PHY 116 From Newton to Einstein Problem Sheet 3: Dynamics

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All questions are taken from Young and Freedman

- A1) A picture frame hung against a wall is suspended from a hook by two wires attached to its upper corners. If the two wires make the same angle with the vertical, what must this angle be if the tension in each wire is equal to 0.75 of the weight of the frame? (Ignore any friction between the wall and the frame.)
- A2) Along a certain section of road a car (mass 1600kg) will coast in neutral at a constant speed of 72 km/h if there is no wind. Examination of a topological map shows that for this section of road the elevation decreases by 200m for each 6000m of road. What is the total resistive force (friction plus air resistance) that acts on the car when it is travelling at 72 km/h?
- A3) A person of weight 550N stands on a bathroom scale in an elevator. As the elevator starts moving, the scale reads 450N. a) Find the acceleration of the elevator (magnitude and direction). b) What is the acceleration if the scale reads 670N? c) If the scale reads zero, should the person worry? Explain.
- A4) You are to lower a safe of mass 260kg at constant speed downs skids 20.0m long, from a truck 2.0m high.
 - a) If the coefficient of friction between the safe and the skids is 0.25, do you need to pull the safe down or hold it back?
 - b) How great a force parallel to the skids is needed?
- B5) A proton with a mass 1.67×10^{-27} kg is propelled at an initial speed of 3.00×10^5 m/s directly towards a uranium nucleus 5.00 m away. The proton is repelled by the uranium nucleus with a force of magnitude $F = \alpha / x^2$, where x is the separation between the two objects and $\alpha = 2.12 \times 10^{-26}$ Nm². Assume that the uranium nucleus remains at rest.
 - a) What is the speed of the proton when it is 8.0×10^{-10} m from the uranium nucleus?
 - b) As the proton approaches the uranium nucleus, the repulsive force slows it down until it comes momentarily to rest, after which the proton moves away from the nucleus. How close does the proton get to the uranium nucleus?
 - c) What is the speed of the proton when it is again 5.00 m from the nucleus?