1. Evaluate the integral $\int_{-\infty}^{\infty} e^{-x^2} dx$. (10%)

2. Evaluate the integral $\int_{0}^{\infty} e^{-x} x^n dx$. (15%)

3. Prove that $\ln(n!) \cong n \ln n - n$, where n is an integer and $n \gg 1$. (10%)

4. Given that $dy/dx = x + y$, solve y as a function of x in which $y(x=0) = 1$. (15%)

1. An elevator and its load have a total mass of 900 kg. Find the tension T in the supporting cable when the elevator, originally moving downward at 15 $m.s^{-1}$, is brought to rest with constant acceleration in a distance of 30 m.

2. A steel bar 15 cm long is welded end-to-end to a copper bar 30 cm long. Each bar has a square cross section, 3 cm on a side. The free end of the steel bar is placed in contact with steam at 100°C, and the free end of the copper bar with ice at 0°C. Find the temperature at the junction of the two bars and the total rate of heat flow, when steady-state conditions have been reached. k_s=50.2 $J.S^{-1}m^{-1}.(°C)^{-1}$, k_c=385 $J.S^{-1}, m^{-1}(°C)^{-1}$

3. A particle having a charge q=8 x 10^{-9}C moves from point a to point b along a straight line, a total distance d=0.8m. The electric field is uniform along this line, in the direction from a to b, with magnitude E=300N.C^{-1}. Determine the force on q, the work done on it by the field, and the potential difference Va-Vb.

4. If the current in the coil with self-inductance 20μH increases uniformly from zero to 2 A in 0.5 S, find the magnitude and direction of the self-induced emf.

5. A certain 60-watt lightbulb emits a total luminous flux of 1000 lm, distributed uniformly over a hemisphere. Find the illuminance and the luminous intensity at a distance of 2 m.