Calculus 2 Workbook

Fundamental theorem of calculus

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PART 1 OF THE FTC

1. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of $f(x)$.

$$f(x)=\int_0^{x^2} 7t\cos(2t)\ dt$$

2. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of $g(x)$.

$$g(x)=\int_2^{x^3} \frac{5}{3+e^t}\ dt$$

3. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of $h(x)$.

$$h(x)=\int_{\cos(3x)}^{7} 8t+1\ dt$$

4. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of $f(x)$.

$$f(x) = \int_{1}^{3x^2} \frac{\sin t}{t^3 + 5}\ dt$$

5. Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of $g(x)$.

$$g(x) = \int_{3x}^{2x^2} t^2 - 5t + 4\ dt$$

PART 2 OF THE FTC

1. Use Part 2 of the Fundamental Theorem of Calculus to evaluate the integral.

$$\int_{2}^{5} 5 - \frac{3}{x}\ dx$$

2. Use Part 2 of the Fundamental Theorem of Calculus to evaluate the integral.

$$\int_{4}^{9} 4x^3 - \sqrt{x}\ dx$$

3. Use Part 2 of the Fundamental Theorem of Calculus to evaluate the integral.

$$\int_{-3}^{-1} \frac{3}{x^3}\ dx$$

4. Use Part 2 of the Fundamental Theorem of Calculus to evaluate the integral.

$$\int_{25}^{36} \frac{2-\sqrt{x}}{\sqrt{x}}\ dx$$

NET CHANGE THEOREM

■ 1. Suppose the position of a particle moving along the horizontal s-axis is at $s = -2$ when $t = 0$. The velocity of the particle is given by $v(t)$ with $0 \leq t \leq 10$, where t is time in seconds since the particle began moving. Use the Net Change Theorem to determine the position of the particle on the s-axis after the particle has been moving for 5 seconds.

$$v(t) = \frac{1}{4}t^2 - \frac{9}{(t+1)^2}$$

■ 2. Water is being pumped from a tank at a rate (in gallons per minute) given by $w(t) = 80 - 4\sqrt{t+3}$, with $0 \leq t \leq 60$, where t is the time in minutes since the pumping began. The tank had $5{,}000$ gallons of water in it when pumping began. Use the Net Change Theorem to determine how many gallons of water will be in the tank after 30 minutes of pumping.

■ 3. From 1990 to 2010, the rate of rice consumption in a particular country was $R(t) = 5.8 + 1.07^t$ million pounds per year, with t being years since the beginning of the year 1990. The country had 7.2 million pounds of rice on hand at the beginning of 1994 and produced 7.5 million pounds of rice every year. Use the Net Change Theorem to determine how many millions of pounds of rice were on hand in that country at the end of 1998.

■ 4. A cooling pump connected to a power plant operates at a varying rate, depending on how much cooling is needed by the power plant. The rate (in gallons per second) at which the pump is operated is modeled by $r(t) = 0.003t^3 - 0.02t^2 + 0.29t + 59.81$, where t is defined in seconds for $0 \leq t \leq 120$. The pump has already pumped $1{,}508$ gallons during the first 25 seconds. Use the Net Change Theorem to determine how many gallons the pump will have pumped after 2 minutes.

■ 5. A rocket is launched upward from a cliff that's 86 feet above ground level. The velocity of the rocket is modeled by $v(t) = -32t + 88$, in feet per second, where t is seconds after the launch. Use the Net Change Theorem to determine the height in feet of the rocket 2 seconds after it's launched.

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