هيكل امتحان نهاية الفصل

تم تحميل هذا الملف من موقع المناهج الإماراتية
موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الثاني عشر المتقدم ⇦ رياضيات ⇦ ⇦ ملفات متنوعة ⇦ الملف
تاريخ إضافة الملف على موقع المناهج: 2026-11-15 21:24:13
المزيد من مادة رياضيات:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم					
صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة رياضيات في	
1	المخطط الشامل: تقدير طول القوس وحساب النهايات
2	مقرر الصف الثاني عشر المتقدم - الفصل الدراسي الأول للعام الدراسي 2026-2027
3	هيكل الامتحان باللغتين
4	نماذج إجابة توقعات مرئية
5	هيكل مادة الرياضيات

تحميل تطبيق المناهج للهواتف الذكية	
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End of Term 1 Exam Structure

Mathematics – Grade 12 Advanced

A comprehensive question bank aligned with the learning outcomes

142 Multiple-Choice • 34 Free-Response • 26 Learning Outcomes

Unit 2: Limits and Continuity • Unit 3: Differentiation

Academic Year 2026 – 2027

Student Name : .....

Class : ..... **Score :** .....

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Learning Outcomes Structure – End of Term 1 Exam – Mathematics Grade 12 Advanced

Number of questions: 26 **Maximum grade: 100** **Exam duration: 150 minutes**

Marks per question: 2 or 4 **Scientific calculator: Allowed** **Mode: Electronic & Paper**

Multiple-Choice Questions (1 – 20)

1 : **Estimate an arc length of a given function** — p. 68 — Exercises 7–12

2 : **Find a limit algebraically or graphically, if it exists** — p. 85 — Exercises 21–24

3 : **Use the squeeze theorem to find limits** — p. 85 — Exercises 29–32

4 : **Find limits for polynomials, rational, and trigonometric functions using theorems** — p. 85 — Exercises 7–16

5 : **Study the continuity of a function at a given point** — p. 95 — Exercises 21–28

6 : **Use the continuity properties to study the continuity of a function or a composition of functions at a given point** — p. 89 — Example 4.2

7 : **Find infinite limits and limits at infinity** — p. 106 — Exercises 9–14

8 : **Find the average and instantaneous velocity at a given point** — p. 141 — Exercises 19–22

9 : **Sketch the graph of a function using that of its derivative** — p. 147 — Example 2.5

10 : **Find the derivative of a function at a given point** — p. 152 — Exercises 29–30

11 : **Find the derivative of a function using the Power Rule at a given point** — p. 160 — Exercises 7–14

12 : **Applying the rules of multiplication and division to derivatives** — p. 169 — Exercises 21–24

13 : **Apply the chain rule for differentiation** — p. 177 — Exercises 31–36

14 : **Find the derivative of an inverse function using the Chain Rule** — p. 176 — Exercises 17–22

15 : **Find the derivatives of trigonometric functions using differentiation rules** — p. 184 — Exercises 9–18

16 : **Find the derivatives of exponential functions** — p. 194 — Exercises 29–30

17 : **Find the derivatives of natural logarithmic functions** — p. 193 — Exercises 20–22

18 : **Find derivatives implicitly** — p. 198 — Example 8.2

19 : **Use implicit differentiation to find derivatives of inverse trigonometric functions** — p. 204 — Exercises 29–32

20 : **Recall the hypotheses of Rolle's Theorem** — p. 213 — Rolle's Theorem 10.1

Free-Response Questions (21 – 26)

21 : **a) Determine the continuity of a function at a given point b) Use the continuity properties to study the continuity of a function or a composition of functions at a given point** — p. 88 — Definition 4.1 , p. 95 — Exercises 29–32

22 : **Find horizontal, vertical, and slant asymptotes using limits** — p. 106 — Exercises 29–32

23 : **Apply the Product Rule on derivatives** — p. 169 — Exercises 17–20

24 : **Find the derivatives of trigonometric functions using differentiation rules** — p. 184 — Exercises 3–8

25 : **Solve real-life problems using derivatives of exponential and logarithmic functions** — p. 194 — Exercises 35–38

26 : **Understand the Mean Value Theorem and use it in applications** — p. 219 — Exercises 1–6

Part 1 : Multiple-Choice Questions (1 – 20)

Question 1 : Estimate an arc length of a given function

Bridge (English) p. 68 — Exercises 7–12

7 Estimate the length of the curve $y = f(x)$, $f(x) = cosx,\ 0 \le x \le \frac{\pi}{2}$, using $n = 4$ line segments.

(a) 1.9033
(b) 1.9101
(c) 1.8950
(d) 1.9063

8 Estimate the length of the curve $y = f(x)$, $f(x) = sinx,\ 0 \le x \le \frac{\pi}{2}$, using $n = 4$ line segments.

(a) 1.9101
(b) 1.8950
(c) 1.9033
(d) 1.9063

9 Estimate the length of the curve $y = f(x)$, $f(x) = \sqrt{x+1},\ 0 \le x \le 3$, using $n = 4$ line segments.

(a) 3.1660
(b) 3.1673
(c) 3.1670
(d) 3.1678

10 Estimate the length of the curve $y = f(x)$, $f(x) = \frac{1}{x},\ 1 \le x \le 2$, using $n = 4$ line segments.

(a) 1.1302
(b) 1.1280
(c) 1.1310
(d) 1.1321

11 Estimate the length of the curve $y = f(x)$, $f(x) = x^2 + 1,\ -2 \le x \le 2$, using $n = 4$ line segments.

(a) $2\sqrt{10} + 2\sqrt{2}$

(b) $\frac{8\sqrt{73}}{9} + \frac{4}{3}$

(c) $2\sqrt{10} + \sqrt{2}$

(d) $4\sqrt{5}$

12 Estimate the length of the curve $y = f(x)$, $f(x) = x^3 + 2,\ -1 \le x \le 1$, using $n = 4$ line segments.

(a) $\frac{\sqrt{65}+\sqrt{17}}{8}$

(b) $2\sqrt{2}$

(c) $\frac{20\sqrt{10}+2\sqrt{82}}{27}$

(d) $\frac{\sqrt{65}+\sqrt{17}}{4}$

7 Estimate the length of the curve $y = f(x)$, $f(x) = cosx,\ 0 \le x \le \frac{\pi}{2}$, using $n = 2$ line segments.

(a) 1.9101

(b) 1.9063

(c) 1.8950

(d) 1.9033

8 Estimate the length of the curve $y = f(x)$, $f(x) = sinx,\ 0 \le x \le \frac{\pi}{2}$, using $n = 3$ line segments.

(a) 1.9101

(b) 1.9033

(c) 1.9063

(d) 1.8950

9 Estimate the length of the curve $y = f(x)$, $f(x) = \sqrt{x+1},\ 0 \le x \le 3$, using $n = 2$ line segments.

(a) 3.1660

(b) 3.1678

(c) 3.1670

(d) 3.1673

10 Estimate the length of the curve $y = f(x)$, $f(x) = \frac{1}{x}$, $1 \le x \le 2$, using $n = 3$ line segments.

(a) 1.1321

(b) 1.1310

(c) 1.1302

(d) 1.1280

11 Estimate the length of the curve $y = f(x)$, $f(x) = x^2 + 1$, $-2 \le x \le 2$, using $n = 2$ line segments.

(a) $\frac{8\sqrt{73}}{9} + \frac{4}{3}$

(b) $4\sqrt{5}$

(c) $2\sqrt{10} + 2\sqrt{2}$

(d) $2\sqrt{5}$

12 Estimate the length of the curve $y = f(x)$, $f(x) = x^3 + 2$, $-1 \le x \le 1$, using $n = 3$ line segments.

(a) $\frac{20\sqrt{10}+2\sqrt{82}}{27}$

(b) $2\sqrt{2}$

(c) $\frac{\sqrt{65}+\sqrt{17}}{4}$

(d) $\frac{10\sqrt{10}+2\sqrt{82}}{27}$

Question 2 : Find a limit algebraically or graphically, if it exists

Bridge (English) p. 85 — Exercises 21–24

21 Find $\lim_{x\to 2} f(x)$, where $f(x) = \begin{cases} 2x, & x < 2 \\ x^2, & x \ge 2 \end{cases}$

(a) 2

(b) 8

(c) DNE

(d) 4

22 Find $\lim_{x\to -1} f(x)$, where $f(x) = \begin{cases} x^2 + 1, & x < -1 \\ 3x + 1, & x \ge -1 \end{cases}$

(a) DNE

(b) 0

(c) 2

(d) -2

23 Find $\lim_{x\to -1} f(x)$, where $f(x)=\begin{cases}2x+1, & x<-1\\ 3, & -1<x<1\\ 2x+1, & x>1\end{cases}$

(a) 1

(b) 3

(c) -1

(d) DNE

24 Find $\lim_{x\to 1} f(x)$, where $f(x)=\begin{cases}2x+1, & x<-1\\ 3, & -1<x<1\\ 2x+1, & x>1\end{cases}$

(a) DNE

(b) 3

(c) 2

(d) 1

Question 3 : Use the squeeze theorem to find limits

Bridge (English) p. 85 — Exercises 29–32

29 To prove that $\lim_{x\to 0} x^2 \sin\left(\frac{1}{x}\right)=0$ using the Squeeze Theorem, we choose functions $f(x)$ and $h(x)$ such that $f(x)\le x^2\sin\left(\frac{1}{x}\right)\le h(x)$. They are

