

# AP CALCULUS AB/BC



# Q U E S T I O N C A T A L O G U E



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# **AP Calculus**

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# I. FUNCTIONS, GRAPHS AND LIMITS 1. Functions

What is the domain of the function 1071. $f(x) = \frac{x^2 - 16}{x^2 + 7x + 12}$ ? (A) (-4, 4) (D) (- $\infty$ , $\infty$ ) (B) $x \neq -3$ , -4 (E) $x \neq -4$ , 4 (C) $x \neq -3$ , -4, 4	
1097. The domain of the function $f(x) = \frac{1}{\sqrt{4-x}}$ is (A) $x \ge 0$ (D) $x \ge 4$ (B) $x > 4$ (E) $x \le 4$ (C) $x < 4$	Which of the following functions is represented by the graph above?
The graph of $y^2 - 5y - 1 = x^2$ is a(n) 1168. (A) circle (D) line (B) ellipse (E) parabola (C) hyperbola If the zeros of $f(x)$ are $x = -2$ and $x = 3$ , then 1215. the zeros of $f(\frac{x}{2})$ are $x =$ (A)-1, $\frac{3}{2}$ (D)-3, $\frac{9}{2}$ (B)-2, 3 (E)-4, 6 (C)-2, 6	(A) $f(x) = \left  -\frac{3}{2}x + 1 \right $ (D) $f(x) = \frac{3}{x}x + 1$ (B) $f(x) = \left  \frac{3}{2}x + 1 \right $ (E) $f(x) = \frac{3}{2}x - 1$ (C) $f(x) = -\frac{3}{2}x + 1$
If $f(x) = 3 - x$ and $g(x) = \sqrt{x-5}$ , then $f(g(-2)) = 1244$ . (A)0 (D) $\sqrt{2}$ (B) $4 - \sqrt{7}$ (E) Undefined (C) $\sqrt{7}$	1525. The function $h(x) = \frac{f(x)}{g(x)}$ is discontinuous whenever (A) $g(x) = 1$ (D) $g(x) = 0$ (B) $g(x)$ is negative (E) $f(x) = g(x)$
1524. The function $f(x) = \frac{x^2 + 9x - 90}{x^2 + 19x + 60}$ has a removable discontinuity at (A)-15 (D)7 (B)-4 (E) 15 (C) 6 1582. If $f(x) = \frac{3}{x^2 - 2}$ and $g(x) = 4x$ , then $g(f(3)) =$ (A) $\frac{3}{7}$ (D) $\frac{12}{7}$ (B) $\frac{2}{3}$ (E) $\frac{14}{7}$ (C) $\frac{12}{3}$	(C) $f(x) = 0$ A polynomial has a relative maximum at (-5, 4), 1726. a relative minimum at (1, -7) and a relative maximum at (4, 2), and no other critical points. How many real roots does the polynomial have? (A) 2 (D) 5 (B) 3 (E) 6 (C) 4

II. DERIVATIVES 1. Definitions			A. Geometric Definition 1. Geometric Definition
If the graph of $f(x)$ 1570. the line $y = x$ and then the graph of $f(x)$ (A)Symmetric with	) is symmetric with respect to as differentiable everywhere, f'(x) is the respect to the line $y = 0$	Where is $f'(x) < 0$ ? 1240. (A) (0, 1) and $(2, \infty)$ (B) $(-\frac{1}{2}, 3)$	(D) (- $\infty$ , 0) and (1, 2) (E) (- $\infty$ , $-\frac{1}{2}$ ) and ( $\frac{3}{2}$ , $\infty$ )
( <b>B</b> ) <b>Symmetric</b> wi (C) A parabola	ith respect to the line $x = 0$	(C) $(\infty, 0)$ and $(1, 2)$	,
(D) A hyperbola		Where is $f'(x) > 0$ ?	
(E) None of the ab	oove	1239. (A) $(\infty, 0)$ and $(1, 2)$	(D) $(-\infty, -\frac{1}{2})$ and (3, 0)
If $f(x)$ is a continu 1503. $f'(a) = 0$ , what ca	ous differentiable function and n always be said about the	(B) $(0, 1)$ and $(2, \infty)$	(E) $(-\infty, -\frac{1}{2})$ and $(\frac{3}{2}, \infty)$
graph of $f(x)$ at $a$	•	(C) (0, 3)	
ז ידי זי	· · · ·	Where is $f'(x) = 0$ ?	
I. The line tar borizontal	ngent to the curve at a 1s	1238. (A) $x = 1$	(D) $x = 0$ and $x = 2$
II. The curve	is at a local maximum or	(B) $x = 2$	(E) $x = 0, x = 1, x = 2$
minimum		(C) $x = 0$	
III. There is an	inflection point at <i>a</i> .		
(A) I only	(D) II only		
(B) I and II	(E) III only	Base your answers to question the graph below of $f(x)$	ons 607 through 605 on
(C) II and III		$\int dx = \frac{1}{2} \int dx$	

Base your answers to questions 1241 through 1238 on the graph below of f(x).



Where is f'(x) undefined?

1241.(A)x = 1(B) x = 2

(C) x = 0





606. At which point is f'(x) < 0 and f''(x) = 0? (A)A(D)D

( )	
(B) <i>B</i>	(E) <i>E</i>

(C)*C* 

# II. DERIVATIVES 4. Applications

1005	There are two lines throug	gh the point $(1, -2)$ that	1 700	What is the slope of the li	ne tangent to the curve
1827	are tangential to the parab	ola $y = x^2 + 2$ . Find the	1580	$y = e^x$ at $x = e$ .	
	x-coordinates of these point (A) $x = 0.972$ ( 972)	(D) = 0.7(5 + 1.450)		(A) $e^{n}$	$(\mathbf{D})e^{\epsilon}$
	$(A)x = -0.8/3, \ 6.8/3$	(D)x = -0.765, 1.459		(B) 1	(E) $e^{x}$
	(B) x = -1.236, 3.236	(E) $x = -1.427$ , 3.683		(C) <i>e</i>	
	(C) $x = -2.327, 3.327$			Find the equation to the li	no tongont to the nolon
	If $2r = 5v - 23$ is the equa	tion of the line normal	1579	Find the equation to the final curve $r = 2\cos\left(\frac{1}{2}\theta\right)$ at (0)	$\sqrt{2}$
1722	to the graph of f at the point $f$	nt $(14, 1)$ , then	1377	(A) $v = -r + \sqrt{2}$	(D) $y = -\frac{1}{2}r$
	f'(14) =			(R) $y = -\frac{1}{2}r + \sqrt{2}$	(E)y = -2x (E) $y = -2r$
	$(A)^{\frac{2}{5}}$	(D)-5		( <b>D</b> ) $y = -\frac{1}{2}x + \sqrt{2}$	$(\mathbf{L})\mathbf{y} = -\mathbf{L}\mathbf{x}$
	$(B)\frac{5}{2}$	$(E) - \frac{5}{2}$		$(C) y = \sqrt{2}$	
	$(C) - \frac{2}{5}$			Find the equation of the li	ne normal to the curve
			1506	$x^{2} + y^{2} = 1$ at $(\cos \frac{5\pi}{4}, \sin \frac{5\pi}{4})$	$^{\pi}_{\downarrow}$ ).
	The line tangent to the gra	aph of $y = -x^{-2}$ at the		$(\mathbf{A})\mathbf{y} = \mathbf{x}$	$(\mathbf{D}) y = -2x$
1662	point $(1, -1)$ intersects bo	th $x$ and $y$ axes. What is		(B) $y = -x$	(E) $y = -x - 2$
	line and coordinate axes?	med by this tangent		(C) $y = 2x$	
	(A)1	(D) 3.5		Which of the following is	the equation of the line
	(B) 2	(E) 0.75	1499	. tangent to the curve $f(x)$ =	$= 2 \sin(x)$ at $x = \pi$ .
	(C) <b>2.25</b>			$(\mathbf{A})\mathbf{y} = -2\mathbf{x} + 2\pi$	$(\mathbf{D})\frac{\mathbf{y}}{2} = \mathbf{x} + \mathbf{\pi}$
				(B) $\frac{y}{2} = -x - \pi$	(E) None of the above
1658	The equation of the normal $y = 3x^2 - 2x$ at $x = 1$ is	al line to the curve		$(C) y = 2x - 2\pi$	~ /
	$(\mathbf{A})  \mathbf{y} = \frac{\mathbf{x}}{4} + \frac{5}{4}$	(D) $y = 4x - 3$		The tangent line to the cur	rve $y = x^3 - 2x + 4$ at
	(B) $y = \frac{x}{4} + \frac{3}{4}$	(E) None of the above	1485	the point $(0,4)$ has an x-in	ntercept at
	$(\mathbf{C})\mathbf{y} = -\frac{x}{4} + \frac{5}{4}$			(A)(0, 0)	(D)(3,0)
				(B) (-2, 0)	(E) (-3, 0)
1646	What is the slope of the li $x^2 + y^2 = 9$ when $x = 3$ ?	ne tangent to the curve		(C)( <b>2</b> , <b>0</b> )	
	(A)–1	$(D)\pi$		If $f(x) = 3x^2 - 5$ , what is t	he equation for the
	(B)0	(E) Infinite slope	1039	. tangent line to the curve v	when $x = 1$ ?
	(C) 1			(A)y + 2 = 6(x - 1)	(D) $y - 2 = 6(x + 1)$
		1 1 6 1 1 1		(B) $y - 2 = -12(x - 1)$	(E) $y = 6x$
1645	What is the length of the $x^2 + y^2 = 0$ formed by the	chord of the circle		(C) $y - 2 = 6(x - 1)$	
1043	$x + y = 9$ formed by the circle at $x = \frac{3}{2}$ ?				
	(A)3	(D) 12	982	. If $f(x) = 2x^3 - 4x^2 - 6x + $	1, then the equation for
	(B) 6	(E) $\sqrt{3}$		the normal line to the curv y + 3 = 2(x - 1) is	ve perpendicular to
	(C) 9			(A)y + 2x + 15 = 0	(D) $2y - x + 15 = 0$
				(B) $y + 2x - 15 = 0$	(E) $2y + x + 15 = 0$
				(C)y - 2x + 15 = 0	

