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Unified Engineering
Fall 2004
Problem Set #1

	Time Spent (min)
U1	
U2	
Study Time	

Name: _____

UNIFIED ENGINEERING Fall 2004

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Problem U1 (Range Equation)

a) Assuming steady-level flight and no fuel reserves, estimate the range of a B-777 using the information given in the lecture notes (and/or on Boeing's web page). How well does this compare to the estimates Boeing publishes on their web page?

b) Now assuming that L/D, propulsion system efficiency and final weight are unchanged, estimate the range of a B-777 if the same volume of liquid hydrogen were to be used instead of Jet-A.

c) Derive an equation for the range of a battery-powered aircraft in steady-level flight. Express the range in terms of L/D, propulsion system efficiency, battery mass and heating value, and aircraft weight. Estimate the range of a B-777 if the fuel was taken out and replaced with its equivalent weight in batteries.

"FUEL"	Heating Value (MJ/kg)	Density (kg/m^3)
Jet-A	42.8	800
Liquid Hydrogen	120	70
Batteries	2.5	8000

Unified Engineering Problem Set #1 **U3, U4-Lectures**
Fall, 2004

U2 A 10 m by 10 m grid is situated in the (x-y) plane. The grid is made up of rigid rods connected at 1 m increments. The following set of forces act on this grid:

Force 1 acts at point (1,1) at an angle of 0.0° with a magnitude of 2 N
Force 2 acts at point (1,-4) at an angle of 63.4° with a magnitude of 5 N
Force 3 acts at point (2,-3) at an angle of -116.6° with a magnitude of 5 N
Force 4 acts at point (-5,-5) at an angle of 45° with a magnitude of 3 N
Force 5 acts at point (2,4) at an angle of 251.5° with a magnitude of 3 N
Force 6 acts at point (-5,5) at an angle of 315° with a magnitude of 4 N

(**Note:** Angles are measured positive counterclockwise relative to a line drawn parallel to the x-axis and through the acting point of the force.)

For this configuration:

(a) Describe each force as a vector and neatly draw out the described configuration.

(b) Determine the total (resultant) force acting on the grid.

(c) Can any of the forces be expressed as a couple? If so, do so?

(d) Determine the moment acting about the origin (center) of the grid

(e) Determine the moment acting about the upper right-hand corner of the grid.

(f) Determine the components of the moment acting about the y-axis and about the x-axis.

NOTE: Express the answer as a vector as appropriate.