(a) $f(x)=0,\ h(x)=x^2$

(b) $f(x)=-x^2,\ h(x)=x^2$

(c) $f(x)=-x,\ h(x)=x$

(d) $f(x)=-1,\ h(x)=1$

29 Use the Squeeze Theorem to find $\lim_{x\to 0} x^2 \sin\left(\frac{1}{x}\right)$

(a) DNE

(b) 1

(c) -1

(d) 0

30 The Squeeze Theorem cannot be used as in Exercise 29 to prove that $\lim_{x\to 0} x^2 sec\left(\frac{1}{x}\right) = 0$ because

(a) the limit of x^2 at 0 is not zero

(b) the function $sec\left(\frac{1}{x}\right)$ is periodic

(c) the function x^2 is not continuous at 0

(d) the function $sec\left(\frac{1}{x}\right)$ is unbounded near 0

31 To prove that $\lim_{x\to 0^+} \left[\sqrt{x}\cos^2\left(\frac{1}{x}\right)\right] = 0$ using the Squeeze Theorem, the appropriate inequality for all $x > 0$ is

(a) $0 \le \sqrt{x}\cos^2\left(\frac{1}{x}\right) \le x$

(b) $-\sqrt{x} \le \sqrt{x}\cos^2\left(\frac{1}{x}\right) \le 0$

(c) $0 \le \sqrt{x}\cos^2\left(\frac{1}{x}\right) \le \sqrt{x}$

(d) $-1 \le \sqrt{x}\cos^2\left(\frac{1}{x}\right) \le 1$

31 Use the Squeeze Theorem to find $\lim_{x\to 0^+} \left[\sqrt{x}\cos^2\left(\frac{1}{x}\right)\right]$

(a) 1

(b) 0

(c) DNE

(d) ∞

32 If $f(x)$ is bounded with $|f(x)| \le M$ for all x , then the inequality used with the Squeeze Theorem to prove that $\lim_{x\to 0} x^2 f(x) = 0$ is

(a) $-M \le x^2 f(x) \le M$

(b) $-x^2 \le x^2 f(x) \le M$

(c) $0 \le x^2 f(x) \le M$

(d) $-Mx^2 \le x^2 f(x) \le Mx^2$

Question 4 : Find limits for polynomials, rational, and trigonometric functions using theorems

Bridge (English) p. 85 — Exercises 7–16

7 Find $\lim_{x\to 2} \frac{x^2-x-2}{x^2-4}$

(a) $\frac{3}{4}$

(b) 1

(c) 0

(d) $-\frac{1}{4}$

8 Find $\lim_{x\to 1} \frac{x^3-1}{x^2+2x-3}$

(a) $\frac{1}{4}$

(b) 1

(c) 3

(d) $\frac{3}{4}$

9 Find $\lim_{x\to 0} \frac{sinx}{tanx}$

(a) DNE

(b) 0

(c) -1

(d) 1

10 Find $\lim_{x\to 0} \frac{tanx}{x}$

(a) 1

(b) 0

(c) DNE

(d) ∞

11 Find $\lim_{x\to 0} \frac{x\,e^{-2x+1}}{x^2+x}$

(a) e

(b) 1

(c) 0

(d) $\frac{1}{e}$

12 Find $\lim_{x\to 0} x^2 \csc^2 x$

(a) 1

(b) ∞

(c) -1

(d) 0

13 Find $\lim_{x\to 0} \frac{\sqrt{x+4}-2}{x}$

(a) $\frac{1}{4}$

(b) 2

(c) 0

(d) $\frac{1}{2}$

14 Find $\lim_{x\to 0} \frac{2x}{3-\sqrt{x+9}}$

(a) 0

(b) -12

(c) -6

(d) 12

15 Find $\lim_{x\to 1} \frac{x-1}{\sqrt{x}-1}$

(a) 2

(b) 1

(c) $\frac{1}{2}$

(d) 0

16 Find $\lim_{x\to 4} \frac{x^3-64}{x-4}$

(a) 64

(b) 12

(c) 48

(d) 16

Question 5 : Study the continuity of a function at a given point

Bridge (English) p. 95 — Exercises 21–28

21 The interval(s) on which $f(x) = \sqrt{x+3}$ is continuous:

(a) $(-\infty, \infty)$

(b) $(-\infty, -3]$

(c) $[-3, \infty)$

(d) $(-3, \infty)$

22 The interval(s) on which $f(x) = \sqrt{x^2-4}$ is continuous:

(a) $(-\infty, -2] \cup [2, \infty)$

(b) $[2, \infty)$

(c) $[-2, 2]$

(d) $(-\infty, -2) \cup (2, \infty)$

23 The interval(s) on which $f(x) = \sqrt[3]{x+2}$ is continuous:

(a) $(-\infty, \infty)$

(b) $(-\infty, -2) \cup (-2, \infty)$

(c) $(-2, \infty)$

(d) $[-2, \infty)$

24 The interval(s) on which $f(x) = (x-1)^{3/2}$ is continuous:

(a) $(1, \infty)$

(b) $[1, \infty)$

(c) $(-\infty, \infty)$

(d) $(-\infty, 1]$

25 The interval(s) on which $f(x) = sin^{-1}(x+2)$ is continuous:

(a) $[-3, -1]$

(b) $[-1, 1]$

(c) $[1, 3]$

(d) $(-3, -1)$

26 The interval(s) on which $f(x) = ln(sinx)$ is continuous:

(a) $(0, \infty)$

(b) $(2k\pi, (2k+1)\pi),\ k \in \mathbb{Z}$

(c) $(k\pi, (k+1)\pi),\ k \in \mathbb{Z}$

(d) $[2k\pi, (2k+1)\pi],\ k \in \mathbb{Z}$

27 The interval(s) on which $f(x)=\frac{\sqrt{x+1}+e^x}{x^2-2}$ is continuous:

(a) $(-1,\sqrt{2})\cup(\sqrt{2},\infty)$

(b) $[-1,\sqrt{2})\cup(\sqrt{2},\infty)$

(c) $[-1,\infty)$

(d) $(-\infty,-\sqrt{2})\cup(-\sqrt{2},\sqrt{2})\cup(\sqrt{2},\infty)$

28 The interval(s) on which $f(x)=\frac{ln(x^2-1)}{\sqrt{x^2-2x}}$ is continuous:

(a) $(-\infty,-1)\cup(1,\infty)$

(b) $(-\infty,-1)\cup(2,\infty)$

(c) $(-1,1)\cup(2,\infty)$

(d) $(-\infty,0)\cup(2,\infty)$

Question 6 : Use the continuity properties to study the continuity of a function or a composition of functions at a given point

Bridge (English) p. 89 — Example 4.2

1 The value of a that makes $g(x)=\begin{cases}\frac{x^2+2x-3}{x-1}, & x\neq 1\\ a, & x=1\end{cases}$ continuous at $x=1$ is

(a) 1

(b) 0

(c) 4

(d) 3

2 To extend $f(x)=\frac{x^2+x-2}{x+2}$ to a function that is continuous at $x=-2$, we define $f(-2)=$

(a) -3

(b) 3

(c) 1

(d) 0

3 To extend $f(x)=\frac{x^2-x-6}{x-3}$ to a function that is continuous at $x=3$, we define $f(3)=$

(a) 5

(b) 6

(c) 0

(d) -5

4 The value(s) of x at which $f(x) = \frac{x-1}{x^2-1}$ has a removable discontinuity:

(a) $x = 1$

(b) $x = 0$

(c) $x = 1,\ x = -1$

(d) $x = -1$

5 Which of the following functions has a removable discontinuity at $x = 0$?

(a) $f(x) = \frac{sinx}{x}$

(b) $f(x) = \frac{1}{x^2}$

(c) $f(x) = \frac{|x|}{x}$

(d) $f(x) = cos\left(\frac{1}{x}\right)$

6 The function $f(x) = \sqrt{4 - x^2}$ is continuous on the interval

(a) $(-2, 2)$

(b) $(-\infty, \infty)$

(c) $[-2, 2]$

(d) $(-\infty, 2]$

7 The function $f(x) = ln(x - 3)$ is continuous on the interval

(a) $(0, \infty)$

(b) $[3, \infty)$

(c) $(-\infty, \infty)$

(d) $(3, \infty)$

Question 7 : Find infinite limits and limits at infinity

Bridge (English) p. 106 — Exercises 9–14

9 Find $\lim_{x\to\infty} \frac{x^2+3x-2}{3x^2+4x-1}$

(a) 3

(b) 2

(c) $\frac{1}{3}$

(d) 0

10 Find $\lim_{x\to\infty} \frac{2x^2-x+1}{4x^2-3x-1}$

(a) 2

(b) -1

(c) $\frac{1}{2}$

(d) 0

11 Find $\lim_{x\to-\infty} \frac{-x}{\sqrt{4+x^2}}$

(a) 0

(b) $\frac{1}{2}$

(c) -1

(d) 1

12 Find $\lim_{x\to\infty} \frac{2x^2-1}{4x^3-5x-1}$

(a) 0

(b) $\frac{1}{2}$

(c) ∞

(d) 2

13 Find $\lim_{x\to\infty} ln\left(\frac{x^2+1}{x-3}\right)$

(a) $-\infty$

(b) 0

(c) ∞

(d) 1

14 Find $\lim_{x\to0^+} ln(xsinx)$

(a) 0

(b) $-\infty$

(c) ∞

(d) 1

Question 8 : Find the average and instantaneous velocity at a given point

Bridge (English) p. 141 — Exercises 19–22

19a The position (in feet) of an object after t seconds is $s(t) = 16t^2 + 10$. The average velocity between $t = 0$ and $t = 2$ is