Base your answers to questions **586** through **584** on the graph below, which shows the velocity of an object moving along a straight line during the time interval  $0 \le t \le 7$ .

**II. DERIVATIVES** 

4. Applications



- 586. At what time(s) does the object change direction?
  - (A) t = 3 and t = 5(B) t = 5 and t = 6(C) t = 3(D) t = 6(E) t = 5
- 584. At what time(s) does the object reach its maximum acceleration?

(A) 1 < t < 5	(D) $t = 6$
(B) $0 < t < 2$	(E) $t = 5$
(C) $t = 3$	

519. The displacement from the origin of a particle moving on a line is given by  $s = t^4 - 2t^3$ . The maximum displacement during the time interval  $-1 \le t \le 3$  is approximately

(A)13.966	(D)18

- (B) 18.685 (E) **34.604**
- (C) 27.000

Base your answers to questions **504** through **500** on the information below.

A particle moves along a horizontal line and its position at time *t* is  $s = \frac{1}{2}t^4 - 2t^3 + 2t^2 + 5$ .

504. The position of the particle is always increasing for

(A) 
$$t > 0$$
(D)  $t < 0$ (B)  $t > 1$ (E)  $0 < t < 2$ (C)  $t > 2$ 

502. The velocity is increasing when

(A) 
$$t < 0$$
  
(B)  $t > 2$   
(C)  $0 < t < 1$  or  $t > 2$   
(D)  $\frac{\sqrt{3} - 3}{3} < t < \frac{\sqrt{3} + 3}{3}$   
(E)  $t < -\frac{\sqrt{3} - 3}{3}$  and  $t > \frac{\sqrt{3} + 3}{3}$ 

500. The particle is at 1	rest when t is equal to
(A)0	(D)0 and 2
(B) 1 and 2	(E) 0, 1, and 2
$(\mathbf{C})$ 0 and 1	

Base your answers to questions **499** through **496** on the information below.

The position of a particle moving along a straight line is given by  $s = t^3 - 9t^2 + 24t - 6$ .

499. The speed of the particle is decreasing for

(A) $t < 1$	(D) $t < 1$ and $t > 2$
(B) $t > 2$	(E) all $t$
(C)t < 3	

498. The acceleration is positive

(A) when $t < 3$	(D) for $2 < t < 4$
(B) when $t > 3$	(E) for all $t, t \neq 3$
(C) for $2 < t < 3$	

II. DERIVATIVES 4. Applications			C. Related Rates 1. Related Rates
775. The sides of an equilate at the rate of 12 in/sec. area increasing when th each 2 inches long? (A) $6\sqrt{3}$ ft/sec (B) $12\sqrt{3}$ ft/sec	ral triangle are increasing How fast is the triangle's e sides of the triangle are (D) $36\sqrt{3}$ ft/sec (E) $48\sqrt{3}$ ft/sec	553. An inverted circular has a depth of 10 in 4 in. Water is leakin is falling at the rate leaking out of the co deep?	cone with its vertex down and a radius at the top of ig out so that the water level of 1 in/hr. How fast the water one when the water is 6 in $(D) 2.8 = i \pi^3 t m$
(C) $24\sqrt{3}$ ft/sec		(A) $1.92\pi \text{ m}^3/\text{hr}$	(D) $3.8\pi \ln^{3}/\ln^{2}$
<ul> <li>740. A boat is being pulled to attached to its bow thro 3 feet above the bow. If rate of 5 ft/sec, how fast the dock when its 4 feet (A) 2 ft/sec</li> <li>(B) 3 ft/sec</li> <li>(C) 4 ft/sec</li> <li>716. An inverted conical com 36 in and a depth of 12 out of the vertex of the 15π in<sup>3</sup>/sec, how fast is dropping when the heig (A) <sup>15</sup>/<sub>2</sub> in/s</li> <li>(B) <sup>15</sup>/<sub>4</sub> in/s</li> <li>(C) <sup>10</sup>/<sub>2</sub> in/s</li> </ul>	oward a dock by a rope ugh a pulley on the dock f the rope is hauled in at a t is the boat approaching t from the dock? (D) 5 ft/sec (E) 6 ft/sec (E) 6 ft/sec ttainer has a diameter of in. If water is flowing container at a rate of the depth of the water ht his 3 inches? (D) $\frac{20}{27}$ in/s (E) $\frac{20}{27}\pi$ in/s	(B) $2.4\pi \text{ in}^3/\text{hr}$ (C) $3\pi \text{ in}^3/\text{hr}$ 551. A spherical balloon the rate of 9 ft <sup>3</sup> /min. increasing when the (A) 2 ft <sup>2</sup> /min (B) $2\pi$ ft <sup>2</sup> /min (C) 3 ft <sup>2</sup> /min 470. A 5-foot-tall person 3 ft/sec away from a tall. How fast is the changing? (A) $\frac{3}{11}$ ft/sec (B) $\frac{15}{11}$ ft/sec (C) 3 ft/sec	(E) 5.76 $\pi$ in <sup>3</sup> /hr is being filled with helium at . How fast is the surface area volume is $36\pi$ ft <sup>3</sup> ? (D) $3\pi$ ft <sup>2</sup> /min (E) 6 ft <sup>2</sup> /min is walking at a rate of a street lamp that is 16 feet e length of her shadow (D) 11 ft/sec (E) 15 ft/sec
597. A foot tall rectangular b at the rate of 0.25 feet/s decreasing at 0.5 feet/se 0.8 feet and its width is box is changing at (A)-0.25 ft <sup>3</sup> /sec (B)-0.15 ft <sup>3</sup> /sec (C) 0.15 ft <sup>3</sup> /sec 555. The height ( <i>h</i> ) and radiu increase at the rate of 1 the surface area increase (A) $2\pi (r + h)$ (B) $2\pi (3r + h)$ (C) $6\pi$	box's length is increasing ec and its width is ec. When the length is 1 foot, the volume of the (D) 0.25 ft <sup>3</sup> /sec (E) 0.4 ft <sup>3</sup> /sec us (r) of a cylinder both in/sec. How fast does e? (D) $4\pi r + 2\pi h$ (E) $4\pi r$	<ul> <li>468. Milk spilled from a whose circumference 20 ft/sec. How fast increasing when the is 81π ft?</li> <li>(A)810 ft<sup>2</sup>/sec</li> <li>(B) 360 ft<sup>2</sup>/sec</li> <li>(C) 270 ft<sup>2</sup>/sec</li> <li>212. [Calculator] The best increase in volume of increased from 2 to (A)9</li> <li>(B) 8</li> <li>(C) 7</li> </ul>	carton spreads in a circle ce increases at a rate of is the area of the spill circumference of the circle (D) 180 ft <sup>2</sup> /sec (E) 90 ft <sup>2</sup> /sec st approximation to the of a sphere when the radius is 2.1 is (D) 6 (E) 5

