Pesto Pasta

A Journey

Ingredients

- Spaghetti, raw
- Pesto cubes, frozen
- Parmesan cheese, fresh
- Olive oil, succulent
- Salt, possibly

1. Put $\lim_{x \to 0} \frac{\sin 24x}{\frac{3}{2}x}$ cups of water on the water boiling machine in order to boil the water.
2. While the water is coming to a boil, defrost $\frac{1}{3} \left. \frac{d}{dx} \right|_{x=1} \left(-x^3 + 3x^2 + 9x\right)$ cubes of pesto in the microwave and mix with a small amount of olive oil.
3. When the water is rollingly boiling, add $\pi \int_0^{\frac{1}{2}} \cos(\pi t) \mathrm{d}t$ pounds of spaghetti.

   > Jeremiah has recently won a 100 liter tub of honey from his local fair. He is sad because his jar has started to leak and Jeremiah is slowly losing his most favorite succulent treat. His sadness t days after discovering the leak can be represented by the function $s(t) = \sin\left(\ln\left(10t + 1\right)\right)$ for all $t \geq 0$. Let T_s be the time (in days) when Jeremiah's sadness is the lowest between $t = 0$ and $t = 30$ (calculator allowed).

4. Cook the pasta for T_s minutes, then strain out the pasta.

Day	0	2	4	6
Velocity (m/day)	0.5	1	0.5	0

The Gregarious ~~Gooner~~ Goofball has been ~~gooning~~ working non-stop for years. He needs a break, and is going on a 7-day all-inclusive stay at the gorgeous Goofy Getaway. He is charged \$1 per meter that he travels while at the resort. His average velocity in meters per day at specific days during his vacation is given in the above table. Using a four-part left Riemann sum from $t = 0$ to $t = 7$ with the bounds given in the table, approximate the total charge for this vacation, and call this charge C_g.

5. Mix in the pesto, C_g tablespoons of olive oil, and add parmesean cheese to taste.
6. If and only if the series $\displaystyle\sum_{n=1}^{\infty} \frac{\sqrt[n]{n}}{n \ln n}$ converges, also mix in 74 pounds of salt.
7. Serve and possibly enjoy.

1. $\lim_{x \to 0} \frac{\sin 24x}{\frac{3}{2}x}$

2. $\frac{1}{3} \left. \frac{d}{dx} \right|_{x=1} \left(-x^3 + 3x^2 + 9x\right)$

3. $\pi \int_0^{\frac{1}{2}} \cos(\pi t) \mathrm{d}t$

Day	0	2	4	6
Velocity (m/day)	0.5	1	0.5	0

4. Jeremiah has recently won a 100 liter tub of honey from his local fair. He is sad because his jar has started to leak and Jeremiah is slowly losing his most favorite succulent treat. His sadness t days after discovering the leak can be represented by the function $s(t) = \sin(\ln(10t + 1))$ for all $t \geq 0$. Find the time t (in days) when Jeremiah's sadness is the lowest between $t = 0$ and $t = 30$ (calculator allowed).

5. The Gregarious ~~Gooner~~ Goofball has been ~~gooning~~ working non-stop for years. He needs a break, and is going on a 7-day all-inclusive stay at the gorgeous Goofy Getaway. He is charged \$1 per meter that he travels while at the resort. His average velocity in meters per day at specific days during his vacation is given in the table above. Using a four-part left Riemann sum from $t = 0$ to $t = 7$, approximate the total charge for this vacation.

1. $\lim_{x\to 0} \dfrac{\sin 24x}{\frac{3}{2}x}$

$$\begin{aligned}\lim_{x\to 0} \frac{\sin 24x}{\frac{3}{2}x} &= \frac{2}{3}\lim_{x\to 0} \frac{\sin 24x}{x} \\ &= \frac{2}{3}\underbrace{\lim_{x\to 0} \frac{\sin 24x}{x}}_{24} \\ &= \frac{2}{3}\cdot 24 \\ &= \boxed{16}\end{aligned}$$

2. $\dfrac{1}{3}\left.\dfrac{d}{dx}\right|_{x=1}\left(-x^3+3x^2+9x\right)$

$$\begin{aligned}&\frac{d}{dx}\left(-x^3+3x^2+9x\right) = -3x^2+6x+9 \\ &\quad \left(-3x^2+6x+9\right)\big|_{x=1} = -3(1)^2+6(1)+9 = 12 \\ &\frac{1}{3}\cdot 12 = \boxed{4}\end{aligned}$$

3. $\pi\displaystyle\int_0^{\frac{1}{2}} \cos(\pi t)\mathrm{d}t$

u-sub:

$$u = \pi t \qquad\qquad du = \pi dt$$

$$\begin{aligned}\pi\int_0^{\frac{1}{2}} \cos(\pi t)\,\mathrm{d}t &= \int_0^{\frac{1}{2}} \cos(\pi t)\,\pi\mathrm{d}t \\ \int_0^{\frac{1}{2}} \cos(\underbrace{\pi t}_{u})\,\underbrace{\pi\mathrm{d}t}_{\mathrm{d}u} &= \int_0^{\frac{1}{2}\pi} \cos(u)\mathrm{d}u \\ \int_0^{\frac{1}{2}\pi} \cos(u)\mathrm{d}u &= \boxed{1}\end{aligned}$$

Day	0	2	4	6
$v(t)$ (m/day)	0.5	1	0.5	0

4. Jeremiah has recently won a 100 liter tub of honey from his local fair. He is sad because his jar has started to leak and Jeremiah is slowly losing his most favorite succulent treat. His sadness t days after discovering the leak can be represented by the function $s(t) = \sin(\ln(10t+1))$ for all $t \geq 0$. Find the time t (in days) when Jeremiah's sadness is the lowest between $t = 0$ and $t = 30$ (calculator allowed).

$$
\begin{aligned}
s'(t) = &\quad \frac{10\cos(\ln(10\,t+1))}{10\,t+1} \\
s'(t) = 0 &\iff \cos(\ln(10\,t+1)) = 0 \\
&\iff \ln(10t+1) = \frac{3}{2}\pi \leftarrow \boxed{\text{When } \sin(\theta) = -1} \\
&\iff 10t+1 = \exp\left(\frac{3}{2}\pi\right) \\
&\iff t = \frac{\exp\left(\frac{3}{2}\pi\right) - 1}{10} \\
&\iff t \approx \boxed{11.032}
\end{aligned}
$$

[1]

5. The Gregarious ~~Gooner~~ Goofball has been ~~gooning~~ working non-stop for years. He needs a break, and is going on a 7-day all-inclusive stay at the gorgeous Goofy Getaway. He is charged \$1 per meter that he travels while at the resort. Let $v(t)$ represent his average velocity in meters per day. Values of $v(t)$ at specific days during his vacation are given in the table above. Using a four-part left Riemann sum from $t = 0$ to $t = 7$, approximate the total charge for this vacation.

$$
\begin{aligned}
\int_0^7 v(t)\mathrm{d}t &\approx \underbrace{(2)(0.5)}_{1} + \underbrace{(2)(1)}_{2} + \underbrace{(2)(0.5)}_{1} + \underbrace{(1)(0)}_{0} \\
&\approx 1+2+1+0 \\
&\approx \boxed{4}
\end{aligned}
$$

[1] In the original equation, it takes a minimum when $\sin(\theta) = -1$, which does not happen at $\theta = \frac{1}{2}\pi$. So, we solve for when $\theta = \frac{3}{2}\pi$ as opposed to the $\frac{1}{2}\pi$ that a traditional algebraic solve would get with arccos and all that jazz.