American University of Beirut
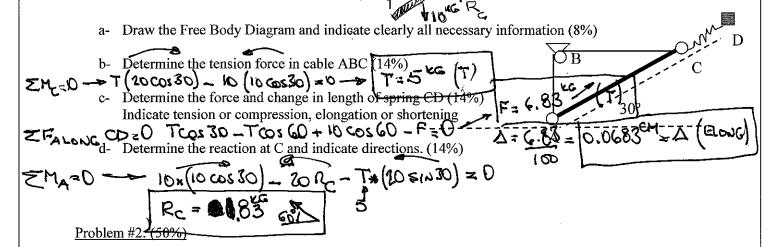## Department of Civil and Environmental Engineering
Fall 2008-2009   Instructor: Professor Fouad Kasti

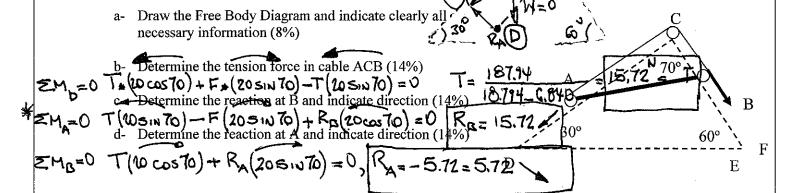NAME: $\mathcal{S}$OLUTION   ID:

CIVE 210 Statics	Exam I 1 ½ Hour Exam	Sat Nov 15, 08 Closed Books	1/1

Problem #1: (50%)

The uniform and homogeneous rigid bar AC shown has 10Kg mass. AC & CD are parallel to the sloping plane which makes an angle of 30° with the horizontal. A single cable ABC connects at bar end A, winds around pulley at B and ties to C. Bar AC is roller supported at ends A and C with dimensionless and frictionless pulleys / surfaces. Assume the length of AC = 20cm. Assume D is fully fixed. CD spring constant = 100 Kg/cm. Assume cable segment AB is vertical, BC horizontal and roller at A only is barely touching. B is hinge supported.

a- Draw the Free Body Diagram and indicate clearly all necessary information (8%)

b- Determine the tension force in cable ABC (14%)

$$\Sigma M_c = 0 \longrightarrow T\left(20\cos 30\right) - 10\left(10\cos 30\right) = 0 \longrightarrow \boxed{T = 5 \, kg \, (T)}$$

c- Determine the force and change in length of spring CD (14%)
Indicate tension or compression, elongation or shortening

$$\Sigma F_{ALONG} \, CD = 0 \quad T\cos 30 - T\cos 60 + 10\cos 60 - F = 0 \quad F = 6.83$$

$$\Delta = \frac{6.83}{100} = \boxed{0.0683 \, cm = \Delta \ (ELONG)}$$

d- Determine the reaction at C and indicate directions. (14%)

$$\Sigma M_A = 0 \longrightarrow 10 \times \left(10\cos 30\right) - 20 R_c - T \times \left(20\sin 30\right) = 0$$

$$\boxed{R_c = 1.83 \, kg}$$

Problem #2: (50%)

The rigid weightless bar AB is roller supported at A and B. A single cable ACB ties at A, winds around C and ties at B. Inclined plane CD makes 30° with the horizontal and is perpendicular to inclined plane CE. Inclined plane CE makes 60° with the horizontal and 70° with rigid bar AB. A concentrated force F is applied at B along the inclined surface CE. Assume frictionless and dimensionless pulleys / surfaces. Force F = 10N and length of AB = 20cm.

a- Draw the Free Body Diagram and indicate clearly all necessary information (8%)

b- Determine the tension force in cable ACB (14%)

$$\Sigma M_b = 0 \quad T \times \left(20\cos 70\right) + F \times \left(20\sin 70\right) - T\left(20\sin 70\right) = 0 \quad T = \frac{187.94}{10.714 - 6.840}$$

c- Determine the reaction at B and indicate direction (14%)

$$\Sigma M_A = 0 \quad T\left(20\sin 70\right) - F\left(20\sin 70\right) + R_B\left(20\cos 70\right) = 0 \quad \boxed{R_B = 15.72}$$

d- Determine the reaction at A and indicate direction (14%)

$$\Sigma M_B = 0 \quad T\left(10\cos 70\right) + R_A\left(20\sin 70\right) = 0, \quad \boxed{R_A = -5.72 = 5.72}$$

Values near diagram: $T = 15.72$, $R_B = 15.72$, $70°$, $30°$, $60°$

* OR $\Sigma F_{ALONG} AC = 0 \longrightarrow T + R_B = 0 \longrightarrow R_B = -T = -15.72$