18/04/2019

Civil Engineering I
- introduction to structural mechanics- Newton's 2nd law and Vector Algebra

Excersises 1

- Exercise 1-1:
  Verify that the vector addition is associative,i.e.,

  $$\boldsymbol{a} + (\boldsymbol{b} + \boldsymbol{c}) = (\boldsymbol{a} + \boldsymbol{b}) + \boldsymbol{c}$$

  using graphic representation of vectors.

- Exercise 1-2:
  For vectors $\boldsymbol{a}$ and $\boldsymbol{b}$ given in Fig.1, work out $\boldsymbol{a}+\boldsymbol{b}$ by the component based method when $|\boldsymbol{a}| = 1$ and $|\boldsymbol{b}| = 2$. Also, obtain $|\boldsymbol{a} + \boldsymbol{b}|$ numerically.

- Exercise 1-3:
  For vectors given in Fig.2 Prove that

  $$\boldsymbol{a} + \boldsymbol{b} + \boldsymbol{c} = \boldsymbol{0}$$

  if $|\boldsymbol{a}| = |\boldsymbol{b}| = |\boldsymbol{c}|$.

- Exercise 1-4:
  Suppose that a perfectly rigid bar AB is supported horizontally by a wall as shown in Fig.3, and is subjected to infinitely many vertical forces $\boldsymbol{f}_i (i = 1, 2, ...)$ whose magnitude decreases monotonically as

  $$\frac{|\boldsymbol{f}_{i+1}|}{|\boldsymbol{f}_i|} = \frac{9}{10}$$

  Determine the direction and the magnitude of the total force acting on the bar.

- Exercise 1-5:
  Suppose that an iron weight is hung from a ceiling by a string AB as shown in Fig.4-(a). Determine the magnitude of the horizontal force F required to hold the weight as in the position shown in Fig4-(b). Note that m is mass and g is gravity constant.

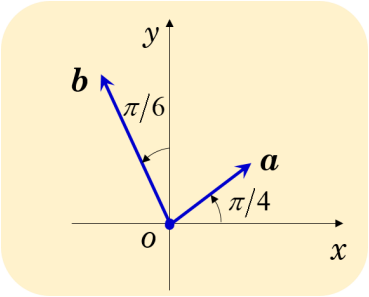

Figure 1: Vectors $\boldsymbol{a}$ and $\boldsymbol{b}$ in 2-dimensional space with an xy Cartesian coordinate system.

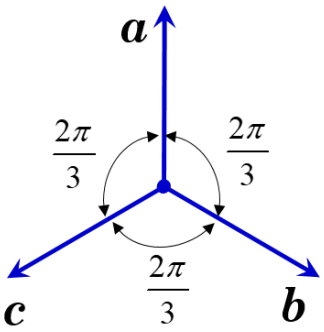

Figure 2: Vectors $\boldsymbol{a}, \boldsymbol{b}$ and $\boldsymbol{c}$ of equal magnitude.

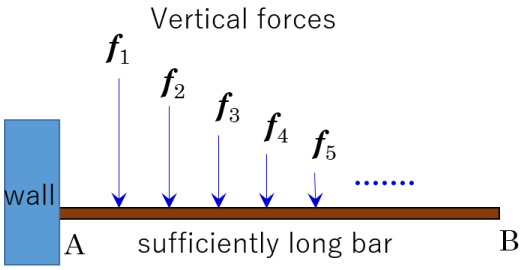

Figure 3: Infinitely many downward forces acting to a horizontally supported bar AB.

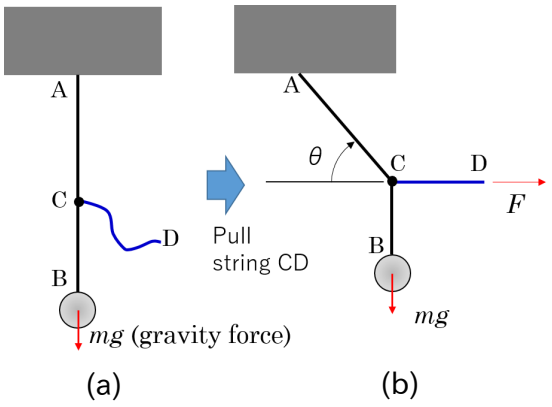

Figure 4: An weight of mass m hung from a ceiling by a string AB.