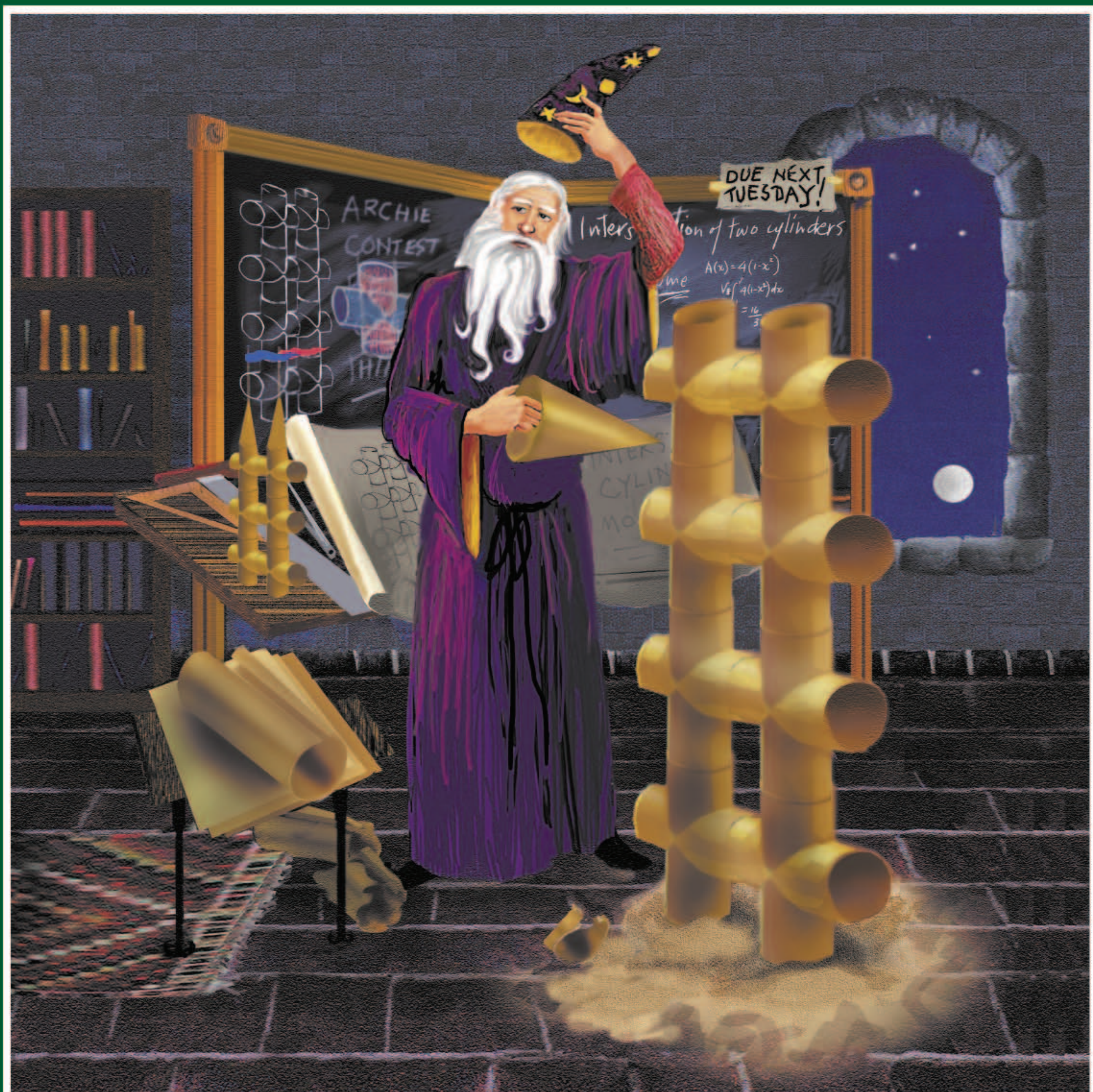
Wizard
Test Maker

AP CALCULUS AB/BC



QUESTION CATALOGUE

eduware

AP Calculus

Table of Contents

I. FUNCTIONS, GRAPHS AND LIMITS

II. DERIVATIVES

III. INTEGRALS

IV. POLYNOMIAL APPROXIMATIONS AND SERIES

1071. What is the domain of the function $f(x) = \dfrac{x^2 - 16}{x^2 + 7x + 12}$?

(A) $(-4, 4)$
(B) $x \neq -3, -4$
(C) $x \neq -3, -4, 4$
(D) $(-\infty, \infty)$
(E) $x \neq -4, 4$

