Ph.D. Qualifying Examination

Dynamics

Fall 2015

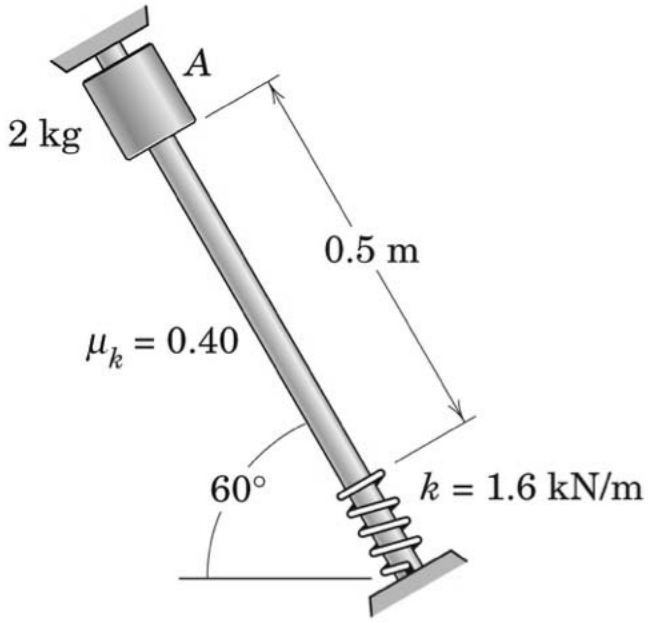
Notes:

1. Duration: 2.5 hours

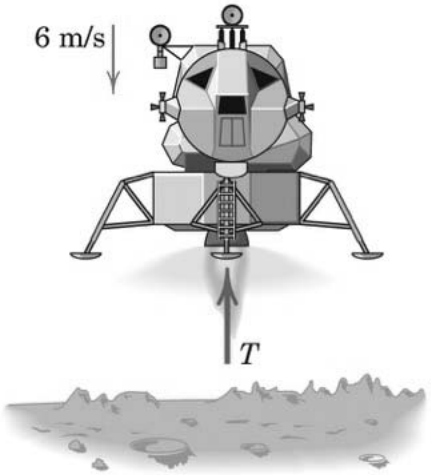
2. Closed book, closed notes (one sheet of formulas is allowed).

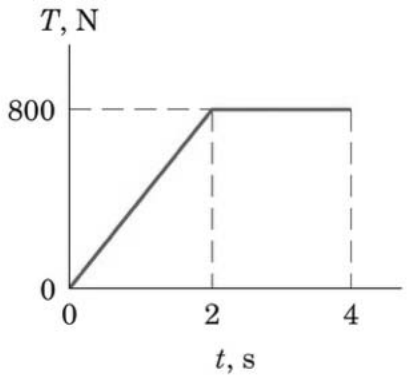
3. Total of 4 problems (all of the same value); calculator is allowed.

Problem 1:
The 2-kg collar is released from rest at A and slides down the inclined fixed rod in the vertical plane. The coefficient of kinetic friction is 0.4. What is the **maximum deflection** of the spring? k = 1600 N/m.

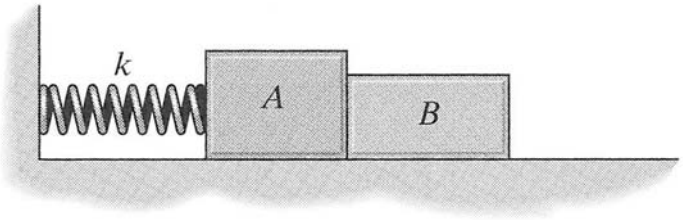


Problem 2:
The 200-kg lunar lander is descending onto the moon's surface with a velocity of 6 m/s when its retro-engine is fired. If the engine produces a thrust T for 4 seconds which varies with time as shown and then cuts off, calculate the **velocity of the lander** when t = 5 (s), assuming that it has not yet landed. Gravitational acceleration at the moon's surface is 1.62 m/s^2.





Problem 3:
Block A has a mass m_A and is attached to a spring having a stiffness k and unstretched length l_o. If another block B having a mass m_B is pressed against A so that it compresses the spring a distance d, determine the **distance** $\boldsymbol{x}$, both blocks slide on the smooth surface before they begin to separate. Assume x is measured from the unstretched spring length. What is their **velocity** v, at this instant?



Problem 4:
The *20kg* disk *A* is attached to the *10kg* block *B* using the cable and pulley system shown. Determine the **minimum coefficient of static friction** between the disk and the surface such that disk rolls without slip. Neglect the mass of the pulleys.