

1. (a). Find an equation of the sphere that passes through the point  $(6, -3, 3)$  and has center  $(-1, 3, 1)$ .

(b). Find the curve in which this sphere intersects the  $xy$ -plane.

2. Find the work done by a force  $\mathbf{F} = \mathbf{i} + 5\mathbf{j} + 7\mathbf{k}$  that moves an object from the point  $(2, 0, 4)$  to the point  $(7, 5, 10)$  along a straight line. The distance is measured in meters and the force in newtons.

3. At what point on the curve  $x = t^3, y = 3t, z = t^4$  is the normal plane parallel to the plane  $3x + 3y - 4z = 2$ ?

4. The helix  $\mathbf{r}_1(t) = 6\cos t\mathbf{i} + \sin t\mathbf{j} + t\mathbf{k}$  intersects the curve  $\mathbf{r}_2(t) = (6+t)\mathbf{i} + 8t^2\mathbf{j} + 7t^3\mathbf{k}$  at the point  $(6, 0, 0)$ . Find the angle of intersection.

5. Consider the polar equation  $r = -\frac{11}{4\sin\theta - 1}$ .

Find the eccentricity and an equation of the directrix of the conic.

(a) Identify the conic.

(c) Sketch the curve.

6. Find an equation of the tangent to the curve at the point corresponding to the given value of the parameter.  $x = 2t\cos t, y = 2t\sin t, t = -\pi$