# II. DERIVATIVES 4. Applications

Base your answers to questions **538** through **537** on the graph below of f'(x).



538. <i>f</i> has a point of i	nflection at $x =$
(A)0.5	(D)0.5 and 3
(B) 3	(E) 1 and 5

(C) 5

537. *f* has a local minimum at x =

(A)0	(D)3
(B) 0.5	(E) 5
(C) 1	

480. On the closed in	terval [0, $2\pi$ ], the maximum
value of the fun	$\operatorname{ction} f(x) = 5\sin x - 12\cos x \text{ is}$
(A)0	(D) 12
$(B)\frac{60}{13}$	<b>(E) 13</b>
(C) 5	

225. The minimum value of the slope of the curve  $y = x^6 - x^4 + 3x$  is

(A) - 3.025	(D) <b>2.595</b>
(B) - 2.595	(E) 3.025
$(\mathbf{C})0$	

215. If *f* is differentiable and difference quotients underestimate the slope of *f* at x = a for all h > 0, which of the following must be true?

$(\mathbf{A})f'' < 0$	(D)f'' > 0
(B)f' < 0	(E) None of the above
(C)f' > 0	

# D. Maximum, Minimum and Inflection Point 1. Maximum, Minimum and Inflection Point

Base your answers to questions **320** through **318** on the graph below of f'(x).

	3					
	2					
$\mathbf{N}$	1					
	/					
		/	1	2	3	
		,				

- 320. The function is concave downward for which interval?
  - (A)(1, 2)(D)(-1, 1)(B)(1, 4)(E)(-1, 4)
  - (C)(2,3)
- 319. Which statement best describes f at x = 0?
  (A) f is a minimum
  (B) f is a maximum
  (C) f has a root
  - (D) *f* has a point of inflection
  - (E) None of the above
- 318. Which of the following is true based upon the graph above?(A)*f* has a local maximum at x = 0

(B) *f* has a local maximum at x = -1(C) *f* is a constant for 1 < x < 4

- (D) *f* is decreasing for -1 < x < 1
- (E) *f* is discontinuous at x = 1
- 151. The number of inflection points of  $f(x) = 4x^4 4x^2$  is
  - (A)0 (D)3
  - (B) 1 (E) 4
  - (C)2

#### II. DERIVATIVES 5. Part 2 Questions

Given the function 
$$f'(x) = e^{-x}(x^2 + 1)$$
  
1271. (a) For what values if *f* increasing?  
(b) For what values is *f* concave up?  
(c) Set up, but do not evaluate an integral (or set  
of integrals) which give the arc length of the  
segment of *f* from  $x = 0$  to  $x = 1$ .

(a) { }  
(b) 
$$x < 1$$
 or  $x > 3$   
(c)  $\int_{0}^{1} \sqrt{e^{-2x} (x-1)^{4} + 1} dx$ 



The figure above shows the graph of *f*', the derivative of a function *f*. The domain of *f* is the set of all real numbers *x* such that  $-6 \le x \le 6$ .

(a) For what values of *x* does the graph of *f* have a horizontal tangent?

(b) For what values of x in the interval -6 < x < 6 does *f* have a relative minimum? Justify your answer.

(c) For what values of *x* is the graph of *f* concave upward?

(a) 
$$x = -\frac{11}{2}, -2, 0, 2, \frac{9}{2}$$
  
(b)  $x = -\frac{11}{2}, 0, \frac{9}{2}$   
(c)  $x < -\frac{7}{2}$  or  $-\frac{1}{2} < x < 1$  or  $x > 3$ 

Let f be a differentiable function, defined for all 1217. real x, with the following properties:

1) f''(1) = f'(1) = f(1)2) f is a polynomial of degree at most 2 3) f has only one fixed point (that is, there is exactly one p such that f(p) = p. Find f(x).

 $f(\mathbf{x}) = \mathbf{0}$ 

A particle moves along the *x*-axis in such a way 1266. that its acceleration at time *t* for  $t \ge 0$  is given by  $a(t) = 6\sin(3t)$ . At time t = 0, the velocity of the particle is  $v(0) = \sqrt{2}$  and its position is x(0) = 0.

(a) Write an equation for the velocity v(t) of the particle.

(b) Write an equation for the position x(t) of the particle.

(a) 
$$v(t) = -2\cos(3t) + \sqrt{2} + 2$$
  
(b)  $x(t) = -\frac{2}{3}\sin(3t) + t\sqrt{2} + 2t$ 

A particle moves along the *x*-axis so that its 1265. velocity at any time  $t \ge 0$  is given by  $v(t) = 1 - 2 \cos \pi t$ .

(a) Find the acceleration a(t) of the particle at any time *t*.

(b) Find all values of t,  $0 \le t \le 4$ , for which the particle is at rest.

(c) Find the position x(t) of the particle at any time *t* if x(0) = 0.

(a) 
$$a(t) = 2\pi \sin(\pi t)$$
  
(b)  $t = \frac{1}{3}, \frac{5}{3}, \frac{7}{3}, \frac{11}{3}$   
(c)  $x(t) = t - \frac{2\sin(\pi t)}{\pi}$ 

Let 
$$f(x) = 8 - 2x^2$$
 for  $x \ge 0$  and  $f(x) \ge 0$ .  
1264.

(a) The line tangent to the graph of *f* at the point (x, y) intercepts the *x*-axis at x = 3. What are the coordinates of the point (x, y)?

(b) An isosceles triangle whose base is the interval from (0, 0) to (k, 0) has its vertex on the graph of *f*. For what value of *k* does the triangle have maximum area? Justify your answer.

(a) 
$$\left(\sqrt{5} + 3, -12\sqrt{5} - 20\right)$$
  
(b)  $k = \sqrt{\frac{20}{3}}$ 

#### **III. INTEGRALS** 2. Definite Integrals

729. Using a right Riem	ann sum, what is the area
under the curve <i>y</i> =	$x^{2} + x$ from $x = 0$ to $x = 3$
when $n = 6$ ?	
(A)10.625	(D) 13.625
(B) 13.438	(E) <b>16.625</b>
(C) 13.500	

3

723. Using the Trapezoidal Rule, what is the area under the curve  $y = x^2 + x$  from x = 0 to x = 3when n = 6? (A) 10.625 (D) 13.625

(B) 13.438	(E) 16.625
(C) 13.500	

703. A Riemann sum to calculate the area under f(x)on the interval  $a < x \le b$  with an infinite number of subintervals will yield the value

(A)  $\int_{a}^{b} f(x) dx$ (D)  $\frac{df(x)}{dx}\Big|_{a}$ 

(B) 
$$f(b) - f(a)$$
 (E)  $\frac{d}{dx} \int_{a}^{b} f(x) dx$ 

 $\frac{(C)}{dt}\frac{df(x)}{dx}\Big|_{(a,b)}$ 

694. Using the Midpoint Formula, what is the area under the curve  $y = x^2 + x$  from x = 0 to x = 3when n = 6? (A) 10.625 (D) 13 625

A) 10.025	(D)15.025
<b>B) 13.438</b>	(E) 16.625
C) 13.500	

682. Using a right Riemann sum, what is the area under the curve  $y = 2x - x^2$  from x = 1 to x = 2when n = 4?

(A)**0.53125** (D)0.67187 (B) 0.65625 (E) 0.78125 (C) 0.66667

658. What is an approximation for the area under the curve  $y = 4x - x^2$  on the interval [0, 4] using the midpoint formula with 20 subintervals?

