INSTRUCTIONS

Full marks will be awarded for the correct solutions to BOTH QUESTIONS. This paper will be marked out of a TOTAL MAXIMUM MARK OF 100. Credit will be given for clearly presented solutions.

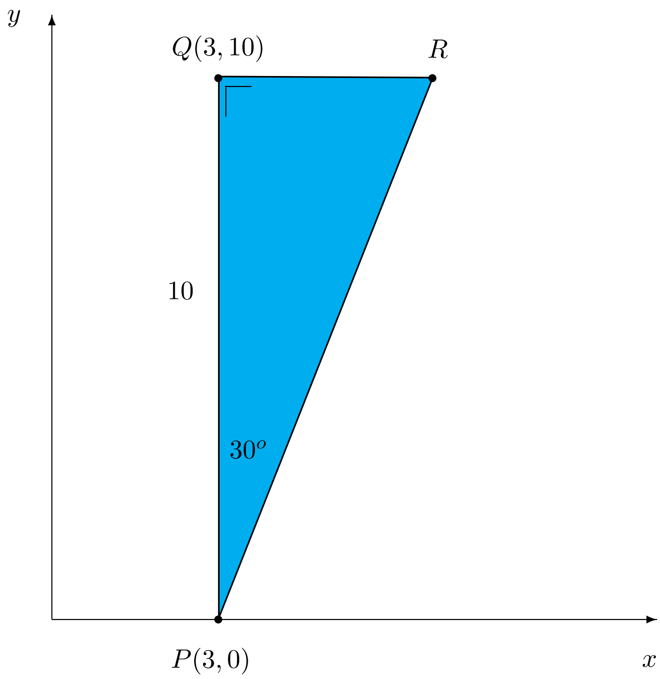
BSc (Hons) in Computer Games Development

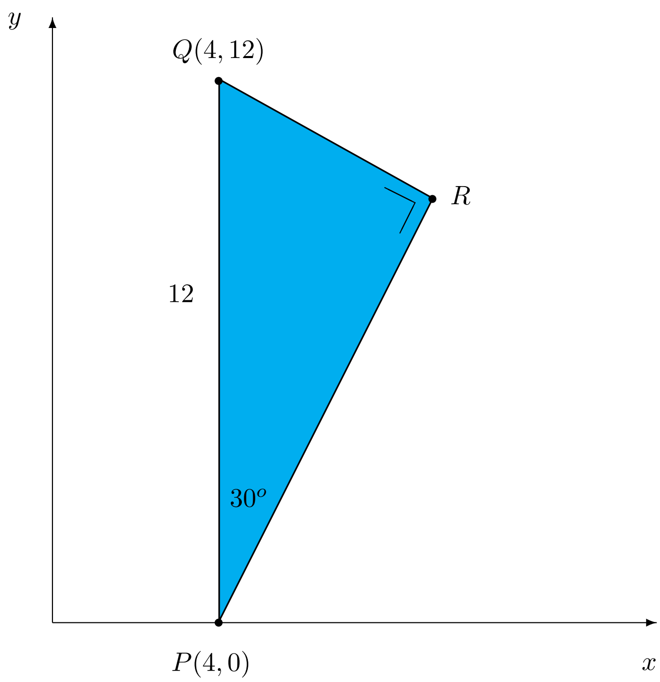
Tuesday, October 24^{th}, 2017

YEAR 1

CLASS TEST 1

1. In the following coordinate diagrams in $\mathbb{R}^2$ the triangle PQR is a right-angled triangle. Using *basic trigonometry*, determine the coordinates of the point R.

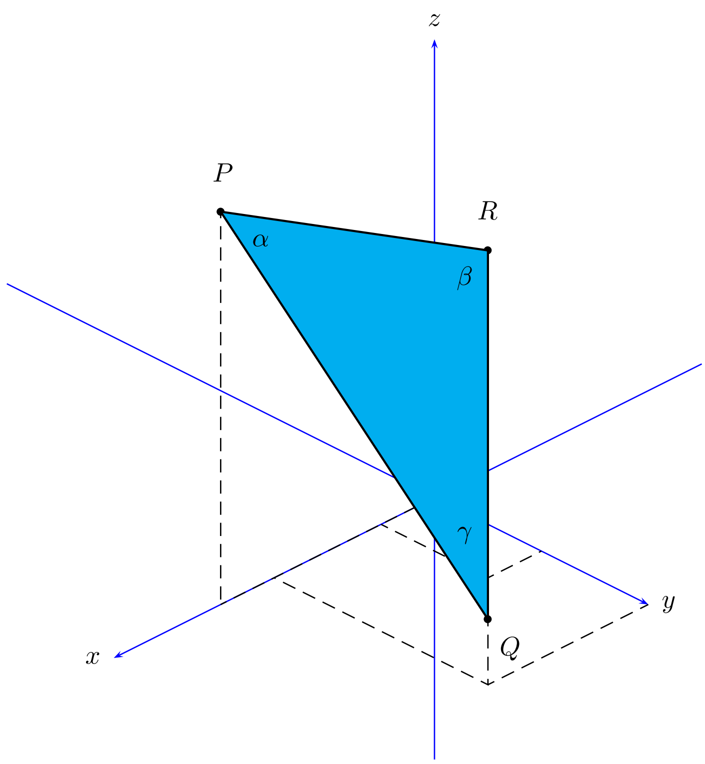




30 marks

2. Consider the following points in $\mathbb{R}^3$.

$$P(1,2,-3) \quad , \quad Q(3,2,1) \quad , \quad R(4,0,-2)$$



i Evaluate $P - 2Q + 3R$.

ii Determine $||2P - 4Q||$.

iii Evaluate $P.Q$, i.e., the *scalar product* of P with Q.

iv Evaluate $P \times Q$.

v Show that the vectors defining this triangle $\triangle PQR$ are *coplanar*.

vi Determine all internal angles α, β, γ of the triangle $\triangle PQR$.

vii Determine the area of the triangle $\triangle PQR$.

70 marks

USEFUL INFORMATION

VECTORS IN $\mathbb{R}^3$:

For any vector $\vec{u} = (u_1, u_2, u_3)$ in $\mathbb{R}^3$, we define the magnitude of $\vec{u}$ to be the non-negative real number

$$\|\vec{u}\| = \sqrt{u_1^2 + u_2^2 + u_3^2}$$

Suppose that $\vec{u} = (u_1, u_2, u_3)$ and $\vec{v} = (v_1, v_2, v_3)$ are vectors in $\mathbb{R}^3$ and that $\theta \in [0, \pi]$ represents the angle between them. We define the scalar product $\vec{u}.\vec{v}$ of $\vec{u}$ and $\vec{v}$ by $\vec{u}.\vec{v} = \|\vec{u}\|\|\vec{v}\| \cos\theta$. Hence

$$\cos\theta = \frac{\vec{u}.\vec{v}}{\|\vec{u}\|\|\vec{v}\|}$$

Note that the scalar product may also be defined as

$$\vec{u}.\vec{v} = u_1v_1 + u_2v_2 + u_3v_3$$

Theorem 1

Suppose that $\vec{u}, \vec{v} \in \mathbb{R}^3$. Then the parallelogram with $\vec{u}$ and $\vec{v}$ as two of its sides has area $\|\vec{u} \times \vec{v}\|$.