(a) $32\ ft/s$
(b) $64\ ft/s$
(c) $16\ ft/s$
(d) $48\ ft/s$

19b The position (in feet) of an object after t seconds is $s(t) = 16t^2 + 10$. The average velocity between $t = 1$ and $t = 2$ is

(a) $24\ ft/s$
(b) $64\ ft/s$
(c) $48\ ft/s$
(d) $32\ ft/s$

19c The position (in feet) of an object after t seconds is $s(t) = 16t^2 + 10$. The average velocity between $t = 1.9$ and $t = 2$ is

(a) $62.4\ ft/s$
(b) $60.8\ ft/s$
(c) $64\ ft/s$
(d) $63.84\ ft/s$

19e The position (in feet) of an object after t seconds is $s(t) = 16t^2 + 10$. The instantaneous velocity at $t = 2$ is

(a) $32\ ft/s$
(b) $64\ ft/s$
(c) $62.4\ ft/s$
(d) $74\ ft/s$

20b The position (in feet) of an object after t seconds is $s(t) = 3t^3 + t$. The average velocity between $t = 1$ and $t = 2$ is

(a) $37\ ft/s$
(b) $13\ ft/s$
(c) $26\ ft/s$
(d) $22\ ft/s$

20e The position (in feet) of an object after t seconds is $s(t) = 3t^3 + t$. The instantaneous velocity at $t = 2$ is

(a) $37\ ft/s$
(b) $13\ ft/s$
(c) $22\ ft/s$
(d) $36\ ft/s$

21a The position (in feet) of an object after t seconds is $s(t) = \sqrt{t^2 + 8t}$. The average velocity between $t = 0$ and $t = 2$ is

(a) $2\sqrt{5}\ ft/s$
(b) $\frac{\sqrt{5}}{4}\ ft/s$
(c) $\sqrt{5}\ ft/s$
(d) $\frac{3}{\sqrt{5}}\ ft/s$

21e The position (in feet) of an object after t seconds is $s(t) = \sqrt{t^2 + 8t}$. The instantaneous velocity at $t = 2$ is

(a) $\frac{6}{\sqrt{5}}\ ft/s$
(b) $\sqrt{5}\ ft/s$
(c) $\frac{1}{2\sqrt{5}}\ ft/s$
(d) $\frac{3}{\sqrt{5}}\ ft/s$

22a The position (in feet) of an object after t seconds is $s(t) = 3sin(t - 2)$. The average velocity between $t = 0$ and $t = 2$ is

(a) $0\ ft/s$
(b) $\frac{3}{2}sin2\ ft/s$
(c) $-\frac{3}{2}sin2\ ft/s$
(d) $3sin2\ ft/s$

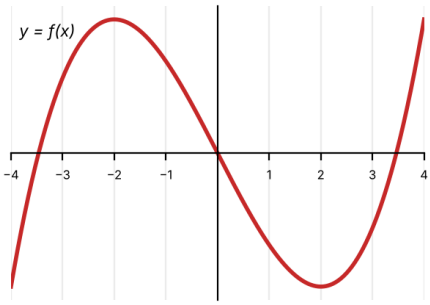
22e The position (in feet) of an object after t seconds is $s(t) = 3sin(t - 2)$. The instantaneous velocity at $t = 2$ is

(a) $-3\ ft/s$
(b) $1\ ft/s$
(c) $0\ ft/s$
(d) $3\ ft/s$

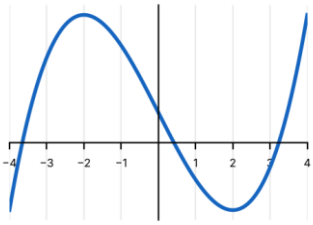
Question 9 : Sketch the graph of a function using that of its derivative

Bridge (English) p. 147 — Example 2.5

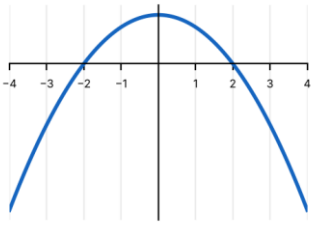
1 **The graph shows $y = f(x)$. Which of the following is the graph of the derivative $y = f'(x)$?**



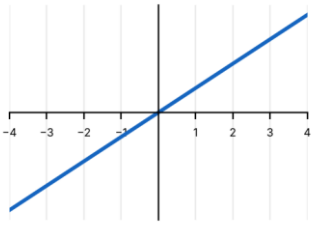
a



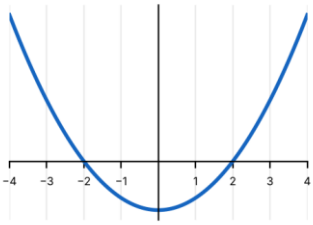
b



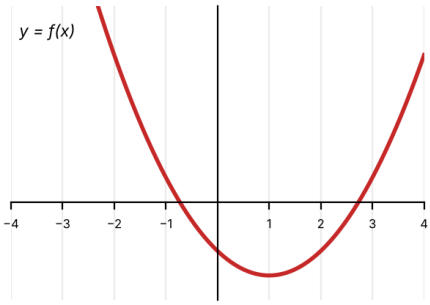
c



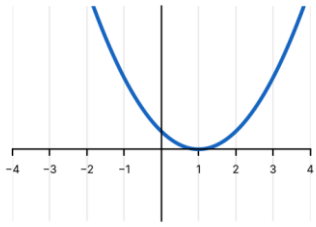
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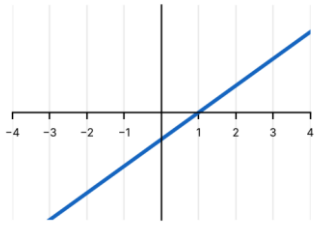
2 **The graph shows $y = f(x)$. Which of the following is the graph of the derivative $y = f'(x)$?**



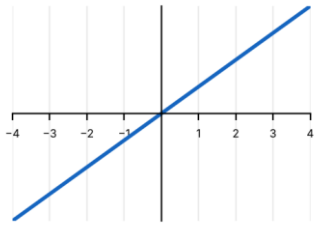
(a)



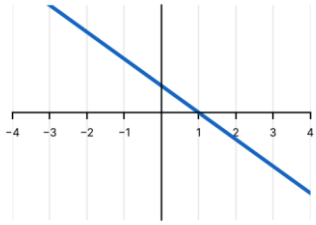
(b)



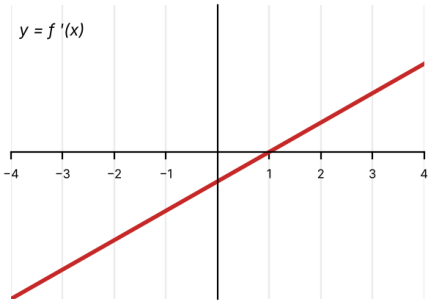
(c)



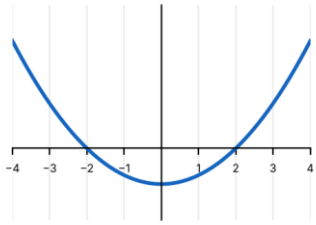
(d)



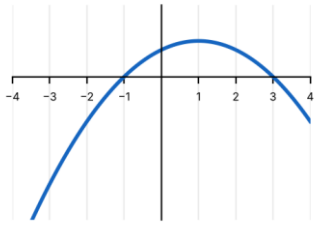
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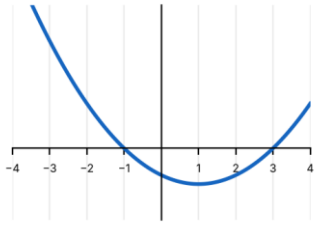
(a)



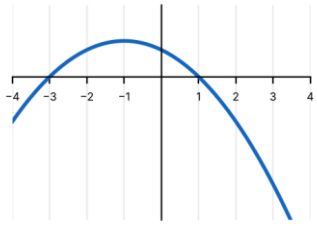
(b)



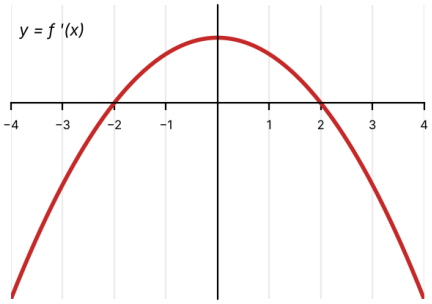
(c)



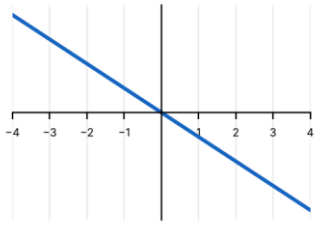
(d)



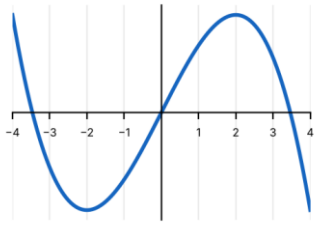
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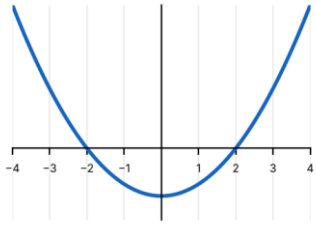
(a)



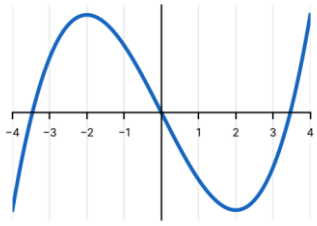
(b)



(c)



(d)