1097. The domain of the function $f(x) = \dfrac{1}{\sqrt{4-x}}$ is

(A) $x \geq 0$
(B) $x > 4$
(C) $x < 4$
(D) $x \geq 4$
(E) $x \leq 4$

1168. The graph of $y^2 - 5y - 1 = x^2$ is a(n)

(A) circle
(B) ellipse
(C) hyperbola
(D) line
(E) parabola

1215. If the zeros of $f(x)$ are $x = -2$ and $x = 3$, then the zeros of $f\left(\frac{x}{2}\right)$ are $x =$

(A) $-1, \frac{3}{2}$
(B) $-2, 3$
(C) $-2, 6$
(D) $-3, \frac{9}{2}$
(E) $-4, 6$

1244. If $f(x) = 3 - x$ and $g(x) = \sqrt{x-5}$, then $f(g(-2)) =$

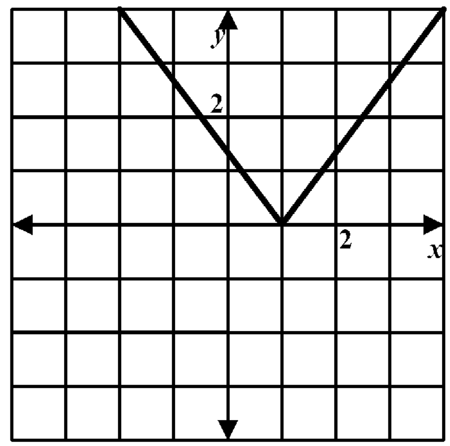
(A) 0
(B) $4 - \sqrt{7}$
(C) $\sqrt{7}$
(D) $\sqrt{2}$
(E) Undefined

1524. The function $f(x) = \dfrac{x^2 + 9x - 90}{x^2 + 19x + 60}$ has a removable discontinuity at

(A) -15
(B) -4
(C) 6
(D) 7
(E) 15

1582. If $f(x) = \dfrac{3}{x^2 - 2}$ and $g(x) = 4x$, then $g(f(3)) =$

(A) $\frac{3}{7}$
(B) $\frac{2}{3}$
(C) $\frac{12}{3}$
(D) $\frac{12}{7}$
(E) $\frac{14}{7}$

1218. 

Which of the following functions is represented by the graph above?

(A) $f(x) = \left|-\dfrac{3}{2}x + 1\right|$
(B) $f(x) = \left|\dfrac{3}{2}x + 1\right|$
(C) $f(x) = -\dfrac{3}{2}x + 1$
(D) $f(x) = \dfrac{3}{x}x + 1$
(E) $f(x) = \dfrac{3}{2}x - 1$

1525. The function $h(x) = \dfrac{f(x)}{g(x)}$ is discontinuous whenever

(A) $g(x) = 1$
(B) $g(x)$ is negative
(C) $f(x) = 0$
(D) $g(x) = 0$
(E) $f(x) = g(x)$

1726. A polynomial has a relative maximum at $(-5, 4)$, 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
(B) 3
(C) 4
(D) 5
(E) 6

1570. If the graph of $f(x)$ is symmetric with respect to the line $y = x$ and is differentiable everywhere, then the graph of $f'(x)$ is

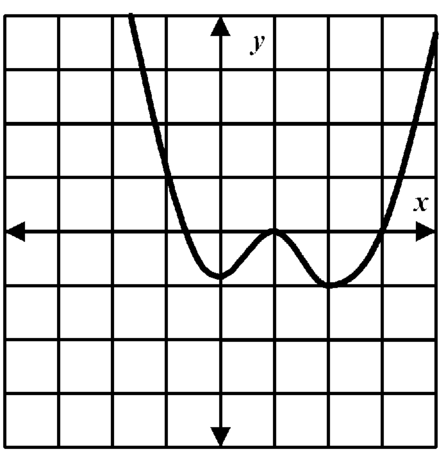
(A) Symmetric with respect to the line $y = 0$
(B) Symmetric with respect to the line $x = 0$
(C) A parabola
(D) A hyperbola
(E) None of the above

1503. If $f(x)$ is a continuous differentiable function and $f'(a) = 0$, what can always be said about the graph of $f(x)$ at a?

I. The line tangent to the curve at a is horizontal.
II. The curve is at a local maximum or minimum
III. There is an inflection point at a.

(A) I only
(B) I and II
(C) II and III
(D) II only
(E) III only

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



1241. Where is $f'(x)$ undefined?

(A) $x = 1$
(B) $x = 2$
(C) $x = 0$
(D) All of the above
(E) None of the above

1240. Where is $f'(x) < 0$?

(A) (0, 1) and (2, ∞)
(B) $(-\frac{1}{2}, 3)$
(C) (∞, 0) and (1, 2)
(D) (–∞, 0) and (1, 2)
(E) $(-\infty, -\frac{1}{2})$ and $(\frac{3}{2}, \infty)$

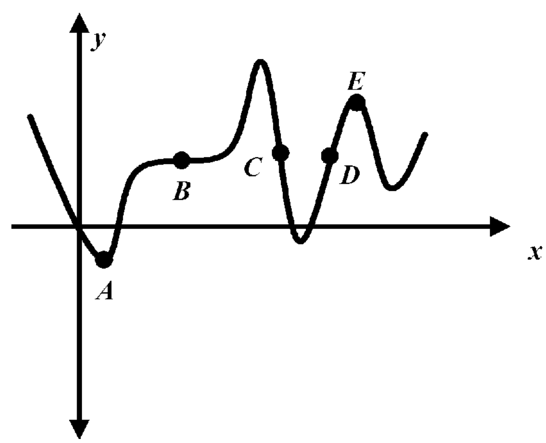
1239. Where is $f'(x) > 0$?

