1. (30%) The weights of collars A and B are $W_A = 60 \text{ lb}$ and $W_B = 90 \text{ lb}$, respectively. If the effect of friction is negligible and equilibrium of the system as shown exists, determine (a) the tension $T_{AB}$ in the connecting cable $AB$, (b) the reaction A exerted on the collar A by the rod, (c) the reaction B exerted on the collar B by the rod.

2. (30%) A 90-N force $F$ acts at the end $D$ of a pipeline as shown. Determine (a) the moment $M_A$ of the force $F$ about the joint at $A$, (b) the moment $M_{AB}$ of $F$ about the axis of the pipe $AB$, (c) whether the action of $F$ tends to tighten or loosen the joint at $A$ where the threads are right-handed, (d) the shortest distance $d_{s1}$ between the point $A$ and the line of action of $F$, (e) the shortest distance $d_{s2}$ between the line containing $AB$ and the line of action of $F$.

3. (20%) The tensions in the guy wires $PA$ and $PB$, attached to a pole supporting a dish antenna as shown, are $T_{PA} = 510 \text{ N}$ and $T_{PB} = 600 \text{ N}$, respectively. Let the resultant of $T_{PA}$ and $T_{PB}$ at $P$ be $R$ and $R = R_x i + R_y j + R_z k$. Circle on this test sheet the correct or nearest item for each of the following:

A. The value of $R_x$ is
   (a) 520 N.  (b) 522 N.  (c) 523 N.  (d) 525 N.  (e) 526 N.

B. The value of $R_y$ is
   (a) –854 N.  (b) –850 N.  (c) –846 N.  (d) –843 N.  (e) –839 N.

C. The value of $R_z$ is
   (a) 152.0 N.  (b) 149.2 N.  (c) 146.4 N.  (d) 143.6 N.  (e) 140.9 N.

D. The rate of flow of oil in a pipeline is $Q = 82 \text{ bbl/min}$. It is known that 1bbl = 42 gal, 1 gal = 231 in$^3$, and 1 m$^3$ = 1000 L. In SI, this value of $Q$ is equivalent to
   (a) 217 L/s.  (b) 223 L/s.  (c) 228 L/s.  (d) 233 L/s.  (e) 238 L/s.

4. A. (10%) Describe the **rigid-body principle** versus the **principle of transmissibility**.

B. (10%) The **moment** of a force $F$ about a point $P$ is actually the same as the **moment** of this force $F$ about a specific axis. Describe the **location** and the **orientation** of this **specific axis**.