1. [11 points] Consider the polar curve $r = \theta \sin\theta$.

a. [2 points] What are the x- and y-coordinates of the curve in terms of θ? Use this to write a set of parametric equations for the curve.

Answer: $x(\theta) =$ _____ and $y(\theta) =$ _____

b. [2 points] Which of the following points are on the curve $r = \theta \sin\theta$? Circle **all** options which apply.

i. $\theta = \dfrac{\pi}{2}, r = \dfrac{\pi}{2}$

ii. $\theta = \dfrac{3\pi}{2}, r = \dfrac{3\pi}{2}$

iii. $\theta = \pi, r = \pi$

iv. $\theta = 2\pi + \dfrac{\pi}{2}, r = \dfrac{\pi}{2}$

v. $x = 0, y = \dfrac{\pi}{2}$

vi. $x = 0, y = -\dfrac{\pi}{2}$

vii. $x = 0, y = -\dfrac{3\pi}{2}$

viii. NONE OF THESE

c. [1 point] Find $\dfrac{dy}{d\theta}$ in terms of θ.

Answer: $\dfrac{dy}{d\theta} =$ _____

d. [2 points] At which of the following values of θ could the curve $r = \theta \sin\theta$ have a horizontal tangent line? Circle **all** options which apply.

i. $\theta = \dfrac{\pi}{2}$

ii. $\theta = \pi$

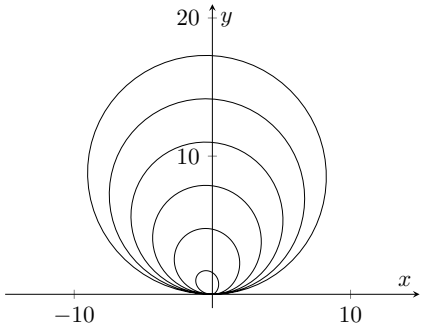
iii. $\theta = 2024\pi$

iv. $\theta = \dfrac{2025}{2}\pi$

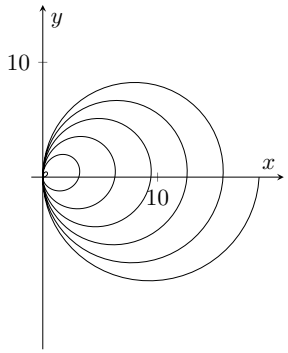
v. NONE OF THESE

e. [2 points] Which of the following could be the graph of the polar curve $r = \theta \sin\theta$, with $0 \le \theta \le 6\pi$? Circle the **one** best option.

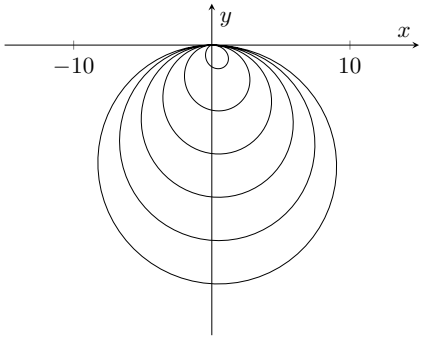
(**A**)



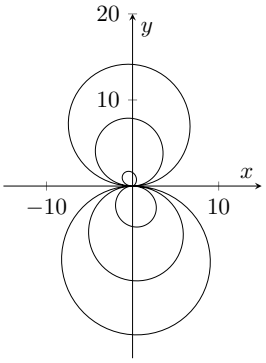
(**B**)



(**C**)



(**D**)



f. [2 points] Which of the following integrals gives the length of the curve $r = \theta \sin\theta$, for $0 \le \theta \le 6\pi$? Circle **all** options which apply.

i. $\displaystyle\int_0^{6\pi} \sqrt{\left(\theta\left(\cos^2\theta - \sin^2\theta\right) + \sin\theta\cos\theta\right)^2 + \left(\sin\theta\left(2\theta\cos\theta + \sin\theta\right)\right)^2}\, d\theta$

ii. $\displaystyle\int_0^{6\pi} \sqrt{\left(\theta\cos\theta + \sin\theta\right)^2 + \left(\theta\sin\theta\right)^2}\, d\theta$

iii. $\displaystyle\int_0^{2\pi} \sqrt{\left(\theta\left(\cos^2\theta - \sin^2\theta\right) + \sin\theta\cos\theta\right)^2 + \left(\sin\theta\left(2\theta\cos\theta + \sin\theta\right)\right)^2}\, d\theta$

iv. $\displaystyle\int_0^{2\pi} \sqrt{\left(\theta\cos\theta + \sin\theta\right)^2 + \left(\theta\sin\theta\right)^2}\, d\theta$

v. None of the above.