(A) (∞, 0) and (1, 2)
(B) (0, 1) and (2, ∞)
(C) (0, 3)
(D) $(-\infty, -\frac{1}{2})$ and (3, 0)
(E) $(-\infty, -\frac{1}{2})$ and $(\frac{3}{2}, \infty)$

1238. Where is $f'(x) = 0$?

(A) $x = 1$
(B) $x = 2$
(C) $x = 0$
(D) $x = 0$ and $x = 2$
(E) $x = 0, x = 1, x = 2$

Base your answers to questions **607** through **605** on the graph below of $f(x)$.



607. At which point is $f'(x) = 0$ and $f''(x) > 0$?

(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

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

(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

1827. There are two lines through the point (1, –2) that are tangential to the parabola $y = x^2 + 2$. Find the x–coordinates of these points of intersection.

(A) $x = -0.873, 6.873$
(B) $x = -1.236, 3.236$
(C) $x = -2.327, 3.327$
(D) $x = -0.765, 1.459$
(E) $x = -1.427, 3.683$

1722. If $2x - 5y = 23$ is the equation of the line normal to the graph of f at the point (14, 1), then $f'(14) =$

(A) $\frac{2}{5}$
(B) $\frac{5}{2}$
(C) $-\frac{2}{5}$
(D) -5
(E) $-\frac{5}{2}$

1662. The line tangent to the graph of $y = -x^{-2}$ at the point (1, –1) intersects both x and y axes. What is the area of the triangle formed by this tangent line and coordinate axes?

(A) 1
(B) 2
(C) 2.25
(D) 3.5
(E) 0.75

1658. The equation of the normal line to the curve $y = 3x^2 - 2x$ at $x = 1$ is

(A) $y = \frac{x}{4} + \frac{5}{4}$
(B) $y = \frac{x}{4} + \frac{3}{4}$
(C) $y = -\frac{x}{4} + \frac{5}{4}$
(D) $y = 4x - 3$
(E) None of the above

1646. What is the slope of the line tangent to the curve $x^2 + y^2 = 9$ when x = 3?

(A) –1
(B) 0
(C) 1
(D) π
(E) Infinite slope

1645. What is the length of the chord of the circle $x^2 + y^2 = 9$ formed by the line normal to the circle at $x = \frac{3}{2}$?

(A) 3
(B) 6
(C) 9
(D) 12
(E) $\sqrt{3}$

1580. What is the slope of the line tangent to the curve $y = e^x$ at $x = e$.

(A) e^{π}
(B) 1
(C) e
(D) e^e
(E) e^x

1579. Find the equation to the line tangent to the polar curve $r = 2\cos\left(\frac{1}{2}\theta\right)$ at $(0, \sqrt{2})$.

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

1506. Find the equation of the line normal to the curve $x^2 + y^2 = 1$ at $\left(\cos\frac{5\pi}{4}, \sin\frac{5\pi}{4}\right)$.

(A) $y = x$
(B) $y = -x$
(C) $y = 2x$
(D) $y = -2x$
(E) $y = -x - 2$

1499. Which of the following is the equation of the line tangent to the curve $f(x) = 2\sin(x)$ at $x = \pi$.

(A) $y = -2x + 2\pi$
(B) $\frac{y}{2} = -x - \pi$
(C) $y = 2x - 2\pi$
(D) $\frac{y}{2} = x + \pi$
(E) None of the above

1485. The tangent line to the curve $y = x^3 - 2x + 4$ at the point (0,4) has an x–intercept at

(A) (0, 0)
(B) (–2, 0)
(C) (2, 0)
(D) (3, 0)
(E) (–3, 0)

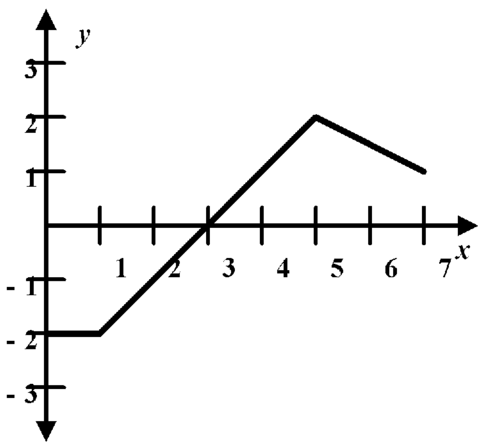
1039. If $f(x) = 3x^2 - 5$, what is the equation for the tangent line to the curve when $x = 1$?