(A) <b>10.589</b>	(D) 10.681
(B) 10.624	(E) 10.703
(C) 10.667	

- 657. What is an approximation for the area under the curve  $y = \frac{1}{x}$  on the interval [2, 5] using the trapezoidal rule with 9 subintervals?
  - (A)0/868 (D)0.918 (B) 0.915 (E) 0.968 (C) 0.916

654. What is an approximation for the area under the

curve  $y = \frac{3}{1+r^2}$  on the interval [0, 3] using the trapezoidal rule with 5 subintervals?

(A)2.932	(D) 3.750
<b>(B) 3.742</b>	(E) 4.552
(C) 3.747	

651. What is an approximation for the area under the

curve  $v = \sqrt{5 + x^5}$  on the interval [0, 3] using the midpoint formula with 4 subintervals?

(D) 17.059
(E) 22.126

647. Using a left Reimann sum, what is the area under the curve  $y = \sqrt{x}$  from x = 1 to x = 3 when n = 4? (A) 2.976 (D)2.793 (B) 2.800 (E) 2.610 (C) 2.797

460. Using a left Riemann sum, what is the area under the curve  $y = 2x - x^3$  from x = 1 to x = 2 when n = 4?(A)0.53125 (D)0.67187 (B) 0.65625 (E) 0.78125 (C) 0.66667

