Find $\dfrac{dy}{dx}$.

1) $x = t - t^3, \quad y = 2 - 5t$ $\boxed{\dfrac{-5}{1-3t^2}}$

Find an equation of the tangent to the curve at the point corresponding to the given value of the parameter.

2) $x = t^4 + 1, \quad y = t^3 + t, \quad t = -1$ $\boxed{y = -x}$

3) $x = e^{\sqrt{t}}, \quad y = t - \ln t^2, \quad t = 1$ $\boxed{y = -\dfrac{2}{e}x + 3}$

4) $x=\cos\theta+\sin 2\theta,\quad y=\sin\theta+\cos 2\theta,\quad t=0$ $\boxed{y=\frac{1}{2}x+\frac{1}{2}}$

Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. For which values of t is the curve concave upward?

5) $x=4+t^2,\quad y=t^2+t^3$ $\boxed{\frac{dy}{dx}=1+\frac{3}{2}t,\quad \frac{d^2y}{dx^2}=\frac{3}{4t},\quad \text{CU: } t>0}$

6) $x=t-e^t,\quad y=t+e^{-t}$ $\boxed{\frac{dy}{dx}=-e^{-t},\quad \frac{d^2y}{dx^2}=\frac{e^{-t}}{1-e^t},\quad \text{CU: } t<0}$

7) $x = 2\sin t, \quad y = 3\cos t, \quad 0 < t < 2\pi$

$\boxed{\dfrac{dy}{dx} = -\dfrac{3}{2}\tan t, \quad \dfrac{d^2y}{dx^2} = -\dfrac{3}{4}\sec^3 t, \quad \text{CU: } \dfrac{\pi}{2} < t < \dfrac{3\pi}{2}}$

Find the points on the curve where the tangent is horizontal or vertical.

8) $x = 2t^3 + 3t^2 - 12t, \quad y = 2t^3 + 3t^2 + 1$

Horizontal: $(0,1)$ and $(13,2)$
Vertical: $(20,-3)$ and $(-7,6)$

9) $x = 2\cos\theta, \quad y = \sin 2\theta$

Horizontal: $(\pm\sqrt{2}, \pm 1)$ (4 points)
Vertical: $(\pm 2, 0)$

10) At what points on the curve $x = t^3 + 4t$, $y = 6t^2$ is the tangent parallel to the line with equations $x = -7t$, $y = 12t - 5$?

$$\boxed{(-5,6) \text{ or } \left(-\frac{208}{27}, \frac{32}{3}\right)}$$

11) Use the parametric equations of an ellipse, $x = a\cos\theta$, $y = b\sin\theta$, $0 \le \theta \le 2\pi$, to find the area that it encloses.

$$\boxed{\pi ab}$$

12) Find the area bounded by the curve $x = \cos t$, $y = e^t$, $0 \le t \le 2\pi$, and the lines $y = 1$ and $x = 0$.

$$\boxed{\frac{1}{2}\left(e^{\pi/2} - 1\right)}$$

Set up, but do not evaluate, an integral that represents the length of the curve.

13) $x = t - t^2, \quad y = \frac{4}{3}t^{3/2}, \quad 1 \le t \le 2$ $\qquad \boxed{L = \int_1^2 \sqrt{1 + 4t^2}\, dt}$

14) $x = \ln t, \quad y = \sqrt{t+1}, \quad 1 \le t \le 5$ $\qquad \boxed{L = \int_1^5 \frac{t+2}{2t\sqrt{t+1}}\, dt}$

Find the length of the curve.

15) $x = 1 + 3t^2, \quad y = 4 + 2t^3, \quad 0 \le t \le 1$ $\boxed{2\left(2\sqrt{2} - 1\right)}$

16) $x = e^t \cos t, \quad y = e^t \sin t, \quad 0 \le t \le \pi$ $\boxed{\sqrt{2}\left(e^{\pi} - 1\right)}$

17) $x = e^t - t, \quad y = 4e^{t/2}, \quad -8 \le t \le 3$ $\boxed{e^3 - e^{-8} + 11}$