

## ST. MICHAEL SENIOR SCHOOL AMEN

### S.5 HOLIDAY WORK

**Subject: Mathematics**

**Class: S.5**

**Theme: Mechanics**

**Topic: Dynamics 1 (Resultant Forces and Equilibrium)**

#### Item 1

In a community development project in Masaka, a group of "Jua Kali" artisans is constructing a large, hexagonal-framed canopy for a local marketplace. To ensure the canopy is stable during a windstorm, they have anchored a central metal junction plate to five different pillars using high-tension steel cables. The junction plate is shaped like a regular hexagon  $ABCDEF$ .

The cables are attached to the centre of the plate and pulled in the directions of the vertices. Currently, four cables are active: a force of 100 N acts towards vertex  $A$ , 150 N towards vertex  $B$ , 200 N towards vertex  $C$ , and 120 N towards vertex  $D$ . The artisans are worried that the unequal pulling might cause the central junction to shift or the supporting uniform steel beam (which acts as the main pillar) to buckle. The main pillar is a 6-metre uniform beam of mass 80 kg, leaning at an angle against a wall, and must remain in equilibrium to support the weight of the hexagonal plate.

#### Task

- By resolving the forces acting towards vertices  $A$ ,  $B$ ,  $C$ , and  $D$  into horizontal and vertical components, determine the magnitude and direction of the resultant force acting on the central junction plate. (Assume the direction of  $A$  is  $000^\circ$  and the hexagon is regular).
- The artisans wish to add a fifth cable towards vertex  $E$  to keep the junction plate in a state of static equilibrium. Calculate the magnitude of the force required in this fifth cable and comment on whether a single cable towards  $E$  is sufficient to achieve perfect balance.
- The main support pillar is a uniform beam of mass 80 kg and length 6 m. It rests against a smooth vertical wall at one end and on a rough horizontal floor at the other. If the beam is in limiting equilibrium at an angle of  $60^\circ$  to the horizontal floor, determine the coefficient of friction between the floor and the beam.