem: 3

A rigid tank of volume 2.0m^3 contains 15.8 Kg of saturated liquid-vapour mixture of water at 90°c. Now the water is slowly heated. Determine the temperature at which the liquid in the tank is completely vapourized.

Problem: 4

A 3- m^3 rigid vessel contains steam at 4 MPa and 500°C. Calculate the mass of the steam.

Problem: 5

Air at 100 KPa and 280k is compressed steadily to 600 KPa and 400k. The mass flow rate of the air is 0.02 Kg/s, and a heat loss of 16 KJ/Kg occurs during the process. Assuming the change in kinetic and potential energies are negligible, determine the necessary power input to the compressor. (Cp=1.0 KJ/Kg-k)

Problem: 6

A reversible heat engine receives 500 KJ of heat per cycle from a high temperature reservoir at 652°c and rejects heat to a low temperature reservoir at 30°c. Calculate the amount of heat rejected to the low temperature reservoir per cycle and the efficiency of the cycle.

Problem: 7

Steam enters an adiabatic turbine at 6.0 MPa and 500°c and leaves at a pressure of 1.6 MPa. Determine the work output per Kg of steam if the process is reversible.

End of Sections A and B.