# III. INTEGRALS 4. Applications

1851. $f_{\infty}^{-1} = f_{\infty}^{-1} = f_{\infty}^{-1}$		If $\int_{-3}^{3} (2x^2 - x + 3) dx$ is ap	proximated by three		The area o	f the region bo	unded by the graph of
The total rectangles of equal with of the 4-axis, the approximation is (A) 16 (D) 23.5 (B) 22 (E) 31 (C) 22.5 Find the area in the first quadrant bounded by the 1795, graphs of $y = \cot x$ , $y = 2\sin x$ and the $x$ -axis, (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784, $y = 2\cos x$ and $y = \frac{3}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{x}^{b} f(x) dx = -2$ and $\int_{y}^{b} g(x) dx = -5$ , which of the following must be true? 1. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{x}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{x}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{x}^{b} [f(x) - g(x)] dx = 10$ (A)1 only (D) II and III (C) 1 and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $\frac{y}{(c, 0)} = x^{2}$ ? (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $\frac{y}{(c, 0)} = x^{2}$ ? (A) 157 (C) 177 (B) 177 (E) 237 (C) 197 (C) 197	1851.	$\int_0^\infty \int_0^\infty (2\pi i n + e) \sin i x \exp i x$	usl width on the reavie	1674.	$y = 2xe^{x^2}a$	and the <i>x</i> -axis f	from $x = 0$ to $x = 1$ is
(A) 16 (D) 23.5 (B) 22 (E) 31 (C) 22.5 Find the area in the first quadrant bounded by the 1795. graphs of $y = \cot x$ , $y = 2\sin x$ and the <i>x</i> -axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{3}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 (C) 1 and II (C) 1 and II (D) 17 (C) 107 (C) 1		the expression stice is	ual width on the x-axis,		$(\Lambda) c^2 = 1$		$(\mathbf{D})$ a
(A) 16 (D) 23.5 (B) 22 (E) 31 (C) 22.5 Find the area in the first quadrant bounded by the 1795. graphs of $y = \cot x$ , $y = 2\sin x$ and the <i>x</i> -axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{x}^{5} f(x) dx = -2$ and $\int_{x}^{5} g(x) dx = -5$ , which of the following must be true? 1. $f(x) > g(x)$ for $a \le x \le b$ III $\int_{x}^{5} [f(x)g(x)] dx = 10$ (A) 1 only (D) II and III (C) 1 and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 15 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi		the approximation is			(A)e - 1 (B) $e - 1$		(D) $e^{3}(1-e)$
(b) 22 (c) 22.5 (c) 22.5 Find the area in the first quadrant bounded by the 1795. graphs of $y = \cot x$ , $y = 2\sin x$ and the <i>x</i> -axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{3}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{x}^{x} f(x) dx = -2$ and $\int_{x}^{x} g(x) dx = -5$ , which of the following must be true? I. $f(x) > g(x) dx = x \le b$ II. $\int_{x}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{x}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{x}^{b} [f(x) - g(x)] dx = 10$ (A) I only (D) II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$		(A) <b>16</b>	(D)23.5		$(\mathbf{D})e^{-1}$		$(\mathbf{L}) \mathbf{\epsilon} (\mathbf{I} - \mathbf{\epsilon})$
(C) 22.5 Find the area in the first quadrant bounded by the 1795. graphs of $y = \cot x$ , $y = 2\sin x$ and the $x$ -axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{x}^{b} f(x) dx = -2$ and $\int_{a}^{b} g(x) dx = -5$ , which of the following must be true? 1. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{a}^{x} [f(x) - g(x)] dx = 3$ III. $\int_{a}^{b} [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I. II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ What is the average area of the rectangle to the shaded part of it above $y = x^{2}$ ? (A) 2.1 (D) 4.3 (B) 3.1 (E) 5.4 (C) 31.2 (C) 31.2 (C) 31.2 (D) 4.3 (D) 5.4 (C) 0.3 (D) 69 (B) 65 (C) 12.874 840. (C) 67 840. (C) 0. (C) 67 (C) 0. (C) 0.		(B) 22	(E) 31		(0) 0 0		
Find the area in the first quadrant bounded by the 1795. graphs of $y = \cot x$ , $y = 2\sin x$ and the $x$ -axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{1}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 The zero of the region enclosed by $y = 2x^2 - 4$ 1651. The area of the region enclosed by $y = 2x^2 - 4$ 1651. The area of the region enclosed by $y = 2x^2 - 4$ 1651. The area of the region enclosed by $y = 2x^2 - 4$ 1651. (A) 8.368 (D) 15.538 (B) 9.082 (E) 16.736 (C) 12.874 847. What is the average area of all squares with sides between 3 and 12? (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. y 4848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) 2.1 (D) 4 : 3 (B) 3 : 1 (E) 5 : 4 (C) 3 : 2		(C) 22.5			$\operatorname{Let} f(x) =$	$x\sin(x-\pi), 0$	$< x < 2\pi$ . The total area
1795. graphs of y = cot x → 2 2si x and the x-axis. (A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746(A) π (D) 4π (A) π (E) 5π (C) 3πThe total area enclosed between the graphs of 1784, y = 2cos x and y = $\frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547(B) 2π (E) 5π (C) 3π1772. If $\int_a^b f(x) dx = -2$ and $\int_a^b g(x) dx = -5$ , which of the following must be true? I. $f(x) > g(x)$ for $a ≤ x ≤ b$ II. $\int_a^b [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) 1, II and III (C) 1 and II847. What is the average area of all squares with sides between 3 and 12? (A) 63 (D) 69 (B) 16 (C) 24848. What is the average area of all circles with radii between 3 and 6? (A) 15π (D) 21π (B) 17π (E) 23π (C) 19π9844. What is the average area of all circles with radii between 3 and 6? (A) 15π (E) 23π (C) 19πWhat is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) 2: 1 (D) 4: 3 (B) 3: 1 (E) 5: 4 (C) 3: 2		Find the area in the first o	madrant bounded by the	1668.	bounded by	f(x) and the $f(x)$	x-axis on the interval
(A) 0.438 (D) 0.909 (B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 (C) 4.547 (T772. If $\int_{-a}^{b} f(x)dx = -2$ and $\int_{-a}^{b} g(x)dx = -5$ , which of the following must be true? I. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{-a}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{-a}^{b} [f(x) - g(x)] dx = 10$ (A) 1 only (D) II and III (B) II only (E) I. II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi (A) $x$ (A) $x$ (A) $x$ (A) $x$ (A) $x$ (A) $x$ (A) $x$ (B) $x$ (C) $y$ (A) $x$ (C) $y$ (A) $x$ (B) $x$ (C) $y$ (C) $y$ (D) $y$ (C) $y$ (C) $y$ (D) $y$	1795.	graphs of $y = \cot x$ , $y = 2$	$\sin x$ and the <i>x</i> -axis.		$0 < x < 2\pi$	15	$(\mathbf{D})$ $4$
(B) 0.470 (E) 1.571 (C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 (C) 5.538 (D) 15.538 (B) 9.082 (E) 16.736 (C) 12.874 847. What is the average area of all squares with sides between 3 and 12? (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $\oint y$ (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $\oint y$ (C) 12.874 847. What is the average area of all squares with sides between 3 and 12? (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $\oint y$ (C) 97 (C) 97 (C) 12.874 847. What is the average area of all squares with sides between 3 and 12? (C) 67 840. $\oint y$ (C) 67 840. $\oint y$ (C) 97 (C) 97		(A)0.438	(D)0.909		$(A)\pi$ (B) $2\pi$		$(\mathbf{D}) 4\pi$
(C) 0.746 The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{4}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{a}^{b} f(x)dx = -2$ and $\int_{a}^{b} g(x)dx = -5$ , which of the following must be true? $L f(x) > g(x)$ for $a \le x \le b$ II. $\int_{a}^{b} [f(x)-g(x)]dx = 3$ III. $\int_{a}^{b} [f(x)g(x)]dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (B) 18 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi (C) 5.4 (C)		(B) 0.470	(E) <b>1.571</b>		$(\mathbf{D}) 2\pi$		(E) 3n
The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 1772. If $\int_{a}^{b} f(x)dx = -2$ and $\int_{a}^{b} g(x)dx = -5$ , which of the following must be true? 1. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{a}^{b} [f(x)g(x)]dx = 3$ III. $\int_{a}^{b} [f(x)g(x)]dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) 1 and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi The area of the region enclosed by $y = 2x^{2} - 4$ and $y = \sqrt{9-x^{2}}$ is (A) 8.368 (D) 15.538 (B) 9.082 (E) 16.736 (C) 12.874 847. What is the average area of all squares with sides between 3 and 12? (A) 63 (D) 69 (B) 65 (E) 71 (C) 67 840. $y$ $y = x^{2}$ (A) $y$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^{2}$ ? (A) 2: 1 (D) 4: 3 (B) 3: 1 (E) 5: 4 (C) 3: 2		(C) 0.746			(C) 3n		
The total area enclosed between the graphs of 1784. $y = 2\cos x$ and $y = \frac{x}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 (C) 4.54 (C) 4.547 (C) 4.54 (C) 4.54 (C) 4.55 (C) 4.55 (					The area o	f the region en	closed by $y = 2x^2 - 4$
$1794, y = 2\cos x$ and $y = \frac{1}{2}$ is (A) 3.862 (D) 4.812 (B) 3.985 (E) 5.914 (C) 4.547 $1772. If \int_{a}^{b} f(x)dx = -2 \text{ and } \int_{b}^{b} g(x)dx = -5, \text{ which of the following must be true?}$ $I.f(x) > g(x) \text{ for } a \le x \le b$ $I. \int_{a}^{b} [f(x) - g(x)] dx = 3$ $II. \int_{a}^{b} [f(x) - g(x)] dx = 3$ $II. \int_{a}^{b} [f(x) - g(x)] dx = 3$ $II. \int_{a}^{b} [f(x) g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714, graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi (D) 4.3 (D)	1701	The total area enclosed be $y = 2\cos x$ and $y = \frac{x}{\cos x}$ in	etween the graphs of	1651.	and $y = \sqrt{c}$	$\overline{\mathbf{r}}$	
(A) 8.368 (D) 15.538 (B) 3.985 (E) 5.914 (C) 4.547 (C) 4.547	1/04	$y = 2\cos x$ and $y = \frac{1}{2}$ is (A)3.862	(D) <b>4 812</b>		and $y = \sqrt{3}$	x = x 15	
(b) 3.50 (c) 4.547 (c) 4.547		(R) 3.985	( <b>D</b> ) <b>4.012</b> ( <b>F</b> ) <b>5</b> 914		(A)8.368		(D) 15.538
(C) 4.547 (C) 12.874 (C) 12		$(\mathbf{C}) 4 547$	(L) 5.914		(B) 9.082		(E) <b>16.736</b>
1772. If $\int_{a}^{b} f(x)dx = -2$ and $\int_{a}^{b} g(x)dx = -5$ , which of the following must be true? I. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{a}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{a}^{b} [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (A) $x = -2$ and $\int_{a}^{b} g(x)dx = -5$ , which of the following must be true? (A) $63$ (D) $69$ (B) $65$ (E) $71$ (C) $67$ 840. $\int y$ (C) $67$ 840. $\int (x - y)^{2} - x^{2} - y^{2} - y^$		(0) 1.5 17			(C) 12.874		
1772. $J_a \circ C f = J_a \circ C f $		If $\int_{a}^{b} f(x) dx = -2$ and $\int_{a}^{b} s dx$	g(x)dx = -5, which of	847.	What is the	e average area	of all squares with sides
the following must be file: I. $f(x) > g(x)$ for $a \le x \le b$ II. $\int_{a}^{b} [f(x) - g(x)] dx = 3$ II. $\int_{a}^{b} [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15\pi (D) 21\pi (B) 17\pi (E) 23\pi (C) 19\pi (D) 4 : 3 (B) 3 : 1 (E) 5 : 4 (C) 3 : 2	1772. If $\int_{a}^{a} f(x) dx = 2$ and $\int_{a}^{a} g(x) dx = 3$ , which of		between 3 and 12?				
1. $f(x) > g(x)$ for $d \le x \le b$ I. $\int_{a}^{b} [f(x) - g(x)] dx = 3$ II. $\int_{a}^{b} [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (C) $19\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (C) $19\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$		the following must be the $\mathbf{L} = f(\mathbf{x}) + f(\mathbf{x})$			(A)63		(D)69
II. $\int_{a}^{b} [f(x) - g(x)] dx = 3$ III. $\int_{a}^{b} [f(x)g(x)] dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (C) $67$ 840. $4y$ $y = x^{2}$ (C) $67$ 840. $4y$ (C) $67$ (C) $67$ 840. $4y$ (C) $67$ 840. $4y$ (C) $67$ 840. $4y$ (C) $67$ (C) $67$		1. $f(x) > g(x)$ for $d \le a^{h}$	$X \leq D$		(B) 65		(E) 71
III. $\int_{a}^{b} [f(x)g(x)]dx = 10$ (A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^{2} + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ 840. $y$ $y = x^{2}$ (a) $(x, 0) = x$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^{2}$ ? (A) 2 : 1 (D) 4 : 3 (B) 3 : 1 (E) 5 : 4 (C) 3 : 2		$II. \int_a^b [f(x) - g(x)] dx$	= 3		(C) 67		
(A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) $2 : 1$ (D) $4 : 3$ (B) $3 : 1$ (E) $5 : 4$ (C) $3 : 2$	$\prod_{k=1}^{b} \left[ f(x)g(x) \right] dx = 10$		840	<b>A</b>			
(A) I only (D) II and III (B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) $2: 1$ (D) $4: 3$ (B) $3: 1$ (E) $5: 4$ (C) $3: 2$		$- \mathbf{j}_a \mathbf{j}_c (\mathbf{r}) \mathbf{s} (\mathbf{r}) \mathbf{j}_{\mathbf{r}}$		010	J.		
(B) II only (E) I, II and III (C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (E) 23 $\pi$ (D) 21 $\pi$ (D) 21 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (E) 23 $\pi$ (E)		(A) I only	(D) II and III				
(C) I and II The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) 2 : 1 (D) 4 : 3 (B) 3 : 1 (E) 5 : 4 (C) 3 : 2		(B) II only	(E) I, II and III		$v = r^2$	Λ	
The area in the first quadrant bounded by the 1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A)9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (C) 19 $\pi$ (D) 21 $\pi$ (D) 2		(C) I and II					
1714. graphs of $y = x^2 + 3$ and $y = 12$ is (A) 9 (D) 36 (B) 18 (E) 30 (C) 24 848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) $2 : 1$ (D) $4 : 3$ (B) $3 : 1$ (E) $5 : 4$ (C) $3 : 2$		The area in the first quad	rant bounded by the			(c,0) x	
(A) 9(D) 36(B) 18(E) 30(C) 24(E) 30848. What is the average area of all circles with radii between 3 and 6?What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ?(A) 15 $\pi$ (D) 21 $\pi$ (B) 17 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (E) 23 $\pi$ (C) 19 $\pi$ (C) 3: 2	1714	graphs of $y = x^2 + 3$ and $y = x^2 + 3$	y = 12 is				
(B) 18(E) 30(C) 24848. What is the average area of all circles with radii between 3 and 6?What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ?(A) 15 $\pi$ (D) 21 $\pi$ (A) 2 : 1(D) 4 : 3(B) 17 $\pi$ (E) 23 $\pi$ (B) 3 : 1(E) 5 : 4(C) 19 $\pi$ (C) 3 : 2(C) 3 : 2		(A)9	(D)36				
(C) 24848. What is the average area of all circles with radii between 3 and 6? (A) $15\pi$ (B) $17\pi$ (C) $19\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) $2:1$ (B) $3:1$ (C) $3:2$		<b>(B) 18</b>	(E) 30				
848. What is the average area of all circles with radii between 3 and 6?What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ?(A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ (E) $23\pi$ (C) $19\pi$ (C) $3:2$		(C) 24			+		
between 3 and 6? (A) $15\pi$ (D) $21\pi$ (B) $17\pi$ (E) $23\pi$ (C) $19\pi$ What is the ratio of the area of the rectangle to the shaded part of it above $y = x^2$ ? (A) $2:1$ (D) $4:3$ (B) $3:1$ (E) $5:4$ (C) $3:2$	848	. What is the average area	of all circles with radii		W/h of 1 = 41	and of the	of the mester of the
(A) $15\pi$ (D) $21\pi$ (A) $2:1$ (D) $4:3$ (B) $17\pi$ (E) $23\pi$ (B) $3:1$ (E) $5:4$ (C) $19\pi$ (C) $3:2$ (C) $3:2$	010	between 3 and 6?			what is the	ratio of the ar nart of it above	ea of the rectangle to e $v = x^{29}$
(B) $17\pi$ (E) $23\pi$ (B) $3:1$ (E) $5:4$ (C) $19\pi$ (C) $3:2$		(A)15π	<b>(D)</b> 21π		(A)2:1	r and of it above	(D)4:3
(C) $19\pi$ (C) $3:2$		(B) 17π	(E) 23π		(B) 3 : 1		(E) 5 : 4
		(C) 19π			(C)3:2		× /