(A) $y + 2 = 6(x - 1)$
(B) $y - 2 = -12(x - 1)$
(C) $y - 2 = 6(x - 1)$
(D) $y - 2 = 6(x + 1)$
(E) $y = 6x$

982. If $f(x) = 2x^3 - 4x^2 - 6x + 1$, then the equation for the normal line to the curve perpendicular to $y + 3 = 2(x - 1)$ is

(A) $y + 2x + 15 = 0$
(B) $y + 2x - 15 = 0$
(C) $y - 2x + 15 = 0$
(D) $2y - x + 15 = 0$
(E) $2y + x + 15 = 0$

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 $0 \le t \le 7$.



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

---

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
   (B) 18.685
   (C) 27.000
   (D) 18
   (E) 34.604

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

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 rest when t is equal to
   (A) 0
   (B) 1 and 2
   (C) 0 and 1
   (D) 0 and 2
   (E) 0, 1, and 2

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

498. The acceleration is positive
   (A) when $t < 3$
   (B) when $t > 3$
   (C) for $2 < t < 3$
   (D) for $2 < t < 4$
   (E) for all t, $t \neq 3$

775. The sides of an equilateral triangle are increasing at the rate of 12 in/sec. How fast is the triangle's area increasing when the sides of the triangle are each 2 inches long?

(A) $6\sqrt{3}$ ft/sec
(B) $12\sqrt{3}$ ft/sec
(C) $24\sqrt{3}$ ft/sec
(D) $36\sqrt{3}$ ft/sec
(E) $48\sqrt{3}$ ft/sec

740. A boat is being pulled toward a dock by a rope attached to its bow through a pulley on the dock 3 feet above the bow. If the rope is hauled in at a rate of 5 ft/sec, how fast is the boat approaching the dock when its 4 feet from the dock?

(A) 2 ft/sec
(B) 3 ft/sec
(C) 4 ft/sec
(D) 5 ft/sec
(E) 6 ft/sec

716. An inverted conical container has a diameter of 36 in and a depth of 12 in. If water is flowing out of the vertex of the container at a rate of 15π in^3/sec, how fast is the depth of the water dropping when the height his 3 inches?

(A) $\frac{15}{2}$ in/s
(B) $\frac{15}{4}$ in/s
(C) $\frac{10}{9}$ in/s
(D) $\frac{20}{27}$ in/s
(E) $\frac{20}{27}\pi$ in/s

597. A foot tall rectangular box's length is increasing at the rate of 0.25 feet/sec and its width is decreasing at 0.5 feet/sec. When the length is 0.8 feet and its width is 1 foot, the volume of the box is changing at

(A) –0.25 ft^3/sec
(B) –0.15 ft^3/sec
(C) 0.15 ft^3/sec
(D) 0.25 ft^3/sec
(E) 0.4 ft^3/sec

555. The height (h) and radius (r) of a cylinder both increase at the rate of 1 in/sec. How fast does the surface area increase?

(A) $2\pi(r + h)$
(B) $2\pi(3r + h)$
(C) $6\pi r$
(D) $4\pi r + 2\pi h$
(E) $4\pi r$

553. An inverted circular cone with its vertex down has a depth of 10 in and a radius at the top of 4 in. Water is leaking out so that the water level is falling at the rate of 1 in/hr. How fast the water leaking out of the cone when the water is 6 in deep?

(A) 1.92π in^3/hr
(B) 2.4π in^3/hr
(C) 3π in^3/hr
(D) 3.8π in^3/hr
(E) 5.76π in^3/hr

551. A spherical balloon is being filled with helium at the rate of 9 ft^3/min. How fast is the surface area increasing when the volume is 36π ft^3?

(A) 2 ft^2/min
(B) 2π ft^2/min
(C) 3 ft^2/min
(D) 3π ft^2/min
(E) 6 ft^2/min

470. A 5-foot-tall person is walking at a rate of 3 ft/sec away from a street lamp that is 16 feet tall. How fast is the length of her shadow changing?

