Department of Mathematics


Explain what you are doing briefly. Otherwise you will get no credits!

1. (10 points) Let $P$ be a point in the plane with a pair of polar coordinates $(2, \pi / 6)$.
(a) Find the Cartesian coordinates $(x, y)$ of $P$.
(b) Find a polar equation for the line $\ell$ through $(2, \pi / 6)$ perpendicular to the polar axis.
(c) Find a polar equation for the line $m$ through $P$ and the pole $O$.
2. (14 points) In a given triangle $\triangle A B C, A(1,8), B(2,1)$ and $C(3,3 / 2)$.
(a) Find an equation of the line $\ell$ containing the altitude $\overline{A D}$.
(b) Find the point(s) on the line $m$ containing the side $\overline{B C}$ such that $|C E|=2|B C|$.
(c) Find the point $D$ and its distance from $B$ and $C$.
3. (12 points) Consider the line $\ell$ with equation $x+2 y+7=0$.
(a) Find a translation that translates the $X Y$-coordinates $(x, y)$ into a suitable $\tilde{X} \tilde{Y}$ coordinates $(\tilde{x}, \tilde{y})$ such that $\ell$ passes through the origin $\tilde{O}$ in the new system.
(b) Rotate the XY-coordinate system through an angle of $45^{\circ}$ in the clockwise direction to obtain $\bar{X} \bar{Y}$-coordinate system. Write this rotation.
(c) Use (b) to express the equation of $\ell$ in terms of $\bar{x}$ and $\bar{y}$.
4. (14 points) Let the points $A(-9,3), B(-2,2)$ and $C(2,5)$ be given.
(a) Determine whether or not the measure of the angle $\angle A B C$ exceeds $\pi / 2$. In other words is $\angle A B C$ an obtuse angle?
(b) Find the point $D$ so that the quadrilateral $A B C D$ is a parallelogram.