5 If $f'(x) > 0$ for $x < -2$, $f'(x) < 0$ for $-2 < x < 2$ and $f'(x) > 0$ for $x > 2$, then the graph of f is

(a) decreasing, then increasing, then decreasing

(b) always increasing

(c) increasing, then decreasing, then increasing

(d) always decreasing

Question 10 : Find the derivative of a function at a given point

Bridge (English) p. 152 — Exercises 29–30

29a The x-value(s) at which $f(x) = |x| + |x-2|$ is not differentiable:

(a) $x = 0$

(b) $x = 0,\ x = 2$

(c) $x = 1$

(d) $x = 2$

29b The x-value(s) at which $f(x) = |x^2 - 4x|$ is not differentiable:

(a) $x = 0,\ x = 2,\ x = 4$

(b) $x = 2$

(c) $x = 4$

(d) $x = 0,\ x = 4$

30a The x-value(s) at which $g(x) = e^{-2/x}$ is not differentiable:

(a) $x = 2$

(b) $x = -2$

(c) $x = \pm 2$

(d) $x = 0$

30b The x-value(s) at which $g(x) = e^{-2/(x^3 - x)}$ is not differentiable:

(a) $x = 0$

(b) $x = \pm 1$

(c) $x = 0,\ x = \pm 1$

(d) $x = \pm 2$

Question 11 : Find the derivative of a function using the Power Rule at a given point

Bridge (English) p. 160 — Exercises 7–14

7 If $h(x) = \frac{10}{\sqrt[3]{x}} - 2x + \pi$, then $h'(1) =$

(a) $-\frac{16}{3}$

(b) $\frac{4}{3}$

(c) $-\frac{10}{3}$

(d) $-\frac{16}{3} + \pi$

8 If $h(x) = 12x - x^2 - \frac{3}{\sqrt{x^2}},\ x > 0$, then $h'(1) =$

(a) 7

(b) 11

(c) 13

(d) 10

9 If $f(s) = 2s^{3/2} - 3s^{-1/3}$, then $f'(1) =$

(a) 2

(b) 4

(c) 3

(d) 6

10 If $f(t) = 3t^{\pi} - 2t^{1.3}$, then $f'(1) =$

(a) $\pi - 2.6$

(b) $3\pi - 2.6$

(c) $3\pi - 1.3$

(d) $3\pi + 2.6$

11 If $f(x) = \frac{3x^2 - 3x + 1}{2x}$, then $f'(1) =$

(a) $\frac{1}{2}$

(b) 2

(c) 1

(d) $\frac{3}{2}$

12 If $f(x)=\frac{4x^2-x+3}{\sqrt{x}}$, then $f'(1)=$

(a) 4

(b) 6

(c) 5

(d) 7

13 If $f(x)=x\left(3x^2-\sqrt{x}\right)$, then $f'(1)=$

(a) $\frac{15}{2}$

(b) $\frac{3}{2}$

(c) $\frac{17}{2}$

(d) 8

14 If $f(x)=(x+1)(3x^2-4)$, then $f'(1)=$

(a) 6

(b) 9

(c) 11

(d) 15

Question 12 : Applying the rules of multiplication and division to derivatives

Bridge (English) p. 169 — Exercises 21–24

21a If f and g are differentiable functions with $f(0)=-1,\ f'(0)=-1,\ g(0)=3,\ g'(0)=-1$, then an equation of the tangent line to the graph of $h(x)=f(x)\,g(x)$ at $x=0$ is

(a) $y=-4x-3$

(b) $y=-2x-3$

(c) $y=x-3$

(d) $y=-2x+3$

21b If f and g are differentiable functions with $f(1)=-2,\ f'(1)=3,\ g(1)=1,\ g'(1)=-2$, then an equation of the tangent line to the graph of $h(x)=f(x)\,g(x)$ at $x=1$ is

(a) $y=-6x+4$

(b) $y=-x-1$

(c) $y=7x-2$

(d) $y=7x-9$

22a If f and g are differentiable functions with $f(1) = -2,\ f'(1) = 3,\ g(1) = 1,\ g'(1) = -2$, then an equation of the tangent line to the graph of $h(x) = \frac{f(x)}{g(x)}$ at $x = 1$ is

(a) $y = x - 3$
(b) $y = -3x + 1$
(c) $y = 7x - 9$
(d) $y = -x - 1$

22b If f and g are differentiable functions with $f(0) = -1,\ f'(0) = -1,\ g(0) = 3,\ g'(0) = -1$, then an equation of the tangent line to the graph of $h(x) = \frac{f(x)}{g(x)}$ at $x = 0$ is

(a) $y = -\frac{4}{3}x - \frac{1}{3}$
(b) $y = -\frac{4}{9}x - \frac{1}{3}$
(c) $y = -\frac{2}{9}x - \frac{1}{3}$
(d) $y = \frac{4}{9}x - \frac{1}{3}$

23a If f and g are differentiable functions with $f(1) = -2,\ f'(1) = 3,\ g(1) = 1,\ g'(1) = -2$, then an equation of the tangent line to the graph of $h(x) = x^2 f(x)$ at $x = 1$ is

(a) $y = -4x + 2$
(b) $y = -x - 1$
(c) $y = 3x - 5$
(d) $y = -x + 1$

23b If f and g are differentiable functions with $f(0) = -1,\ f'(0) = -1,\ g(0) = 3,\ g'(0) = -1$, then an equation of the tangent line to the graph of $h(x) = x^2 f(x)$ at $x = 0$ is

(a) $y = -x$
(b) $y = 0$
(c) $y = -2x$
(d) $y = -1$

24a If f and g are differentiable functions with $f(1) = -2,\ f'(1) = 3,\ g(1) = 1,\ g'(1) = -2$, then an equation of the tangent line to the graph of $h(x) = \frac{x^2}{g(x)}$ at $x = 1$ is

(a) $y = 4x - 3$
(b) $y = 2x - 1$
(c) $y = -4x + 5$
(d) $y = 1$

24b If f and g are differentiable functions with $f(0) = -1,\ f'(0) = -1,\ g(0) = 3,\ g'(0) = -1$, then an equation of the tangent line to the graph of $h(x) = \frac{x^2}{g(x)}$ at $x = 0$ is

(a) $y = \frac{x}{3}$

(b) $y = -\frac{x}{9}$

(c) $y = 0$

(d) $y = \frac{1}{3}$

Question 13 : Apply the chain rule for differentiation

Bridge (English) p. 177 — Exercises 31–36

31 If $h(x) = f(g(x))$, where $f(1) = 3,\ g(1) = 2,\ f'(1) = 4,\ f'(2) = 3,\ g'(1) = -2,\ g'(3) = 5$, then $h'(1) =$

(a) -6

(b) 3

(c) -8

(d) 15

32 If $h(x) = f(g(x))$, where $f(2) = 1,\ g(2) = 3,\ f'(2) = -1,\ f'(3) = -3,\ g'(1) = 2,\ g'(2) = 4$, then $h'(2) =$

(a) -6

(b) -12

(c) -4

(d) 12

35a If f is a differentiable function, then the derivative of $f(x^2)$ is

(a) $f'(x^2)$

(b) $2x\,f'(x^2)$

(c) $f'(2x)$

(d) $2x\,f'(x)$

35b If f is a differentiable function, then the derivative of $[f(x)]^2$ is

(a) $2f'(x)$

(b) $2f(x)\,f'(x)$

(c) $2f(x)$

(d) $[f'(x)]^2$

35c If f is a differentiable function, then the derivative of $f\big(f(x)\big)$ is

(a) $f'\big(f(x)\big)\,f'(x)$

(b) $f'\big(f'(x)\big)$

(c) $[f'(x)]^2$

(d) $f\big(f'(x)\big)\,f'(x)$

36a If f is a differentiable function, then the derivative of $f\big(\sqrt{x}\big)$ is

(a) $\frac{f\prime(\sqrt{x})}{2\sqrt{x}}$

(b) $\sqrt{f'(x)}$

(c) $f'\big(\sqrt{x}\big)$

(d) $\frac{f\prime(x)}{2\sqrt{x}}$

36b If f is a differentiable function, then the derivative of $\sqrt{f(x)}$ is

(a) $\frac{f\prime(x)}{2\sqrt{f(x)}}$

(b) $\frac{1}{2\sqrt{f(x)}}$

(c) $2\sqrt{f(x)}\,f'(x)$

(d) $\frac{f\prime(x)}{2\sqrt{x}}$

36c If f is a differentiable function, then the derivative of $f\big(x\,f(x)\big)$ is

(a) $f'\big(xf(x)\big)\,f'(x)$

(b) $f'\big(xf(x)\big)\,[f(x)+xf'(x)]$

(c) $f'(x)\,[f(x)+xf'(x)]$

(d) $f'\big(xf(x)\big)\,[1+f'(x)]$

Question 14 : Find the derivative of an inverse function using the Chain Rule

Bridge (English) p. 176 — Exercises 17–22

17 The function $f(x)=x^3+4x-1$ has an inverse g . Find $g'(-1)$

(a) 4

(b) $\frac{1}{7}$

(c) $-\frac{1}{4}$

(d) $\frac{1}{4}$

18 The function $f(x) = x^5 + 4x - 2$ has an inverse g . Find $g'(-2)$

(a) $-\frac{1}{2}$

(b) $\frac{1}{84}$

(c) 4

(d) $\frac{1}{4}$

19 The function $f(x) = x^5 + 3x^3 + x$ has an inverse g . Find $g'(5)$

(a) 15

(b) $\frac{1}{5}$

(c) $\frac{1}{3351}$

(d) $\frac{1}{15}$

20 The function $f(x) = x^3 + 2x + 1$ has an inverse g . Find $g'(-2)$

(a) $\frac{1}{14}$

(b) $\frac{1}{5}$

(c) 5

(d) $-\frac{1}{5}$

21 The function $f(x) = \sqrt{x^3 + 2x + 4}$ has an inverse g . Find $g'(2)$

(a) $\frac{1}{2}$

(b) 4

(c) $\frac{1}{4}$

(d) 2

22 The function $f(x) = \sqrt{x^5 + 4x^3 + 3x + 1}$ has an inverse g . Find $g'(3)$

(a) $\frac{3}{10}$

(b) $\frac{10}{3}$

(c) $\frac{3}{20}$

(d) $\frac{1}{3}$

Question 15 : Find the derivatives of trigonometric functions using differentiation rules

