EGR 140
Statics

Test #1 Overview

Chapters covered: 1 & 2 in Statics, 8th Edition, by Beer & Johnston
Related Homework Assignments: Homework #1
Format: No books, notes, or formula sheets are allowed on the test.
Problems are similar to homework, class, and textbook problems mainly.
Occasional multiple choice, True/False, etc. (probably 15% or less of the test)
Hints for success: Work more textbook problems for preparation.
Study the sample problems in the textbook.
Show clear diagrams and all work on the test.
If significant work is done using a calculator, write down what you entered into the calculator for possible partial credit.

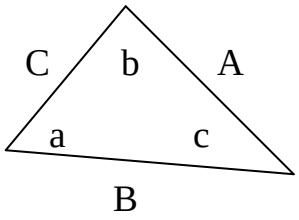
Chapter 1 (Introduction) - Major Topics

Significant digits, units, Newton's laws, mass, weight
$W = mg$, where $g = 9.81\ m/s^2 = 32.2\ ft/s^2$ (average value on Earth)
Background mostly. No direct questions.

Chapter 2 (Statics of Particles) - Major Topics

Determining resultants in 2D: (note that method 1 or 2 below may be specifically required for a given problem)

1) Trigonometrically - draw a force triangle representing the forces
   - use law of sines, law of cosines, right triangle relationships, etc.



Law of cosines:

$$A^2 = B^2 + C^2 - 2BC\cos(a)$$
$$B^2 = A^2 + C^2 - 2AC\cos(b)$$
$$C^2 = A^2 + B^2 - 2AB\cos(c)$$

Law of sines:

$$\frac{\sin(a)}{A} = \frac{\sin(b)}{B} = \frac{\sin(c)}{C}$$

2) By resolving forces into rectangular (Cartesian) components
   A) Express each force using unit vectors (several methods)

$$\bar{F} = F_x\bar{i} + F_y\bar{j}, \quad |F|^2 = (F_x)^2 + (F_y)^2$$

$$\bar{F} = (|F|\cos\theta)\bar{i} + (|F|\sin\theta)\bar{j}\ , \text{ where } \theta \text{ is referenced to the + x - axis}$$

$$\bar{F} = |F|\left(\frac{dx}{d}i + \frac{dy}{d}j\right)\ , \text{ where } d = \sqrt{d_x^{\,2} + d_y^{\,2} + d_z^{\,2}}$$

$$\bar{F} = |F|\overline{\lambda_{12}}, \text{ where } \overline{\lambda_{12}} = \frac{\bar{r}_{12}}{|r_{12}|}, \text{ and } \bar{r}_{12} = (x_2 - x_1)\bar{i} + (y_2 - y_1)\bar{j}$$

   B) The resultant, $\bar{R}$, is the sum of the forces (so sum the x and y components)

$$\bar{R} = R_x\bar{i} + R_y\bar{j}$$

$$\bar{R} = \sum\bar{F} \qquad \text{so } \bar{R}_x = \sum F_x \quad \text{and } \bar{R}_y = \sum F_y$$

Equilibrium in 2D: If an object is in equilibrium, then:

$$\sum \bar{F} = 0 \quad \text{so} \quad \sum F_x = 0, \quad \sum F_y = 0$$

Vectors in 3D: Resultants in 3D are generally found using rectangular components. The components can be found using either angles or distances.

Key relationships:

$$\bar{F} = F_x\bar{i} + F_y\bar{j} + F_z\bar{k}, \qquad |F|^2 = (F_x)^2 + (F_y)^2 + (F_z)^2$$

$$\bar{F} = (|F|\cos\theta_x)\bar{i} + (|F|\cos\theta_y)\bar{j} + (|F|\cos\theta_z)\bar{k} = |F|\left(\frac{dx}{d}\bar{i} + \frac{dy}{d}\bar{j} + \frac{dz}{d}\bar{k}\right), \text{ where } d = \sqrt{d_x^{\,2} + d_y^{\,2} + d_z^{\,2}}$$

$$\bar{F} = |F|\bar{\lambda}, \text{ where } \bar{\lambda} = \frac{\bar{r}_{12}}{|r_{12}|}, \text{ and } \bar{r}_{12} = (x_2 - x_1)\bar{i} + (y_2 - y_1)\bar{j} + (z_2 - z_1)\bar{k}$$

$$\cos^2\theta_x + \cos^2\theta_y + \cos^2\theta_z = 1$$

$$\theta_x = \cos\left(\frac{F_x}{F}\right), \quad \theta_y = \cos\left(\frac{F_y}{F}\right), \quad \theta_z = \cos\left(\frac{F_z}{F}\right)$$

Determining resultants in 3D:

$$\bar{R} = R_x\bar{i} + R_y\bar{j} + R_z\bar{k}$$

$$\bar{R} = \sum \bar{F} \qquad \text{so } \bar{R}_x = \sum F_x, \quad \bar{R}_y = \sum F_y, \quad \bar{R}_z = \sum F_z$$

Equilibrium in 3D: If an object is in equilibrium, then:

$$\sum \bar{F} = 0 \quad \text{so} \quad \sum F_x = 0, \quad \sum F_y = 0, \quad \sum F_z = 0$$

Other topics: All topics are not listed above. In general, any topics covered in class, in the textbook, or in homework may be on the test.

Calculators:

Calculator methods such as the following are very helpful, but are will not be specifically required. Performing the calculations by any technique is sufficient. However, if calculators are used to perform vector functions, it is strongly recommended that you write down whatever you enter into the calculator in order to receive partial credit in case of an error.

- Using polar and rectangular numbers to represent and add vectors
- Finding unit vectors
- Expressing force vectors using unit vectors