(A) $\frac{3}{11}$ ft/sec
(B) $\frac{15}{11}$ ft/sec
(C) 3 ft/sec
(D) 11 ft/sec
(E) 15 ft/sec

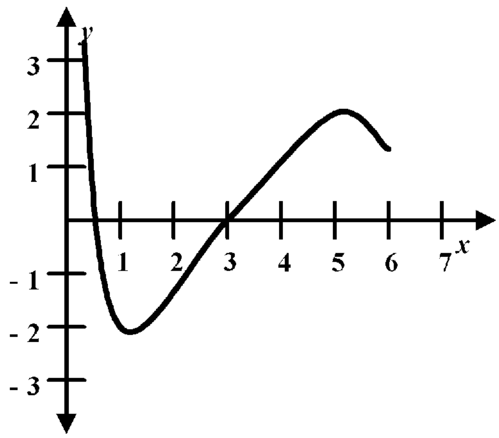
468. Milk spilled from a carton spreads in a circle whose circumference increases at a rate of 20 ft/sec. How fast is the area of the spill increasing when the circumference of the circle is 81π ft?

(A) 810 ft^2/sec
(B) 360 ft^2/sec
(C) 270 ft^2/sec
(D) 180 ft^2/sec
(E) 90 ft^2/sec

212. [Calculator] The best approximation to the increase in volume of a sphere when the radius is increased from 2 to 2.1 is

(A) 9
(B) 8
(C) 7
(D) 6
(E) 5

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



538. f has a point of inflection at x =
   (A) 0.5
   (B) 3
   (C) 5
   (D) 0.5 and 3
   (E) 1 and 5

537. f has a local minimum at x =
   (A) 0
   (B) 0.5
   (C) 1
   (D) 3
   (E) 5

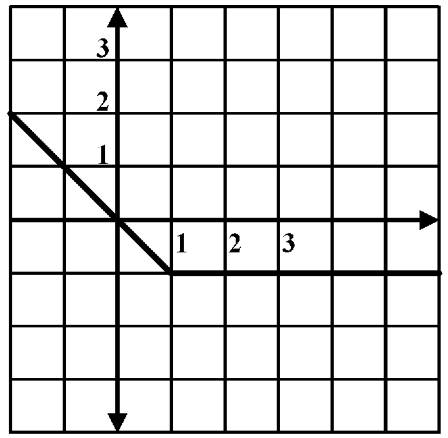
---

480. On the closed interval $[0, 2\pi]$, the maximum value of the function $f(x) = 5\sin x - 12\cos x$ is
   (A) 0
   (B) $\frac{60}{13}$
   (C) 5
   (D) 12
   (E) 13

225. The minimum value of the slope of the curve $y = x^6 - x^4 + 3x$ is
   (A) –3.025
   (B) –2.595
   (C) 0
   (D) 2.595
   (E) 3.025

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?
   (A) $f'' < 0$
   (B) $f' < 0$
   (C) $f' > 0$
   (D) $f'' > 0$
   (E) None of the above

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



320. The function is concave downward for which interval?
   (A) (1, 2)
   (B) (1, 4)
   (C) (2, 3)
   (D) (–1, 1)
   (E) (–1, 4)

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
   (B) 1
   (C) 2
   (D) 3
   (E) 4

Given the function $f(x) = e^{-x}(x^2 + 1)$

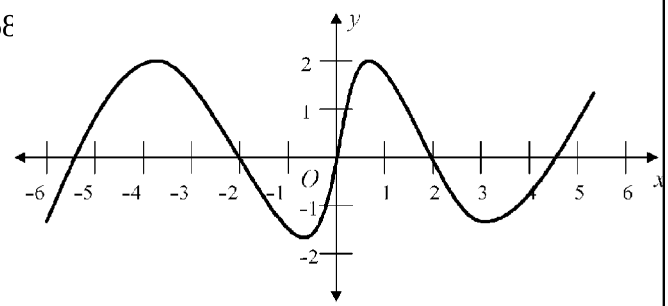
1271. (a) For what values if f increasing?
(b) For what values is f concave up?
(c) Set up, but do not evaluate an integral (or set of integrals) which give the arc length of the segment of f from $x = 0$ to $x = 1$.

(a) $\{\ \}$

(b) $x < 1$ or $x > 3$

(c) $\int_0^1 \sqrt{e^{-2x}(x-1)^4 + 1}\ dx$

1268



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 $f(x)$.

$f(x) = 0$

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) $k = \sqrt{\frac{20}{3}}$

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

723. Using the Trapezoidal Rule, what is the area under the curve $y = x^2 + x$ from $x = 0$ to $x = 3$ when $n = 6$?
(A) 10.625
(B) 13.438
(C) 13.500
(D) 13.625
(E) 16.625

703. A Riemann sum to calculate the area under $f(x)$ on the interval $a \le x \le b$ with an infinite number of subintervals will yield the value
(A) $\int_a^b f(x)dx$
(B) $f(b) - f(a)$
(C) $\left.\frac{df(x)}{dx}\right|_{(a,b)}$
(D) $\left.\frac{df(x)}{dx}\right|_{(b,a)}$
(E) $\frac{d}{dx}\int_a^b f(x)dx$

