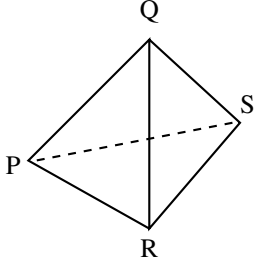


Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531\*\*\*. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

**Question 1.** (5 marks) Let  $P$ ,  $Q$ ,  $R$ , and  $S$  be four points, not all on one plane, as in the diagram. Show that the volume of the pyramid they determine is  $\frac{1}{6}[\vec{PQ} \cdot (\vec{PR} \times \vec{PS})]$ . Hint: The volume of a pyramid with base area  $A$  and height  $h$  is  $\frac{1}{3}Ah$ .



**Question 2.**

a. (3 marks) Show that  $\mathbf{w} \cdot (\mathbf{u} \times \mathbf{v}) = \mathbf{u} \cdot (\mathbf{v} \times \mathbf{w}) = \mathbf{v} \cdot (\mathbf{w} \times \mathbf{u})$  holds for all vectors  $\mathbf{w}$ ,  $\mathbf{u}$ , and  $\mathbf{v}$ .

b. (3 marks) Show that  $\mathbf{v} - \mathbf{w}$  and  $(\mathbf{u} \times \mathbf{v}) + (\mathbf{v} \times \mathbf{w}) + (\mathbf{w} \times \mathbf{u})$  are orthogonal.