1. $x=(y-4)^2$, A parabola opening right. Starting at $(49,-3)$ and ending at $(169,17)$.
2. $y=-\sqrt{36-x^2}$, the bottom half of a circle with radius 6, centered at the origin. Starting at $(-6,0)$ ending at $(6,0)$.
3. $\begin{array}{l} x=-4t^3-t \\ y=t \end{array}$ for $-\infty \le t \le \infty$. The answer is not unique.
4. $\begin{array}{l} x=-4+t \\ y=-2+t \end{array}$ for $0 \le t \le 6$
5. $\dfrac{dy}{dx}=\dfrac{5t^4}{3}$, $\left.\dfrac{dy}{dx}\right|_{t=2}=\dfrac{80}{3}$
6. $y=-x+\dfrac{3\pi\sqrt{2}}{4}$
7. 52
8. $\left(3,\dfrac{2\pi}{3}\right),\left(-3,\dfrac{5\pi}{3}\right)$
9. $\left(-\sqrt{3},-1\right)$
10. $\left(10,\dfrac{\pi}{6}\right)$
11. $\dfrac{dy}{dx}=\dfrac{\cos\theta-2\sin\theta\cos\theta}{\sin^2\theta-\sin\theta-\cos^2\theta}$; $\left.\dfrac{dy}{dx}\right|_{\theta=2}=0$
12. $\dfrac{dy}{dx}=\dfrac{\sin^2\theta-\cos^2\theta}{2\sin\theta\cos\theta}$ Horizontal tangent lines at : $\left(\dfrac{3\sqrt{2}}{2},\dfrac{\pi}{4}\right),\left(\dfrac{-3\sqrt{2}}{2},\dfrac{3\pi}{4}\right)$ Vertical tangent lines at: $(3,0),\left(0,\dfrac{\pi}{2}\right)$
13. Making use of symmetry $2\int_0^{\frac{\pi}{6}}\dfrac{1}{2}(5\cos 3\theta)^2\,d\theta=\dfrac{25\pi}{12}$
14. Points of intersection are: $(0,0),\left(16+8\sqrt{2},\dfrac{\pi}{4}\right),\left(16-8\sqrt{2},\dfrac{5\pi}{4}\right)$ Using symmetry the area is : $2\int_{\frac{\pi}{4}}^{\frac{5\pi}{4}}\dfrac{1}{2}(16+16\cos\theta)^2\,d\theta=384\pi-512\sqrt{2}$
15. $\dfrac{1}{2}\int_{\frac{2\pi}{3}}^{\frac{4\pi}{3}}\left((-6\cos\theta)^2-(3)^2\right)d\theta=3\pi+\dfrac{9\sqrt{3}}{2}$

16. $\int_0^{\frac{\pi}{2}} \sqrt{\left(\frac{20}{1+\cos\theta}\right)^2 + \left(\frac{20\sin\theta}{(1+\cos\theta)^2}\right)^2}\, d\theta = 10\ln\left(\sqrt{2}+1\right)+10\sqrt{2}$

17. $\frac{x^2}{7}+\frac{y^2}{5}=1$, foci are $\left(-\sqrt{2},0\right),\left(\sqrt{2},0\right)$ length of major $2\sqrt{7}$ length of minor $2\sqrt{5}$

18. $\frac{x^2}{144}-\frac{y^2}{25}=1$

19. $y=\frac{3}{40}x+\frac{4}{5}$

20. $\overrightarrow{QT}=\langle 8,1\rangle, \overrightarrow{PU}=\langle 8,1\rangle,$ and $\overrightarrow{RS}=\langle -4,-3\rangle$ so only $\overrightarrow{QT}=\overrightarrow{PU}$

21. $\left\langle \frac{12}{5},-\frac{16}{5}\right\rangle$

22. $\langle -282,0\rangle+\left\langle -19\sqrt{2},-19\sqrt{2}\right\rangle=\left\langle -282-19\sqrt{2},-19\sqrt{2}\right\rangle$ so speed is 310.04 mph and the direction is 4.97° south of west.

23. $F=24\cos 30^\circ\,\mathbf{i}+24\sin 30^\circ\,\mathbf{j}=\left\langle 12\sqrt{3},12\right\rangle$ so horizontal component is $12\sqrt{3}$ and vertical component is 12.

24. Midpoint is $\left(-3,3,\frac{15}{2}\right)$ and equation is $(x+3)^2+(y-3)^2+\left(z-\frac{15}{2}\right)^2=\frac{165}{4}$

25. Center $(7,-3,5)$ radius 5

26. $4\mathbf{u}+2\mathbf{v}=\left\langle 22,12,44\sqrt{3}\right\rangle$ $3\mathbf{u}-\mathbf{v}=\left\langle 14,9,13\sqrt{3}\right\rangle$ $|\mathbf{u}+3\mathbf{v}|=2\sqrt{739}$

27. Same direction $\left\langle -\sqrt{42},-4\sqrt{42},5\sqrt{42}\right\rangle$ opposite direction $\left\langle \sqrt{42},4\sqrt{42},-5\sqrt{42}\right\rangle$

28. $\mathbf{u}\bullet\mathbf{v}=13$ and the angle is 47.05°

29. $\text{proj}_{\mathbf{v}}\mathbf{u}=\frac{\mathbf{u}\bullet\mathbf{v}}{|v|^2}\mathbf{v}=\left(-\frac{5}{3},-\frac{10}{3},\frac{10}{3}\right)$

30. $c=\frac{14}{3}$

31. $\langle -12,-46,21\rangle$

32. Vector equation $\langle x,y,z\rangle=\langle -3,1,4\rangle+t\langle 7,-3,-4\rangle$ parametric equations

$x=-3+7t,\quad y=1-3t,\quad z=4-4t$

33. They intersect at $(1,4,3)$.

34. They are skew.

35. $\dfrac{8\sqrt{21}}{7}$

36. $-9x-6y+6z=-33$

37. Dot product of normal vectors is 0, so orthogonal.

38. Using $z=0$, $x=\dfrac{1}{5}-4t,\ \ y=-\dfrac{1}{5}-t,\quad z=5t$

39. $(53,-8,7)$

40. 51.58°

41. $-\dfrac{x^2}{25}+\dfrac{y^2}{36}=4$; $-\dfrac{x^2}{25}+100z^2=4$; $\dfrac{y^2}{36}+100z^2=4$; hyperboloid of one sheet

42. $-\dfrac{(x-4)^2}{4}-\dfrac{(y+3)}{4}+z^2=1$ a hyperboloid of two sheets with center $(4,-3,0)$