694. Using the Midpoint Formula, what is the area under the curve $y = x^2 + x$ from $x = 0$ to $x = 3$ when $n = 6$?
(A) 10.625
(B) 13.438
(C) 13.500
(D) 13.625
(E) 16.625

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

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) 10.589
(B) 10.624
(C) 10.667
(D) 10.681
(E) 10.703

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
(B) 0.915
(C) 0.916
(D) 0.918
(E) 0.968

654. What is an approximation for the area under the curve $y = \frac{3}{1+x^2}$ on the interval [0, 3] using the trapezoidal rule with 5 subintervals?
(A) 2.932
(B) 3.742
(C) 3.747
(D) 3.750
(E) 4.552

651. What is an approximation for the area under the curve $y = \sqrt{5+x^5}$ on the interval [0, 3] using the midpoint formula with 4 subintervals?
(A) 11.992
(B) 16.155
(C) 16.456
(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
(B) 2.800
(C) 2.797
(D) 2.793
(E) 2.610

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
(B) 0.65625
(C) 0.66667
(D) 0.67187
(E) 0.78125

1851. If $\int_0^3 \left(2x^2 - x + 3\right) dx$ is approximated by three inscribed rectangles of equal width on the x-axis, the approximation is

(A) 16 (D) 23.5
(B) 22 (E) 31
(C) 22.5

1795. Find the area in the first quadrant bounded by the 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

1784. The total area enclosed between the graphs of $y = 2\cos x$ 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?

I. $f(x) > g(x)$ for $a \le x \le b$

II. $\int_a^b \left[f(x) - g(x)\right] dx = 3$

III. $\int_a^b \left[f(x)g(x)\right] dx = 10$

(A) I only (D) II and III
(B) II only (E) I, II and III
(C) I and II

1714. The area in the first quadrant bounded by the 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) 15π **(D) 21π**
(B) 17π (E) 23π
(C) 19π

1674. The area of the region bounded by the graph of $y = 2xe^{x^2}$ and the x-axis from $x = 0$ to $x = 1$ is

(A) $e^2 - 1$ (D) e
(B) $e - 1$ (E) $e^3(1 - e)$
(C) $e^2 - e$

1668. Let $f(x) = x\sin(x - \pi)$, $0 < x < 2\pi$. The total area bounded by $f(x)$ and the x–axis on the interval $0 < x < 2\pi$ is

(A) π **(D) 4π**
(B) 2π (E) 5π
(C) 3π

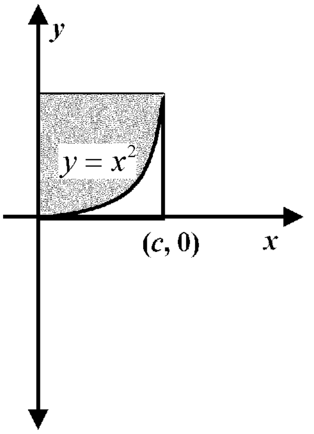
1651. The area of the region enclosed by $y = 2x^2 - 4$ and $y = \sqrt{9 - x^2}$ is

(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.



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

1670. The base of a solid is the region bounded by the line $-y + 6 = 2x$ and the coordinate axes. What is the volume of the solid generated if every cross section perpendicular to the x–axis is a semicircle?

(A) $\frac{7}{2}\pi$
(B) $\mathbf{\frac{9}{2}\pi}$
(C) 9π
(D) 14π
(E) 18π

1661. The region bounded by the graphs of $y = 3 - e^{-x}$ and $y = x^2$ is revolved around the x–axis. The volume of the resulting solid is

(A) 9.805
(B) 11.473
(C) 19.975
(D) 27.362
(E) 30.805

1141. What is the volume of the solid when the region bounded by $xy = 6$ and $x + y = 5$ is revolved about the x-axis?

(A) π
(B) $\frac{2}{3}\pi$
(C) $\mathbf{\frac{1}{3}\pi}$
(D) $\frac{1}{6}\pi$
(E) $\frac{1}{9}\pi$

1100. What is the volume of the solid when the region bounded by $y = \frac{x}{3}$, $y = x$, $y = 1$ and $y = 2$ is revolved about the x-axis?

(A) 8π
(B) $\mathbf{\frac{28}{3}\pi}$
(C) $\frac{32}{3}\pi$
(D) 12π
(E) $\frac{40}{3}\pi$

1076. What is the volume of the solid when the region bounded by $y = \cos x$, $x = \frac{\pi}{2}$ and $y = 0$ is revolved about the y-axis?

(A) 1
(B) π
(C) 2π
(D) $\frac{1}{2}\pi - 1$
(E) $\mathbf{1 - 2\pi}$

1030. What is the volume of the solid when the region bounded by $x = \sqrt{3+y}$, $x = 0$ and $y = 6$ is revolved about the y-axis?