Bridge (English) p. 184 — Exercises 9–18

9 If $f(t) = sin3t\,sec3t$, then $f'(t) =$

(a) $3sec^2 3t$

(b) $3cos3t\,sec3ttan3t$

(c) $sec^2 3t$

(d) $-3csc^2 3t$

10 If $f(t) = \sqrt{cos5t\,sec5t}$, then $f'(t) =$

(a) $-5sin5t\,sec5t$

(b) 5

(c) 0

(d) $\frac{5}{2}$

11 If $f(w) = \frac{1}{sin4w}$, then $f'(w) =$

(a) $-4csc4wcot4w$

(b) $-csc4wcot4w$

(c) $4csc4wcot4w$

(d) $-\frac{1}{4cos4w}$

12 If $f(w) = w^2 sec^2 3w$, then $f'(w) =$

(a) $2wsec^2 3w + 6w^2 sec^2 3wtan3w$

(b) $2wsec^2 3w + 2w^2 sec^2 3wtan3w$

(c) $6wsec^2 3wtan3w$

(d) $2wsec^2 3w + 6w^2 sec3wtan3w$

13 If $f(x) = 2sin2xcos2x$, then $f'(x) =$

(a) $2cos4x$

(b) $4cos2x$

(c) $-4sin4x$

(d) $4cos4x$

14 If $f(x) = 4sin^2 3x + 4cos^2 3x$, then $f'(x) =$

(a) 4

(b) 0

(c) $48sin3xcos3x$

(d) $24sin3xcos3x$

15 If $f(x) = tan\sqrt{x^2+1}$, then $f'(x) =$

(a) $sec^2\sqrt{x^2+1}$

(b) $\frac{x\,sec^2\sqrt{x^2+1}}{\sqrt{x^2+1}}$

(c) $2x\,sec^2\sqrt{x^2+1}$

(d) $\frac{sec^2\sqrt{x^2+1}}{2\sqrt{x^2+1}}$

16 If $f(x) = 4x^2 sinx\,sec3x$, then $f'(x) =$

(a) $8xsinxsec3x + 4x^2 cosxsec3x + 4x^2 sinxsec3xtan3x$

(b) $8xsinxsec3x - 4x^2 cosxsec3x + 12x^2 sinxsec3xtan3x$

(c) $8xsinxsec3x + 4x^2 cosxsec3x + 12x^2 sinxsec3xtan3x$

(d) $8xcosx\,sec3xtan3x$

17 If $f(x) = sin^3\left(cos\sqrt{x^3+2x^2}\right)$, then $f'(x) =$

(a) $3sin^2\left(cos\sqrt{x^3+2x^2}\right)cos\left(cos\sqrt{x^3+2x^2}\right)sin\sqrt{x^3+2x^2}\cdot\frac{3x^2+4x}{2\sqrt{x^3+2x^2}}$

(b) $3sin^2\left(cos\sqrt{x^3+2x^2}\right)\cdot\frac{3x^2+4x}{2\sqrt{x^3+2x^2}}$

(c) $-3sin^2\left(cos\sqrt{x^3+2x^2}\right)cos\left(cos\sqrt{x^3+2x^2}\right)sin\sqrt{x^3+2x^2}$

(d) $-3sin^2\left(cos\sqrt{x^3+2x^2}\right)cos\left(cos\sqrt{x^3+2x^2}\right)sin\sqrt{x^3+2x^2}\cdot\frac{3x^2+4x}{2\sqrt{x^3+2x^2}}$

18 If $f(x) = tan^4\left(sin^2(x^3+2x)\right)$, then $f'(x) =$

(a) $4tan^3\left(sin^2(x^3+2x)\right)sec^2\left(sin^2(x^3+2x)\right)cos^2(x^3+2x)(3x^2+2)$

(b) $8tan^3\left(sin^2(x^3+2x)\right)sec^2\left(sin^2(x^3+2x)\right)sin(x^3+2x)cos(x^3+2x)$

(c) $8tan^3\left(sin^2(x^3+2x)\right)sec^2\left(sin^2(x^3+2x)\right)sin(x^3+2x)cos(x^3+2x)(3x^2+2)$

(d) $4tan^3\left(sin^2(x^3+2x)\right)sec^2\left(sin^2(x^3+2x)\right)$

Question 16 : Find the derivatives of exponential functions

Bridge (English) p. 194 — Exercises 29–30

29a The value(s) of x at which the tangent line to the graph of $f(x) = x\,e^{-2x}$ is horizontal:

(a) $x = 2$

(b) $x = \frac{1}{2}$

(c) $x = -\frac{1}{2}$

(d) $x = 0$

29b The value(s) of x at which the tangent line to the graph of $f(x) = x\,e^{-3x}$ is horizontal:

(a) $x = 3$

(b) $x = \frac{1}{3}$

(c) $x = -\frac{1}{3}$

(d) $x = 0$

30a The value(s) of x at which the tangent line to the graph of $f(x) = x^2 e^{-2x}$ is horizontal:

(a) $x = 1$

(b) $x = 0,\ x = 1$

(c) $x = 0,\ x = 2$

(d) $x = 0,\ x = -1$

30b The value(s) of x at which the tangent line to the graph of $f(x) = x^2 e^{-3x}$ is horizontal:

(a) $x = \frac{2}{3}$

(b) $x = 0,\ x = \frac{2}{3}$

(c) $x = 0,\ x = \frac{3}{2}$

(d) $x = 0,\ x = -\frac{2}{3}$

Question 17 : Find the derivatives of natural logarithmic functions

Bridge (English) p. 193 — Exercises 20–22

20a If $f(x)=\frac{\sqrt{lnx}}{x}$, then $f'(x)=$

(a) $\frac{1}{2x\sqrt{lnx}}$

(b) $\frac{1+2lnx}{2x^2\sqrt{lnx}}$

(c) $\frac{1-2lnx}{2x^2\sqrt{lnx}}$

(d) $\frac{1-2lnx}{2x\sqrt{lnx}}$

20b If $g(t)=\frac{ln\sqrt{t}}{t}$, then $g'(t)=$

(a) $\frac{1-lnt}{t^2}$

(b) $\frac{1-lnt}{2t^2}$

(c) $\frac{1+lnt}{2t^2}$

(d) $\frac{1}{2t^2}$

21a If $h(x)=e^x lnx$, then $h'(x)=$

(a) $\frac{e^x}{x}$

(b) $e^x lnx+\frac{e^x}{x}$

(c) $e^x lnx$

(d) $e^x\left(lnx-\frac{1}{x}\right)$

21b If $f(x)=e^{lnx}$, then $f'(x)=$

(a) $\frac{1}{x}$

(b) x

(c) 1

(d) e^x

22a If $h(x)=2^{e^x}$, then $h'(x)=$

(a) $e^x\,2^{e^x-1}$

(b) $2^{e^x}ln2$

(c) $2^{e^x}\,e^x$

(d) $2^{e^x}\,e^x ln2$

22b If $f(x)=\frac{e^x}{2^x}$, then $f'(x)=$

(a) $\frac{(1+ln2)\,e^x}{2^x}$

(b) $\frac{(1-ln2)\,e^x}{2^x}$

(c) $\frac{e^x}{2^x ln2}$

(d) $\frac{e^x}{2^x}$

Question 18 : Find derivatives implicitly

Bridge (English) p. 198 — Example 8.2

1 Use implicit differentiation to find $y'(x)$ for the curve $x^2y^2-2x=4-4y$

(a) $\frac{2-2xy^2}{2x^2y+4}$

(b) $\frac{2-2xy^2}{2x^2y}$

(c) $\frac{2+2xy^2}{2x^2y-4}$

(d) $\frac{2xy^2-2}{2x^2y+4}$

2 The slope of the tangent line to the curve $x^2y^2-2x=4-4y$ at the point $(2,-2)$ is

(a) $\frac{7}{6}$

(b) $\frac{6}{7}$

(c) $-\frac{7}{6}$

(d) -4

3 The slope of the tangent line to the curve $x^2-4y^3=0$ at the point $(2,1)$ is

(a) 3

(b) $\frac{1}{12}$

(c) $\frac{1}{3}$

(d) $-\frac{1}{3}$

4 The slope of the tangent line to the curve $x^2y^2=4x$ at the point $(1,2)$ is

(a) 0

(b) -2

(c) -1

(d) 1

5 The slope of the tangent line to the curve $x^2y^2 = 3y + 1$ at the point $(2, 1)$ is

(a) -1

(b) $-\frac{4}{11}$

(c) $-\frac{4}{5}$

(d) $\frac{4}{5}$

6 If $y = sin^{-1}x$, then $siny = x$. Using implicit differentiation, $y' =$

(a) $\frac{1}{\sqrt{1-x^2}}$

(b) $\frac{-1}{\sqrt{1-x^2}}$

(c) $\frac{1}{1+x^2}$

(d) $\frac{1}{cosx}$

Question 19 : Use implicit differentiation to find derivatives of inverse trigonometric functions