<b>4.</b> A	pplications				1. Volumes	
1670	The base of a solid is the line $-y + 6 = 2x$ and the c the volume of the solid g section perpendicular to t semicircle?	region bounded by the coordinate axes. What is enerated if every cross the $x$ -axis is a	966.	What is the volume of the bounded by $y = x^{3/2}$ , $x = 0$ revolved about the <i>x</i> -axis (A) 1028 $\pi$ (B) 64 $\pi$	e solid when the region b, $x = 4$ and $y = 0$ is ? (D) $\frac{64}{5}$ (E) $\frac{256}{5}\pi\sqrt{2}$	
	$(A)\frac{1}{2}\pi$	(D) $14\pi$		(C) 3π		
	$(\mathbf{B})\frac{9}{2}\pi$	(E) 18π				
	(C) 9π		941.	941. What is the volume of the solid that has a circular base of radius <i>r</i> and every plane section		
	The region bounded by the	the graphs of $y = 3 - e^{-x}$		perpendicular to a diamet	er is semi-circle?	
1661	and $y = x^2$ is revolved are	ound the <i>x</i> -axis. The		$(A)^{\frac{1}{2}} \pi r^{3}$	$(D)\frac{1}{3}r^{3}$	
	volume of the resulting s	olid is		$(B)\frac{1}{4}\pi r^{3}$	$(E)\frac{2}{3}r^{3}$	
	(A)9.805	(D) 27.362		$(C)\frac{1}{2}\pi r^{3}$		
	(B) 11.473	(E) <b>30.805</b>		(0)31		
	(C) 19.975		940.	What is the volume of the	e solid that has a	
	× /			circular base of radius r a	nd every plane section	
1141	What is the volume of the bounded by $xy = 6$ and $x$	e solid when the region y + y = 5 is revolved		perpendicular to a diamet triangle?	er is an isosceles	
	about the <i>x</i> -axis?			$(A)\frac{1}{2}\pi r^{3}$	$(D)\frac{4}{3}r^{3}$	
	$(A)\pi$	$(D)\frac{1}{6}\pi$		$(B)^{\frac{1}{2}} r^{3}$	$(E)^{\frac{2}{3}}\pi r^{3}$	
	$(B)^{\frac{2}{3}}\pi$	$(E)\frac{1}{9}\pi$		(C) $\pi r^3$	× / 5	
	$(\mathbf{C})^{\frac{1}{2}}\pi$			(-)		
1100	What is the volume of the bounded by $y = \frac{x}{3}$ , $y = x$ , revolved about the <i>x</i> -axis	e solid when the region y = 1 and $y = 2$ is ?	939.	What is the volume of the circular base of radius <i>r</i> a perpendicular to a diamet triangle?	e solid that has a and every plane section arer is an equilateral	
	(A)8π	(D) $12\pi$		$(A)r^3\sqrt{3}$	$(D)\frac{4\sqrt{3}}{3}r^3$	
	$(B)\frac{28}{3}\pi$	(E) $\frac{40}{3} \pi$		(B) $2r^3\sqrt{3}$	$(\mathbf{E})\frac{8\sqrt{3}}{3}r^3$	
	$(C)\frac{32}{3}\pi$			(C) $4r^3\sqrt{3}$		
1076	What is the volume of the bounded by $y = \cos x$ , $x =$ revolved about the y-axis (A) 1 (B) $\pi$ (C) $2\pi$	e solid when the region $=\frac{\pi}{2}$ and $y = 0$ is ? (D) $\frac{1}{2}\pi - 1$ (E) $1 - 2\pi$	922.	What is the volume of the bounded by $y = \sqrt{x}$ , $y = x$ <i>x</i> -axis? (A) $\pi$ (B) $2\pi$ (C) $\frac{1}{2}\pi$	e solid when the region is revolved about the $(D)\frac{1}{3}\pi$ $(E)\frac{1}{6}\pi$	
1030	What is the volume of the bounded by $x = \sqrt{3+y}$ , $x = \sqrt{2}$ revolved about the <i>y</i> -axis $(A)\frac{27}{2}\pi$ (B) $54\pi - \pi\sqrt{3}$ (C) $4\pi\sqrt{6} - 2\pi\sqrt{3}$	e solid when the region = 0 and $y = 6$ is ? (D) $\frac{\$1}{2}\pi$ (E) $6\pi$	917.	What is the volume of the circular base of radius <i>r</i> a perpendicular to a diamet (A) $2\pi r^3$ (B) $4\pi r^3$ (C) $\frac{8}{3}r^3$	the solid that has a and every plane section are is a square? (D) $\frac{8}{3}\pi r^3$ (E) $\frac{16}{3}r^3$	

**B. Volumes** 

III. INTEGRALS

### III. INTEGRALS 4. Applications

time and the population doubles in 20 years, then what is the ratio of the population after 60 years to the initial population?