(A) $\frac{27}{2}\pi$
(B) $54\pi - \pi\sqrt{3}$
(C) $4\pi\sqrt{6} - 2\pi\sqrt{3}$
(D) $\mathbf{\frac{81}{2}\pi}$
(E) 6π

966. What is the volume of the solid when the region bounded by $y = x^{3/2}$, $x = 0$, $x = 4$ and $y = 0$ is revolved about the x-axis?

(A) 1028π
(B) $\mathbf{64\pi}$
(C) 3π
(D) $\frac{64}{5}$
(E) $\frac{256}{5}\pi\sqrt{2}$

941. What is the volume of the solid that has a circular base of radius r and every plane section perpendicular to a diameter is semi–circle?

(A) $\frac{1}{2}\pi r^3$
(B) $\frac{1}{4}\pi r^3$
(C) $\frac{1}{3}\pi r^3$
(D) $\frac{1}{3}r^3$
(E) $\mathbf{\frac{2}{3}r^3}$

940. What is the volume of the solid that has a circular base of radius r and every plane section perpendicular to a diameter is an isosceles triangle?

(A) $\frac{1}{2}\pi r^3$
(B) $\frac{2}{3}r^3$
(C) πr^3
(D) $\mathbf{\frac{4}{3}r^3}$
(E) $\frac{2}{3}\pi r^3$

939. What is the volume of the solid that has a circular base of radius r and every plane section perpendicular to a diameter is an equilateral triangle?

(A) $r^3\sqrt{3}$
(B) $2r^3\sqrt{3}$
(C) $4r^3\sqrt{3}$
(D) $\frac{4\sqrt{3}}{3}r^3$
(E) $\mathbf{\frac{8\sqrt{3}}{3}r^3}$

922. What is the volume of the solid when the region bounded by $y = \sqrt{x}$, $y = x$ is revolved about the x-axis?

(A) π
(B) 2π
(C) $\frac{1}{2}\pi$
(D) $\frac{1}{3}\pi$
(E) $\mathbf{\frac{1}{6}\pi}$

917. What is the volume of the solid that has a circular base of radius r and every plane section perpendicular to a diameter is a square?

(A) $2\pi r^3$
(B) $4\pi r^3$
(C) $\frac{8}{3}r^3$
(D) $\frac{8}{3}\pi r^3$
(E) $\mathbf{\frac{16}{3}r^3}$

1046. If the population of a city increases continuously at a rate proportional to the population at that 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

1043. Which of the following curves passes through 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) $y = -x^2$

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

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

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

(A) parabolas (D) ellipses
(B) straight lines (E) circles
(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) $y = \cos^{-1}(\sin x)$
(B) $\boldsymbol{y = \sin^{-1}(2 - \cos x)}$ (E) $y = \sin^{-1}(\cos x)$
(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) $\boldsymbol{y = \ln\left|\frac{2}{x}\right| + 2}$ (D) $y = \frac{1}{2}\ln|x| + 2$
(B) $y = \ln\left|\frac{x}{2}\right| + 2$ (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) $y = \sqrt{x}e^{\sqrt{x}}$

1014. What is a solution to the differential equation $ydy = 2xdx$?

(A) $x^2 + y^2 = 4$ (D) $x^2 = 2 - y^2$
(B) $y^2 = x^2$ (E) $x^2 - y^2 = 2$
(C) $\boldsymbol{y^2 - 2x^2 = 0}$

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)

1779. A particle moves along a curve so that at any time $t \geq 0$ 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
(B) 4.289
(C) 4.508
(D) 4.697
(E) 4.778

1724. A particle travels in a straight line with a constant acceleration of 2 meters per second per second (m/s^2). 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
(B) 8 m
(C) 10 m
(D) 11 m
(E) 14 m

1718. A particle travels along the x–axis with velocity 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 given.

1680. A particle moves along a path so that at any time t its acceleration is given by $a(t) = 2t + 1$. At time $t = 0$, its velocity is $v(0) = -6$. For what value(s) of t is the particle at rest?

(A) 0 only
(B) 2 only
(C) –3 only
(D) 2 and –3
(E) No values

1663. A particle moves along a path so that's its velocity is given by $v(t) = t^2 - 4$. How far does the particle travel from $t = 0$ to $t = 4$?

(A) $\frac{16}{3}$
(B) 8
(C) 16
(D) 16.819
(E) 20

1222. The acceleration of a car traveling on a straight track along the x-axis is given by the equation $a(t) = 2t + 1$, where a is in meters per second squared and t is in seconds. If at $x(0) = 0$ and $v(0) = 0$, what is its displacement at $t = 3$?

(A) 1 m
(B) 7 m
(C) 9 m
(D) 12 m
(E) 13.5 m

1195. The acceleration of a car traveling on a straight track along the y-axis is given by the equation $a = 5$, where a is in meters per second squared and t 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
(B) 3 m/s
(C) 10 m/s
(D) 13 m/s
(E) 15 m/s

1153. The velocity of a particle is given by the equation $v(t) = 3t - 4$. If $s(0) = 2$, then what is the position function of the particle?

