

1 | Salt Flats

1.1 | 1)

N/A

1.2 | 2&3)

$$\begin{aligned}\vec{v}(t) &= \frac{d}{dt} \vec{f}(t) = \begin{bmatrix} 2t \\ 12 \cos(t) + 1 \end{bmatrix} \\ \vec{a}(t) &= \frac{d^2 t}{dt^2} \vec{f}(t) = \begin{bmatrix} 2 \\ -12 \sin(t) \end{bmatrix}\end{aligned}$$

1.3 | 4)

$$\begin{aligned}v(t) &= \|\vec{v}(t)\| \\ v(\pi) &= \|\vec{v}(\pi)\| \\ &= \left\| \begin{bmatrix} 2\pi \\ 12 \cos(\pi) + 1 \end{bmatrix} \right\| \\ &= \left\| \begin{bmatrix} 2\pi \\ -11 \end{bmatrix} \right\| \\ &= \sqrt{(2\pi)^2 + (-11)^2} \\ &= \sqrt{4\pi^2 + 121}\end{aligned}$$

$$\begin{aligned}a(t) &= \|\vec{a}(t)\| \\ a(\pi) &= \|\vec{a}(\pi)\| \\ &= \left\| \begin{bmatrix} 2 \\ -12 \sin(\pi) \end{bmatrix} \right\| \\ &= \left\| \begin{bmatrix} 2 \\ 0 \end{bmatrix} \right\| \\ &= \sqrt{(2)^2 + (0)^2} \\ &= \sqrt{4} \\ &= 2\end{aligned}$$

1.4 | 5)

$$\begin{aligned}v(t) &= \|\vec{v}(t)\| \\ &= \sqrt{\vec{v}_x(t)^2 + \vec{v}_y(t)^2} \\ &= \sqrt{4t^2 + 144 \cos^2(t) + 24 \cos(t) + 1}\end{aligned}$$

We know that both $\cos^2(t)$ and $\cos(t)$ have a maximum value of 1, and they are maximized at $t \in \{x : \frac{x}{2\pi} \in \mathbb{Z}\}$. However, $4t^2$ is quadratic, and it does not have a maximum value, as it diverges as t increases or

decreases towards infinity. We do know, however, that the function is bounded between -2π and 3π . The value(s) that fits this is -2π (and 2π):

$$\begin{aligned} \max(v(t)) &= \sqrt{4(2\pi)^2 + 144 \cos^2(2\pi) + 24 \cos(2\pi) + 1} \\ &= \sqrt{16\pi^2 + 144 + 24 + 1} \\ &= \sqrt{16\pi^2 + 169} \end{aligned}$$

1.5 | 6)

$$\begin{aligned} a(t) &= ||\vec{a}(t)|| \\ &= \sqrt{\vec{a}_x(t)^2 + \vec{a}_y(t)^2} \\ &= \sqrt{4 + 144 \sin^2(t)} \end{aligned}$$

We know that the maximum value of $\sin^2(t)$ is 1, so the above becomes

$$\begin{aligned} \max(a) &= \sqrt{4 + 144} \\ &= \sqrt{148} \\ &= 2\sqrt{37} \end{aligned}$$

We have no units so I can't tell if I can survive this or not.

1.6 | 7)