(A)3:1	(D)9:2
(B) 3:2	(E) 9:4
(C)9:1	

Which of the following curves passes through 1043. the point (1,1) and whose slope at any point is equal to  $y^2x$ ?

(A) 
$$y = \frac{2}{3-x^2}$$
 (D)  $y = \frac{3}{2-x^2}$   
(B)  $y = \frac{3}{x^2-2}$  (E)  $y = \frac{2}{x^2-3}$   
(C)  $y = -x^2$ 

The general solution to the differential equation 1033. dy/dx = 2 is a family of

(A) parabolas	(D) ellipses
(B) straight lines	(E) circles
(C) hyperbolas	

The general solution to the differential equation 1032. dy/dx = x is a family of

(A) parabolas	(D) ellipses		
(B) straight lines	(E) circles		
(C) hyperbolas			

(C) hyperbolas  
1029. If 
$$\frac{dy}{dx} = \sin x \sec y$$
 and  $y = \frac{\pi}{2}$  when  $x = 0$ , what is  
the solution to the differential equation?  
(A)  $y = \cos^{-1}(\sin x + 2)$  (D)  $y = \cos^{-1}(\sin x)$   
(C)  $y^2 - 2x^2$ 

(B)  $y = \sin^{-1} (2 - \cos x)$  (B)  $y = \sin^{-1} (\cos x)$ (C)  $y = \sin^{-1} (\cos x + 2)$  1027. If  $\frac{dy}{dx} = \frac{x}{\sqrt{1+x^2}}$  and y = 2 when  $x = \sqrt{3}$ , what is

the solution to the differential equation?

(A) 
$$y = \sqrt{1 + x^2} + 1$$
 (D)  $y = \sqrt{1 + x^2}$   
(B)  $y = \frac{1}{2}\sqrt{1 + x^2} + 1$  (E)  $y = 2\sqrt{1 + x^2}$   
(C)  $y = \frac{1}{2}\sqrt{1 + x^2}$ 

1023. If  $\frac{dy}{dx} = \frac{1}{2}e^{y}$  and y = 2 when x = 2, what is the solution to the differential equation?

(A) 
$$y = \ln |\frac{2}{x}| + 2$$
(D)  $y = \frac{1}{2} \ln |x| + 2$ (B)  $y = \ln |\frac{x}{2}| + 2$ (E)  $y = \ln |x| + 2$ (C)  $y = 2\ln |x| + 2$ 

1022. If  $\frac{dy}{dx} = \frac{y}{\sqrt{x}}$  and y = 1 when x = 1, what is the solution to the differential equation?

(A)  $y = e^{2\sqrt{x}-2}$  (D)  $y = e^{\sqrt{x}}-1$ 

(B)  $y = e^{\sqrt{x}}$  (E)  $y = e\sqrt{x} - 1$ (C)  $y = \sqrt{x}e^{\sqrt{x}}$ 

What is a solution to the differential equation 1014. ydy = 2xdx? (A)  $x^2 + y^2 = 4$  (D)  $x^2 = 2 - y^2$ (B)  $y^2 = x^2$  (E)  $x^2 - y^2 = 2$ (C)  $y^2 - 2x^2 = 0$ 965. A growth rate of 5% per year is equal to a continuous growth rate of (A) ln(0.95) (D) 0.95ln(1.05) (B) ln(1.05) (E) ln(1.05) - ln(0.95) (C) 1.05ln(0.05)

III. INTEGRALS 4. Applications	F. Motion 1. Motion
A particle moves along a curve so that at any 1779. time $t \ge 0$ its velocity is given by $v(t) = \ln (t + 1) - t^2 + 1$ . The total distance traveled by the particle from $t = 1$ to $t = 3$ is (A) 3.986 (D) 4.697 (B) 4.289 (E) 4.778 (C) 4.508	The acceleration of a car traveling on a straight 1222. track along the <i>x</i> -axis is given by the equation a(t)=2t+1, where <i>a</i> is in meters per second squared and <i>t</i> is in seconds. If at $x(0) = 0$ and v(0) = 0, what is its displacement at $t = 3$ ? (A) 1 m (D) 12 m (B) 7 m (E) 13.5 m (C) 9 m
A particle travels in a straight line with a 1724. constant acceleration of 2 meters per second per second (m/s <sup>2</sup> ). If the velocity of the particle is 5 meters per second at the time $t = 1$ second, how far does the particle travel from $t = 1$ to $t = 3$ ? (A) 7 m (D) 11 m (B) 8 m (E) 14 m (C) 10 m	The acceleration of a car traveling on a straight 1195. track along the <i>y</i> -axis is given by the equation a = 5, where <i>a</i> is in meters per second squared and <i>t</i> is in seconds. If at $t = 0$ the car's velocity is 3 m/s, what is its velocity at $t = 2$ ? (A) 5 m/s (D) 13 m/s (B) 3 m/s (E) 15 m/s (C) 10 m/s
A particle travels along the <i>x</i> -axis with velocity 1718. at time $t$ , $v(t) = \cos(t^2)$ . If at time $t = 0$ the particle is at $x(0) = 2$ , where is the particle at t = 2? (A) 0.492 (B) 1.529 (C) 2.982 (D) 2.461 (E) It cannot be determined from the information	The velocity of a particle is given by the 1153. equation $v(t) = 3t - 4$ . If $s(0) = 2$ , then what is the position function of the particle? (A) $s(t) = 3t^2 + 2$ (D) $s(t) = 3t^2 - 4t + 2$ (B) $s(t) = \frac{3}{2}t^2 - 4t + 2$ (E) $s(t) = t^2 - 4t + 2$ (C) $s(t) = 3$ The velocity of a car traveling on a straight track
A particle moves along a path so that at any time 1680. <i>t</i> its acceleration is given by $a(t) = 2t + 1$ . At	1091. along the y-axis is given by the equation $v(t) = 12t^2 - 6t + 2$ , where v is in meters per second and t is in seconds. The vehicle's initial position is $y = -1$ m. At what time does the car
time $t = 0$ , its velocity is $v(0) = -6$ . For what value(s) of $t$ is the particle at rest? (A)0 only (D)2 and -3 (B)2 only (E) No values (C) -3 only	pass the origin? $(A)0 s$ $(D)3 s$ $(B)1 s$ $(E) 4 s$ $(C)2 s$
A particle moves along a path so that's its 1663. velocity is given by $v(t) = t^2 - 4$ . How far does the particle travel from $t = 0$ to $t = 4$ ? (A) $\frac{16}{3}$ (D) 16.819 (B) 8 (E) 20 (C) 16	The equation $v(t) = 3t^2 - 4t + 2$ , where v is in 1080. meters per second and t is in seconds gives the velocity of a vehicle moving along a straight track. The vehicle's initial position is 3 meters. What distance has the vehicle traveled after 4 seconds? (A) 30 m (D) 33 m (B) 31 m (E) 34 m (C) 32 m

#### III. INTEGRALS 5. Part 2 Questions

For time *t*,  $0 \le t \le 2\pi$ , the position of a 1184. particle, is given by  $x = \sin^2 t$  and  $y = e^t \cos t$ .

(a) Find the formula for the slope of the path of the particle as a function of time.

(b) For what *t* is the line tangent to the curve vertical.

(c) Set up an integral for the distance traveled by the particle from t = 0 to t = 1.

(a) 
$$s(t) = \frac{e^{t}(\cos t - \sin t)}{2\sin t \cos t}$$
  
(b) 0,  $\frac{\pi}{2}$ ,  $\pi$ ,  $\frac{3\pi}{2}$ ,  $2\pi$   
(c)  $\int_{0}^{1} \sqrt{\sin^{2} 2t + e^{2t}(\cos t - \sin t)^{2}} dt$ 

Let *f* be function given by  $f(x) = x^2$  and let *g* be 1183. the function given by g(x) = kx - 4, where *k* is a positive constant such that *g* is tangent to the graph of *f*.