Bridge (English) p. 204 — Exercises 29–32

29a If $f(x) = sin^{-1}(x^3 + 1)$, then $f'(x) =$

(a) $\frac{3x^2}{\sqrt{1-(x^3+1)^2}}$

(b) $\frac{1}{\sqrt{1-(x^3+1)^2}}$

(c) $\frac{3x^2}{1+(x^3+1)^2}$

(d) $\frac{-3x^2}{\sqrt{1-(x^3+1)^2}}$

29b If $f(x) = sin^{-1}(\sqrt{x})$, then $f'(x) =$

(a) $\frac{1}{\sqrt{1-x}}$

(b) $\frac{1}{2\sqrt{1-x}}$

(c) $\frac{1}{2\sqrt{x}\sqrt{1-x}}$

(d) $\frac{1}{2\sqrt{x}(1+x)}$

30a If $f(x) = cos^{-1}(x^2 + x)$, then $f'(x) =$

(a) $\frac{2x+1}{\sqrt{1-(x^2+x)^2}}$

(b) $\frac{-(2x+1)}{\sqrt{1-(x^2+x)^2}}$

(c) $\frac{-1}{\sqrt{1-(x^2+x)^2}}$

(d) $\frac{-(2x+1)}{1+(x^2+x)^2}$

30b If $f(x) = cos^{-1}\left(\frac{2}{x}\right)$, then $f'(x) =$

(a) $\frac{-2}{x^2\sqrt{1-\frac{4}{x^2}}}$

(b) $\frac{2}{x^2\left(1+\frac{4}{x^2}\right)}$

(c) $\frac{-1}{\sqrt{1-\frac{4}{x^2}}}$

(d) $\frac{2}{x^2\sqrt{1-\frac{4}{x^2}}}$

31a If $f(x) = tan^{-1}\left(\sqrt{x}\right)$, then $f'(x) =$

(a) $\frac{1}{1+x}$

(b) $\frac{1}{2\sqrt{x}(1+x)}$

(c) $\frac{1}{2\sqrt{x}(1+x^2)}$

(d) $\frac{1}{2\sqrt{1+x}}$

31b If $f(x) = tan^{-1}\left(\frac{1}{x}\right)$, then $f'(x) =$

(a) $-\frac{1}{x^2}$

(b) $\frac{x^2}{1+x^2}$

(c) $\frac{1}{1+x^2}$

(d) $\frac{-1}{1+x^2}$

32a If $f(x) = \sqrt{2 + tan^{-1}x}$, then $f'(x) =$

(a) $\frac{1+x^2}{2\sqrt{2+tan^{-1}x}}$

(b) $\frac{1}{2\sqrt{2+tan^{-1}x}}$

(c) $\frac{1}{2(1+x^2)\sqrt{2+tan^{-1}x}}$

(d) $\frac{1}{(1+x^2)\sqrt{2+tan^{-1}x}}$

32b If $f(x) = e^{tan^{-1}x}$, then $f'(x) =$

(a) $(1 + x^2)\, e^{tan^{-1}x}$

(b) $tan^{-1}x\ e^{tan^{-1}x-1}$

(c) $\frac{e^{tan^{-1}x}}{1+x^2}$

(d) $e^{tan^{-1}x}$

Question 20 : Recall the hypotheses of Rolle's Theorem

Bridge (English) p. 213 — Rolle's Theorem 10.1

1 Which of the following is NOT a hypothesis of Rolle's Theorem for f on $[a, b]$?

(a) the function is continuous on the closed interval

(b) $f'(a) = f'(b) = 0$

(c) $f(a) = f(b)$

(d) the function is differentiable on the open interval

2 Which function satisfies the hypotheses of Rolle's Theorem on the given interval?

(a) $f(x) = \frac{1}{x^2},\ [-1, 1]$

(b) $f(x) = x^2 + 1,\ [-2, 2]$

(c) $f(x) = x^2 + 1,\ [0, 2]$

(d) $f(x) = |x|,\ [-1, 1]$

3 The function $f(x) = x^{2/3}$ on $[-1, 1]$ does not satisfy Rolle's Theorem because

(a) the function satisfies all the hypotheses

(b) $f(-1) \neq f(1)$

(c) the function is not continuous on the interval

(d) the function is not differentiable at x = 0

4 The function $f(x) = x^2 - 4x + 3$ satisfies the hypotheses of Rolle's Theorem on $[1, 3]$. The value of c that satisfies the theorem is

(a) $c = 0$
(b) $c = 3$
(c) $c = 1$
(d) $c = 2$

5 The function $f(x) = sinx$ satisfies the hypotheses of Rolle's Theorem on $[0, \pi]$. The value of c that satisfies the theorem is

(a) $c = \frac{\pi}{2}$
(b) $c = 0$
(c) $c = \pi$
(d) $c = \frac{\pi}{4}$

6 The function $f(x) = x^3 - x$ satisfies the hypotheses of Rolle's Theorem on $[-1, 1]$. The values of c that satisfy the theorem are

(a) $c = \pm\frac{1}{\sqrt{3}}$
(b) $c = \pm\sqrt{3}$
(c) $c = 0$
(d) $c = \pm 1$

Part 2 : Free-Response Questions (21 – 26)

Question 21 : a) Determine the continuity of a function at a given point b) Use the continuity properties to study the continuity of a function or a composition of functions at a given point

Bridge (English) p. 88 — Definition 4.1 , p. 95 — Exercises 29–32

a) Investigating the continuity of a function at a given point (Definition 4.1)

1 **Explain why $f(x) = \frac{x}{x-1}$ is not continuous at $x = 1$, stating which of the three conditions of Definition 4.1 is not satisfied.**

2 **Explain why $f(x) = \frac{x^2-1}{x-1}$ is not continuous at $x = 1$, stating which of the three conditions of Definition 4.1 is not satisfied.**

3 Explain why $f(x) = sin\frac{1}{x}$ is not continuous at $x = 0$, stating which of the three conditions of Definition 4.1 is not satisfied.

4 Explain why $f(x) = \frac{e^{x-1}}{e^{x}-1}$ is not continuous at $x = 0$, stating which of the three conditions of Definition 4.1 is not satisfied.

5 Explain why $f(x) = \begin{cases} x^2, & x < 2 \\ 3, & x = 2 \\ 3x - 2, & x > 2 \end{cases}$ is not continuous at $x = 2$, stating which of the three conditions of Definition 4.1 is not satisfied.

6 Explain why $f(x) = \begin{cases} x^2, & x < 2 \\ 3x - 2, & x > 2 \end{cases}$ is not continuous at $x = 2$, stating which of the three conditions of Definition 4.1 is not satisfied.

b) Using the properties of continuity (Exercises 29–32, p. 95)

29 Suppose that a state's income tax code states that the tax liability on x dirhams of taxable income is given by $T(x) = \begin{cases} 0, & x \leq 0 \\ 0.14x, & 0 < x < 10,000 \\ c + 0.21x, & 10,000 \leq x \end{cases}$. Determine the constant c that makes this function continuous for all x. Give a rationale why such a function should be continuous.

30 Suppose a tax code indicates that the tax liability is 12% of the first AED 20,000 of taxable earnings and 16% of the rest. Find the values of the constants a and b for the tax function

$$T(x) = \begin{cases} 0, & x \le 0 \\ a + 0.12x, & 0 < x \le 20,000 \\ b + 0.16(x - 20,000), & x > 20,000 \end{cases}$$ such that $T(x)$ is continuous for all x.

31 In Example 4.8 (federal tax rate schedule): $T(x) = 0.30x - 5685$ for $67,700 < x \le 141,250$, $T(x) = 0.35x - b$ for $141,250 < x \le 307,050$, and $T(x) = 0.386x - c$ for $x > 307,050$. Find b and c so that the function is continuous.

32 In Example 4.8, $T(x) = \begin{cases} 0.10x, & 0 < x \le 6000 \\ 0.15x - 300, & 6000 < x \le 27,950 \end{cases}$. Show that $T(x)$ is continuous at $x = 6000$.

Question 22 : Find horizontal, vertical, and slant asymptotes using limits

Bridge (English) p. 106 — Exercises 29–32

29 Find all vertical and slant asymptotes of $y = \frac{x^3}{4-x^2}$

30 **Find all vertical and slant asymptotes of $y = \frac{x^2+1}{x-2}$**

31 **Find all vertical and slant asymptotes of $y = \frac{x^3}{x^2+x-4}$**

32 **Find all vertical and slant asymptotes of $y = \frac{x^4}{x^3+2}$**

Question 23 : Apply the Product Rule on derivatives

Bridge (English) p. 169 — Exercises 17–20

17 **Find an equation of the tangent line to the graph of $f(x) = (x^2 + 2x)(x^4 + x^2 + 1)$ at $x = 0$**

18 Find an equation of the tangent line to the graph of $f(x) = (x^3 + x + 1)(3x^2 + 2x - 1)$ at $x = 1$

19 Find an equation of the tangent line to the graph of $f(x) = \frac{x+1}{x+2}$ at $x = 0$

20 Find an equation of the tangent line to the graph of $f(x) = \frac{x+3}{x^2+1}$ at $x = 1$

Question 24 : Find the derivatives of trigonometric functions using differentiation rules

Bridge (English) p. 184 — Exercises 3–8

3 Find the derivative of $f(t) = tan^3 2t - csc^4 3t$

4 Find the derivative of $f(t) = t^2 + 2cos^2 4t$

5 **Find the derivative of $f(x) = xcos5x^2$**

6 **Find the derivative of $f(x) = x^2sec4x$**

7 **Find the derivative of $f(x) = \frac{sinx^2}{x^2}$**

8 **Find the derivative of $f(x) = \frac{x^2}{csc^4 2x}$**

Question 25 : Solve real-life problems using derivatives of exponential and logarithmic functions

Bridge (English) p. 194 — Exercises 35–38

35 **A bacterial population starts at 200 and triples every day. Find a formula for the population after t days and find the percentage rate of change in the population.**

36 **A bacterial population starts at 500 and doubles every four days. Find a formula for the population after t days and find the percentage rate of change in the population.**

37 **The concentration of a certain chemical after t seconds of an autocatalytic reaction is given by $c(t) = \frac{6}{2e^{-8t}+1}$. Show that $c'(t) > 0$ and use this information to determine that the concentration of the chemical never exceeds 6.**

38 The concentration of a certain chemical after t seconds of an autocatalytic reaction is given by $c(t) = \frac{10}{9e^{-10t}+2}$. Show that $c'(t) > 0$ and use this information to determine that the concentration of the chemical never exceeds 5.