(A) $s(t) = 3t^2 + 2$
(B) $s(t) = \frac{3}{2}t^2 - 4t + 2$
(C) $s(t) = 3$
(D) $s(t) = 3t^2 - 4t + 2$
(E) $s(t) = t^2 - 4t + 2$

1091. The velocity of a car traveling on a straight track 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 pass the origin?

(A) 0 s
(B) 1 s
(C) 2 s
(D) 3 s
(E) 4 s

1080. The equation $v(t) = 3t^2 - 4t + 2$, where v is in 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
(B) 31 m
(C) 32 m
(D) 33 m
(E) 34 m

1184. For time t, $0 \le t \le 2\pi$, the position of a 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) $s(t) = \dfrac{e^t(\cos t - \sin t)}{2\sin t\cos t}$

(b) $0,\ \dfrac{\pi}{2},\ \pi,\ \dfrac{3\pi}{2},\ 2\pi$

(c) $\int_0^1 \sqrt{\sin^2 2t + e^{2t}(\cos t - \sin t)^2}\, dt$

1183. Let f be function given by $f(x) = x^2$ and let g be 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 $\int_0^{\frac{\pi}{2}} \dfrac{1}{1+x^4}dx.$

(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.

1172. Let R be enclosed by the graph of $y = x \ln x$, the 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) $V = \pi\left[\dfrac{8}{3}(\ln 2)^2 - \dfrac{16}{9}\ln 2 + \dfrac{14}{27}\right]$

(c) $V = 2\pi\int_1^2 (2-x)\, x\ln x dx$

1164. Let f be a function that is defined for all real 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 $f(x)$.
(c) Find the average value of f' on the interval $2 \le x \le 5$.

(a) $-.6, 3$

(b) $f(x) = \dfrac{5x^3}{3} - 6x^2 - 9x + 8$

(c) $\dfrac{232}{3}$

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

1159. Which one of the following series is divergent?

(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?

(A) $n \geq 8$ (D) $n \leq 7$
(B) $n \leq 8$ (E) $n \leq 9$
(C) $n \geq 7$

1148. Which of the following series is convergent?

(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) $\sum_{n=1}^{\infty}\frac{1}{\sqrt{k+9}}$

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

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

(B) $\sum_{n=1}^{\infty}\left(\frac{n^n}{n!}\right)$ (E) $\sum_{n=1}^{\infty}\left(\frac{10^n}{(2n)!}\right)$

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

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

(A) $1+1+1+1+1+\ldots$

(B) $1+2+3+4+5+\ldots$

(C) $1+2+4+6+8+\ldots$

(D) $-\frac{1}{2}+\frac{1}{4}-\frac{1}{8}+\frac{1}{16}-\frac{1}{32}+\ldots$

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

1090. Which of the following generate Taylor series?

(A) $f(x) = \dfrac{1}{1-x}$ 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 $\dfrac{\pi}{2}$

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

$$\sum_{n=1}^{\infty} \frac{x^n}{n}$$

(A) $-1 < x < 1$
(B) $-1 \le x \le 1$
(C) $-1 \le x < 1$
(D) $-1 < x \le 1$
(E) $x > 1$ or $x < 1$

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

$$\sum_{n=1}^{\infty} \frac{(x+3)^n}{n!}$$

(A) $-3 \le x < 3$
(B) $-3 \le x \le 3$
(C) $-3 < x \le 3$
(D) $-3 < x < 3$
(E) { }

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

(A) $\frac{1}{4}$
(B) $-\frac{1}{4}$
(C) $\frac{1}{3\sqrt{2}}$
(D) $\frac{\sqrt{3}}{4}$
(E) $-\frac{\sqrt{3}}{4}$

1031. What is the 3rd order Taylor polynomial at $x = 0$ for $f(x) = \sin x$?

(A) $x + \dfrac{x^3}{3!}$

(B) $x - \dfrac{x^2}{2!} + \dfrac{x^3}{3!}$

(C) $x + \dfrac{x^2}{2!} - \dfrac{x^3}{3!}$

(D) $x - \dfrac{x^3}{3!}$

(E) $x + \dfrac{x^2}{2!} + \dfrac{x^3}{3!}$

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

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

(B) $1 - \dfrac{(x-\pi)^2}{2!}$

(C) $-1 + \dfrac{(x-\pi)^2}{2!}$

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

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

1021. What is an approximation for ln (0.7) using the first three terms of the Taylor series $f(x) = \ln(1 + x)$ about $x = 0$?

(A) –0.340
(B) –0.349
(C) –0.354
(D) –0.355
(E) –0.357