(a) Find the value of *k*.

(b) Find the area bounded on top by the line perpendicular to g and on the bottom by f(x). (c) Find the volume of the solid generated by revolving the region from part (b) about the line y = 0.

(a) k = 4
(b) 44.667
(c) 385.36

1315. Consider  $\int_{0}^{\frac{\pi}{2}} \frac{1}{1+x^4} dx$ .

(a) Requrite the denominator as  $(x^2 + 1)^2 - 2x^2$ . (b) Split up the denominator into a product of

linear factors.

(c) Integrate by partial fractions.

Let *R* be enclosed by the graph of  $y = x \ln x$ , the 1172. line x = 2, and the *x*-axis.

(a) Find the net area of region *R*.
(b) Find the volume of the solid generated by revolving region *R* about the *x*-axis.
(c) Set up, but do not integrate, an integral expression in terms of a single variable for the volume of the solid generated by revolving region *R* about the line *x* = 2.

(a) 
$$A = 2 \ln 2 - 1$$
  
(b)  $V = \pi \left[ \frac{8}{3} (\ln 2)^2 - \frac{16}{9} \ln 2 + \frac{14}{27} \right]$   
(c)  $V = 2\pi \int_{-2}^{2} (2 - x) x \ln x dx$ 

Let *f* be a function that is defined for all real 1164. numbers *x* and that satisfies the following properties.

i. 
$$f''(x) = 10x - 12$$
  
ii.  $f'(1) = -16$   
iii.  $f(0) = 8$ 

(a) Find all values of x such that the line tangent to the graph at (x, f(x)) is horizontal.

(b) Find f(x).

(a) - 6.3

(c) Find the average value of f' on the interval  $2 \le x \le 5$ .

(a) 
$$f(x) = \frac{5x^3}{3} - 6x^2 - 9x + 8$$
  
(c)  $\frac{232}{3}$ 

#### IV. POLYNOMIAL APPROXIMATIONS AND SERIES 1. Series of Constants

1177. The series 
$$\sum_{n=1}^{\infty} \left(\frac{1}{5^n}\right)$$
 is

(A) convergent and decreasing

- (B) convergent and increasing
- (C) divergent and decreasing
- (D) divergent and increasing
- (E) divergent and remain the same

1174. The series 
$$\sum_{n=1}^{\infty} \left( \frac{2^n}{1+2^n} \right)$$
 is

(A) neither increasing nor decreasing

(B) decreasing and convergent

(C) decreasing and divergent

- (D) increasing and convergent
- (E) increasing and divergent

Which one of the following series is divergent?

1159. (A)  $\sum_{k=1}^{\infty} k^{-\frac{5}{2}}$  (D)  $\sum_{k=1}^{\infty} \frac{1}{k^{11}}$ (B)  $\sum_{k=1}^{\infty} \frac{1}{k^{\pi}}$  (E)  $\sum_{k=1}^{\infty} k^{-9}$ (C)  $\sum_{k=1}^{\infty} \frac{1}{k}$ 

1158. The series  $\sum_{n=1}^{\infty} \left( \frac{n^n}{n!} \right)$  is

(A) increasing and convergent(B) decreasing and convergent

- (C) increasing and divergent
- (D) decreasing and divergent
- (E) neither increasing or decreasing

1083. For what values of *n* is the series  $\sum_{n=1}^{\infty} \left(\frac{8^n}{n!}\right)$ 

decreasing?

$(\mathbf{A})\mathbf{n} \ge 8$	$(D) n \le 7$
$(\mathbf{B})n\leq 8$	(E) $n \le 9$
$(\mathbf{C}) n \ge 7$	

Which of the following series is convergent?  
1148. (A) 
$$\sum_{n=1}^{\infty} \frac{\ln k}{9k}$$
 (D)  $\sum_{n=1}^{\infty} \frac{1}{1+9k^2}$   
(B)  $\sum_{n=1}^{\infty} \frac{1}{k+9}$  (E)  $\sum_{n=1}^{\infty} \frac{k}{1+9k^2}$   
(C)  $\sum_{n=1}^{\infty} \frac{1}{\sqrt{k+9}}$ 

Which of the following infinite series has 1143. increasing terms?

$^{\rm (A)}\sum_{n=1}^{\infty} (n-2^n)$	$(D)\sum_{n=1}^{\infty} \left(\frac{n}{4n-1}\right)$





 $(\mathbf{C})\sum_{n=1}^{\infty} \left(\frac{n}{1-2n}\right)$ 

All of the following are examples of a geometric 1142. series except

- $(A)_{1+1+1+1+1+1+\dots}$
- $(\mathbf{B})1 + 2 + 3 + 4 + 5 + \dots$
- (C)1+2+4+6+8+...
- ${}^{(D)}-\frac{1}{2}+\frac{1}{4}-\frac{1}{8}+\frac{1}{16}-\frac{1}{32}+\dots$

(E) 
$$\frac{2}{10} + \frac{2}{10^2} + \frac{2}{10^3} + \frac{2}{10^4} + \frac{2}{10^5} + \dots$$

### **IV. POLYNOMIAL APPROXIMATIONS AND SERIES** 2. Taylor Series

Which of the following generate Taylor series?  
1090. (A) 
$$f(x) = \frac{1}{1-x}$$
 about 0  
(B)  $f(x) = \ln(x-1)$  about 1  
(C)  $f(x) = \sqrt{x-2}$  about 2  
(D)  $f(x) = \sqrt{1+x}$  about -1  
(E)  $f(x) = \tan x$  about  $\frac{\pi}{2}$ 

C 11

For what values of *x* does the following power 1088. series converge?

$$\sum_{n=1}^{\infty} \frac{x^n}{n}$$
(A)-1 < x < 1
(D)-1 < x \le 1  
(B)-1 \le x \le 1
(E) x > 1 or x < 1  
(C)-1 \le x < 1

For what values of *x* does the following power 1044. series diverge?

$$\sum_{n=1}^{\infty} \frac{(x+3)^n}{n!}$$
(A)-3 \le x < 3
(D)-3 < x < 3
(B)-3 \le x \le 3
(E) { }
(C)-3 < x \le 3

What is the coefficient of  $(x - \frac{\pi}{3})^2$  in the Taylor 1024. series about  $\frac{\pi}{3}$  of  $f(x) = \sin x$ ?

$(A)_{4}^{1}$	$(\mathbf{D})\frac{\mathbf{v}\mathbf{s}}{4}$
$(B) - \frac{1}{4}$	$(E) - \frac{\sqrt{3}}{4}$
$(C)\frac{1}{3\sqrt{2}}$	

**A. Taylor Series** 1. Taylor Series What is the  $3^{rd}$  order Taylor polynomial at x = 0

(C)  

$$x + \frac{x^2}{2!} - \frac{x^3}{3!}$$
(D)  
 $x - \frac{x^3}{3!}$ 
(E)  
 $x + \frac{x^2}{2!} + \frac{x^3}{3!}$ 
(E)  
 $x + \frac{x^2}{2!} + \frac{x^3}{3!}$ 

What is the  $2^{nd}$  order Taylor polynomial at  $x = \pi$ 1026. for  $f(x) = \cos x$ ?

(A)  
-1+(x-
$$\pi$$
)- $\frac{(x-\pi)^2}{2!}$ 

<sup>(B)</sup> 
$$1 - \frac{(x-\pi)^2}{2!}$$

$$(\mathbf{C})_{-1+\frac{(x-\pi)^2}{2!}}$$

$$(D) x - \pi + \frac{(x - \pi)^2}{2!}$$

(E) 
$$1 - (x - \pi) + \frac{(x - \pi^2)}{2!}$$

What is an approximation for  $\ln(0.7)$  using the 1021. first three terms of the Taylor series

$$f(x) = \ln (1 + x) \text{ about } x = 0?$$
(A)-0.340
(D)-0.355
(B)-0.349
(E)-0.357
(C)-0.354