AP® Calculus AB (Operational)
2004 Sample Student Responses

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CALCULUS BC

SECTION II, Part A

Time—45 minutes

Number of problems—3

A graphing calculator is required for some problems or parts of problems.

Work for problem 1(a)

$\int_0^{30} [82 + 4\sin(\frac{t}{2})]\,dt \approx 2474$ cars

2474 cars pass through over the 30-minute period.

Work for problem 1(b)

$F(t) = 82 + 4\sin(\frac{t}{2})$

$F'(t) = 4 \cdot \frac{1}{2} \cdot \cos(\frac{t}{2})$

$= 2\cos(\frac{t}{2})$

$F'(7) = 2\cos(\frac{7}{2}) = -1.8729$

Since the derivative of $F(t)$ is negative, the traffic flow is decreasing.

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Continue problem 1 on page 5.

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Work for problem 1(c)

Average value theo, $\dfrac{\int_a^b f(x)\,dx}{b-a}$

$$\frac{\int_{10}^{15} [82+45\sin(\frac{t}{2})]\,dt}{15-10} = \frac{409.4962}{5} = 81.8992 \approx 82 \text{ cars/min}$$

Work for problem 1(d)

$$\frac{\int_{10}^{15} F'(t)\,dt}{15-10}$$

$$= \frac{\int_{10}^{15} [2\cos(\frac{t}{2})]\,dt}{5}$$

$$= \frac{7.587697}{5}$$

$$= 1.5175$$

$$\approx 2 \text{ cars/min}^2$$

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CALCULUS AB

SECTION II, Part A

Time—45 minutes

Number of problems—3

A graphing calculator is required for some problems or parts of problems.

Work for problem 1(a)

$$\int_0^{30} \left[82 + 4\sin\left(\frac{t}{2}\right)\right] dt$$

2474 cars

Work for problem 1(b)

$$F(7) = 82 + 4\sin\left(\frac{7}{2}\right)$$

$$F(7) = 83.403$$

Traffic flow is increasing because $F(7)$ is positive.

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Work for problem 1(c)

$$\frac{1}{5}\int_{10}^{15}\left[82+4\sin\left(\frac{t}{3}\right)\right]dt =$$

81.899 cars

Work for problem 1(d)

$$\frac{F(15)-F(10)}{15-10} = \frac{85.752-78.164}{5}$$

1.518 cars per minute

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