**2F Problem Solving with Tangents & Normals**

1. The point $P(at^{2},2at)$ lies on the parabola $C$ with equation $y^{2}=4ax$ where $a$ is a positive constant. Show that an equation of the normal to $C$ at $P$ is $y+tx=2at+at^{3}$
2. The point $\left(ct,\frac{c}{t}\right), t\ne 0,$ lies on the rectangular hyperbola $H$ with equation $xy=c^{2}$ where $c$ is a positive constant.
3. Show that an equation of the tangent to $H$ at $P$ is $x+t^{2}y=2ct.$

A rectangular hyperbola $G$ has equation $xy=9$. The tangent to $G$ at the point $A$ and the tangent to $G$ at the point $B$ meet at the point $\left(-1,7\right).$

1. Find the coordinates of $A$ and $B$.
2. The parabola $C$ has equation $y^{2}=20x$. The point $P\left(5p^{2},10p\right)$ is a general point on $C$. The line $l$ is normal to $C$ at the point $P$.
3. Show that an equation for $l$ is $px+y=10p+5p^{3}$

The point $P$ lies on $C$. The normal to $C$ at $P$ passes through the point $\left(30,0\right)$ as shown on the diagram. The region $R$ is bounded by this line, the curve $C$ and the $x$-axis.

1. Given that $P$ lies in the first quadrant, show that the area of the shaded region $R$ is $\frac{1100}{3}$