Question 26 : Understand the Mean Value Theorem and use it in applications

Bridge (English) p. 219 — Exercises 1–6

1 Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = x^2 + 1$ on $[-2, 2]$, and find a value of c that makes the conclusion of the appropriate theorem true.

2 **Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = x^2 + 1$ on $[0, 2]$, and find a value of c that makes the conclusion of the appropriate theorem true.**

3 **Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = x^3 + x^2$ on $[0, 1]$, and find a value of c that makes the conclusion of the appropriate theorem true.**

4 **Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = x^3 + x^2$ on $[-1, 1]$, and find a value of c that makes the conclusion of the appropriate theorem true.**

5 **Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = sinx$ on $\left[0, \frac{\pi}{2}\right]$, and find a value of c that makes the conclusion of the appropriate theorem true.**

6 **Check the hypotheses of Rolle's Theorem and the Mean Value Theorem for $f(x) = sinx$ on $[-\pi, 0]$, and find a value of c that makes the conclusion of the appropriate theorem true.**

Important Extra Questions

New-idea questions not covered by the structure questions above – strongly recommended

A) Multiple-Choice Questions

Related to Question 1 : Estimate an arc length of a given function

1 When estimating the arc length of a curve on an interval using line segments, the estimate gets closer to the actual length as

(a) the number of line segments increases

(b) we use a single line segment

(c) the length of the interval increases

(d) the number of line segments decreases

2 The actual arc length of the line $y = 2x + 1$ on $[0, 3]$ is

(a) $3\sqrt{5}$

(b) $\sqrt{45} + 1$

(c) $3\sqrt{3}$

(d) 6

Related to Question 2 : Find a limit algebraically or graphically, if it exists

1 Find the value of the constant k for which $\lim\limits_{x\to 1} f(x)$ exists, where $f(x) = \begin{cases} x^2 + k, & x < 1 \\ 3x, & x \geq 1 \end{cases}$

(a) -2

(b) 3

(c) 2

(d) 1

2 If $\lim\limits_{x\to 3^-} f(x) = 5$, $\lim\limits_{x\to 3^+} f(x) = 5$ and $f(3) = 2$, then $\lim\limits_{x\to 3} f(x)$ equals

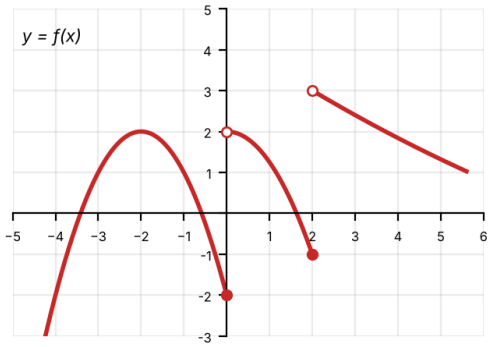
(a) 7

(b) 2

(c) 5

(d) DNE

Use the graph of $y = f(x)$ shown to find each limit (if it exists):



3 $\lim_{x \to -2} f(x) =$

(a) 3

(b) DNE

(c) 2

(d) -1

4 $\lim_{x \to 2^-} f(x) =$

(a) 2

(b) DNE

(c) -1

(d) 3

5 $\lim_{x \to 2^+} f(x) =$

(a) 2

(b) DNE

(c) 3

(d) -1

6 $\lim_{x \to 2} f(x) =$

(a) 2

(b) DNE

(c) 3

(d) -1

7 $\lim\limits_{x\to 0^-} f(x) =$

(a) 2

(b) 0

(c) DNE

(d) -2

8 $\lim\limits_{x\to 0^+} f(x) =$

(a) 0

(b) 2

(c) DNE

(d) -2

9 $\lim\limits_{x\to 0} f(x) =$

(a) -2

(b) 0

(c) 2

(d) DNE

Related to Question 3 : Use the squeeze theorem to find limits

1 If $1 - x^2 \leq f(x) \leq cosx$ for all x near 0 , then $\lim\limits_{x\to 0} f(x)$ equals

(a) 0

(b) DNE

(c) -1

(d) 1

2 If $3x \leq f(x) \leq x^3 + 2$ for all x near 1 , then $\lim\limits_{x\to 1} f(x)$ equals

(a) 3

(b) 2

(c) 1

(d) DNE

3 If $4x - 9 \leq f(x) \leq x^2 - 4x + 7$ for all $x \geq 0$, then $\lim\limits_{x\to 4} f(x)$ equals

(a) 7

(b) 9

(c) DNE

(d) 4

Related to Question 4 : Find limits for polynomials, rational, and trigonometric functions using theorems

1 If $\lim_{x\to a} f(x) = 3$ and $\lim_{x\to a} g(x) = -1$, then $\lim_{x\to a} \frac{2f(x)-g(x)}{f(x)\,g(x)}$ equals

(a) $\frac{7}{3}$

(b) $-\frac{7}{3}$

(c) $-\frac{5}{3}$

(d) -7

2 Find $\lim_{x\to 1} \left(\frac{1}{x-1} - \frac{2}{x^2-1}\right)$

(a) DNE

(b) 0

(c) $\frac{1}{2}$

(d) 1

3 Find $\lim_{x\to 0} \frac{sin2x}{sin5x}$

(a) 1

(b) $\frac{2}{5}$

(c) $\frac{5}{2}$

(d) 0

Related to Question 5 : Study the continuity of a function at a given point

1 At $x = 1$, the function $f(x) = \begin{cases} x^2, & x < 1 \\ 2x - 1, & x \geq 1 \end{cases}$ is

(a) continuous

(b) discontinuous because the limit does not exist

(c) discontinuous because $f(1)$ is undefined

(d) discontinuous because the limit is not equal to $f(1)$

2 The function $f(x) = \begin{cases} \frac{x^2-4}{x-2}, & x \neq 2 \\ 3, & x = 2 \end{cases}$ is discontinuous at $x = 2$ because

(a) $\lim\limits_{x \to 2} f(x) \neq f(2)$

(b) the limit equals ∞

(c) $f(2)$ is undefined

(d) the limit does not exist

3 Which of the following functions is continuous at $x = 0$?

(a) $f(x) = lnx$

(b) $f(x) = \frac{|x|}{x}$

(c) $f(x) = cosx$

(d) $f(x) = \frac{1}{x}$

Related to Question 6 : Use the continuity properties to study the continuity of a function or a composition of functions at a given point

1 If f is continuous, $f(2) = 5$ and $g(x) = x^2 + 1$, then $\lim\limits_{x \to 2} g\big(f(x)\big)$ equals

(a) 26

(b) 5

(c) 10

(d) 25

2 Find $\lim\limits_{x \to 0} cos\left(\frac{\pi sinx}{x}\right)$

(a) 0

(b) DNE

(c) 1

(d) -1

3 If f and g are continuous at $x = a$, the function that may fail to be continuous at $x = a$ is

(a) $f - g$

(b) $\frac{f}{g}$

(c) $f + g$

(d) $f \cdot g$

Related to Question 7 : Find infinite limits and limits at infinity

1 Find $\lim\limits_{x\to 3^+} \frac{2}{x-3}$

(a) 0

(b) 2

(c) $-\infty$

(d) ∞

2 Find $\lim\limits_{x\to 3^-} \frac{2}{x-3}$

(a) ∞

(b) 0

(c) -2

(d) $-\infty$

3 Find $\lim\limits_{x\to\infty}\left(\sqrt{x^2+4x}-x\right)$

(a) 4

(b) ∞

(c) 2

(d) 0

4 Find $\lim\limits_{x\to\infty} cot^{-1}x$

(a) ∞

(b) 0

(c) $-\frac{\pi}{2}$

(d) π

5 Find $\lim\limits_{x\to-\infty} cot^{-1}x$

(a) ∞

(b) $-\frac{\pi}{2}$

(c) 0

(d) π

6 Find $\lim\limits_{x\to\infty} sec^{-1}\left(\frac{x^2+1}{x+1}\right)$

(a) 0

(b) ∞

(c) π

(d) $\frac{\pi}{2}$

7 Find $\lim\limits_{x\to-\infty} sec^{-1}\left(\frac{x^2+1}{x+1}\right)$

(a) ∞

(b) π

(c) 0

(d) $\frac{\pi}{2}$

Related to Question 8 : Find the average and instantaneous velocity at a given point

