

1. Midday traffic through an intersection can be modeled by the function $74 + 6 \cos\left(\frac{t}{3}\right)$ cars per minute, where t is measured in minutes after noon. Find the number of cars that pass through this intersection between noon and 12:30 PM.

$$\int_0^{30} \left[74 + 6 \cos\left(\frac{t}{3}\right) \right] dt \approx \boxed{2210 \text{ cars}}$$

2. At 6:00 AM, a tank holds 2500 gallons of water. Over the next 18 hours, it is being filled at a constant rate of 100 gallons per hour while water is taken out at a rate given by $W(t) = 120 + 60 \sin(4\sqrt{t})$ gallons per hour, where t is measured in hours after 6:00 AM. How much water is in the tank at midnight, when $t = 18$?

$$2500 + 18(100) - \int_0^{18} W(t) dt \approx \boxed{2108.538 \text{ gallons}}$$

3. Ballots are cast for an election at a rate of $r(t) = 5 \sin(0.02t - 3) + 50 + 0.2t$ ballots per hour from the opening of the polls at 8:00am ($t = 0$) until 6:00pm. How many ballots were cast?

$$\int_0^{10} r(t) dt \approx 498.057$$

498 ballots

4. Oil is pumped into a tank for 24 hours starting at midnight on Tuesday at a rate of $p(t) = 2 \ln(t + 1)$ gallons per hour. Starting at 10:00am on Tuesday, oil is also removed from the tank at a rate of $r(t) = 2 + 2^{-t}$ gallons per hour and continues to be removed until midnight on Wednesday. How much oil is in the tank at midnight on Wednesday?

$$\int_0^{24} p(t) dt - \int_{10}^{24} r(t) dt \approx \boxed{84.942 \text{ gallons}}$$

5. The rate at which violent crimes were committed in a large city during the year 2022 is given by the function $V(t) = \frac{t}{2} \sin\left(\frac{t}{3}\right) + \frac{t}{5} + 3$ where V is measured in hundreds of violent crimes and t is measured in months with $t = 0$ being the beginning of January 2022. How many violent crimes were committed during the entire year of 2022?

$$\int_0^{12} V(t) dt \approx 58.760 \text{ hundred}$$

5876 violent crimes