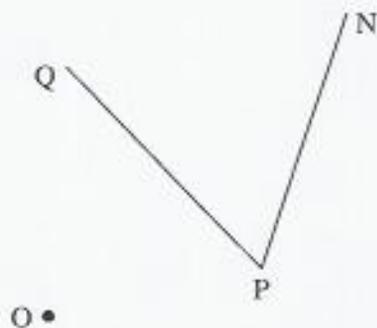


Answer all the questions

1. The complex numbers z and w are $z = 1 + 2i$ and $w = 3 - i$. Calculate the following complex numbers, giving your answers, where appropriate, in the form $a + ib$ where a and b are real.
- (a) $\frac{2z}{w}$ (b) $|z|$ [4]
 (c) $z\bar{z}$ (d) $\arg(w - \bar{w})$
2. Let $f(z) = 2z^3$.
- Show that image of the straight line which joins the complex number $1 - i$ to $1 + i$ is not a straight line when it is mapped by $f(z)$. [4]
3. A function $f(x)$ has the property that at the point $x = a$, $f(a) = 1$ and $f'(a) = f''(a) = f'''(a) = 0.1$. Calculate an approximation to $f(a + 0.1)$ giving 7 significant figures in your answer. [4]
4. (a) Let $\omega = \cos \frac{2}{3}\pi + i \sin \frac{2}{3}\pi$. Find simpler expressions for ω^3 and $1 + \omega + \omega^2$. [2]
- (b) In the figure, the points P and Q in the complex plane have the complex numbers p and q , and O is the origin.



Explain why the point N , with complex number n given by $n = p + \omega(p - q)$, is the third point of an equilateral triangle PQN . [4]