1 If the position function of an object is $s(t) = t^3 - 6t^2 + 9t$, then the acceleration function $a(t)$ is

(a) $a(t) = 6t - 12$

(b) $a(t) = 6t + 12$

(c) $a(t) = 3t^2 - 12t + 9$

(d) $a(t) = 6t$

2 If the position function of an object is $s(t) = t^3 - 6t^2 + 9t$, then its acceleration at $t = 3$ is

(a) -6

(b) 0

(c) 6

(d) 18

3 If the position function of an object is $s(t) = t^3 - 6t^2 + 9t$, then the object is momentarily at rest when

(a) $t = 1,\ t = 3$

(b) $t = 3$

(c) $t = 2$

(d) $t = 0,\ t = 3$

4 If the position function of an object is $s(t) = t^3 - 6t^2 + 9t$, then the acceleration is zero when

(a) $t = 0$
(b) $t = 2$
(c) $t = 1$
(d) $t = 3$

5 A ball is thrown straight up and its height in feet is $s(t) = -16t^2 + 64t + 10$. Its velocity at $t = 1$ second is

(a) $58\ ft/s$
(b) $48\ ft/s$
(c) $32\ ft/s$
(d) $-32\ ft/s$

6 A ball is thrown straight up and its height in feet is $s(t) = -16t^2 + 64t + 10$. Its acceleration is

(a) $64\ ft/s^2$
(b) $-32\ ft/s^2$
(c) $-16\ ft/s^2$
(d) $32\ ft/s^2$

7 A ball is thrown straight up and its height in feet is $s(t) = -16t^2 + 64t + 10$. The maximum height of the ball is

(a) $74\ ft$
(b) $64\ ft$
(c) $58\ ft$
(d) $138\ ft$

8 If the position function of an object is $s(t) = t^3 - 3t$, $t \geq 0$, then the acceleration at the moment the velocity is zero is

(a) 6
(b) -2
(c) 3
(d) 0

9 If the position function of an object is $s(t) = ln(t+1)$, then the acceleration at $t = 1$ is

(a) $\frac{1}{4}$

(b) $-\frac{1}{2}$

(c) $-\frac{1}{4}$

(d) $\frac{1}{2}$

10 If at some instant the velocity of an object is $v(t) > 0$ and its acceleration is $a(t) < 0$, then at that instant the object

(a) moves in the negative direction and is speeding up

(b) moves in the positive direction and is slowing down

(c) is at rest

(d) moves in the positive direction and is speeding up

11 Use the position function $s(t) = -16t^2 + 40t + 10$ to find the velocity and acceleration functions

(a) $v(t) = -32t^2 + 40;\ a(t) = -32t$

(b) $v(t) = -32t + 40;\ a(t) = -32$

(c) $v(t) = -32t + 40;\ a(t) = 40$

(d) $v(t) = 32t + 40;\ a(t) = -32$

12 Use the position function $s(t) = -16t^2 + 40t + 10$ to find the velocity and acceleration at $t = 1$

(a) $v(1) = 8;\ a(1) = -32$

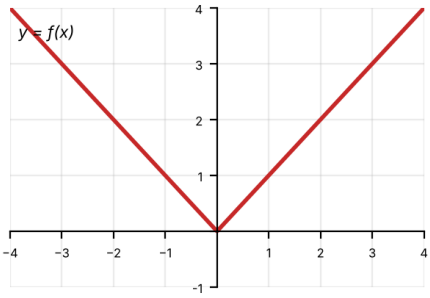
(b) $v(1) = 8;\ a(1) = 40$

(c) $v(1) = -8;\ a(1) = -32$

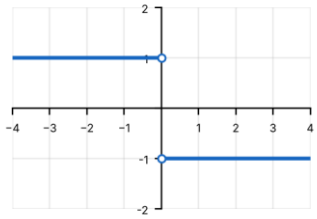
(d) $v(1) = 72;\ a(1) = -32$

Related to Question 9 : Sketch the graph of a function using that of its derivative

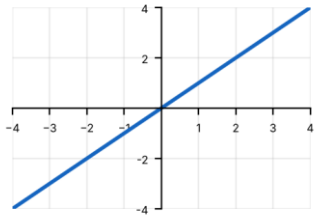
1 **The figure shows the graph of $f(x) = |x|$. Which of the following is the graph of $y = f'(x)$?**



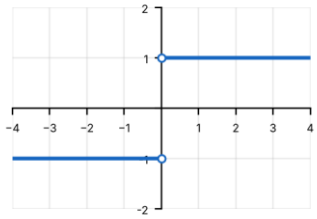
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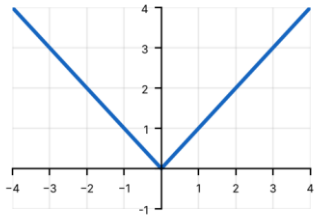
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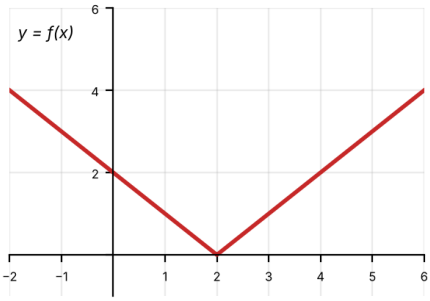
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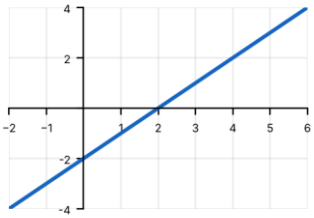
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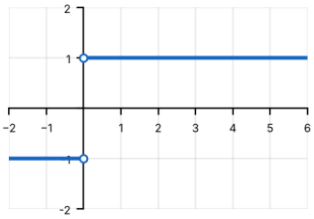
2 **The figure shows the graph of $f(x) = |x - 2|$. Which of the following is the graph of $y = f'(x)$?**



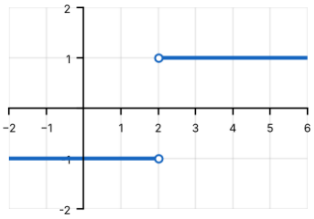
(a)



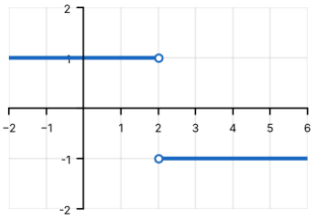
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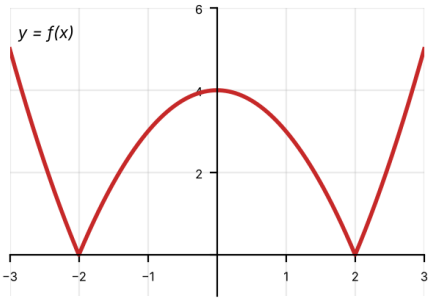
(c)



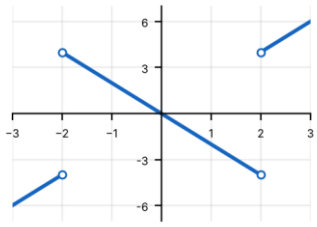
(d)



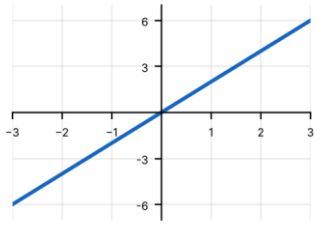
3 **The figure shows the graph of $f(x) = |x^2 - 4|$. Which of the following is the graph of $y = f'(x)$?**



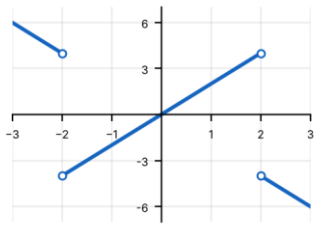
(a)



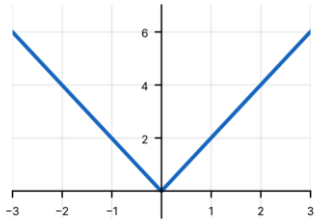
(b)



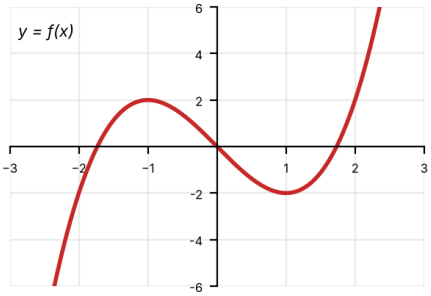
(c)



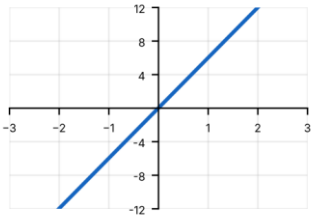
(d)



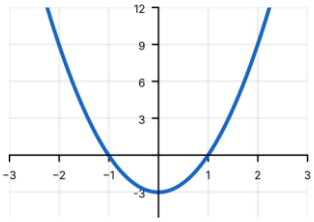
4 **The figure shows the graph of $y = f(x) = x^3 - 3x$. Which of the following is the graph of the second derivative $y = f''(x)$?**



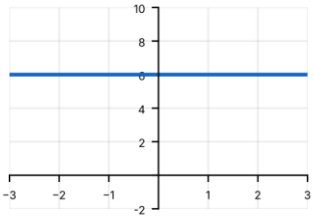
(a)



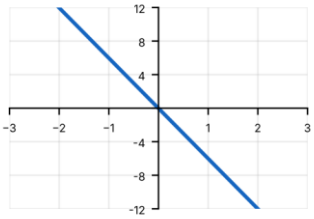
(b)



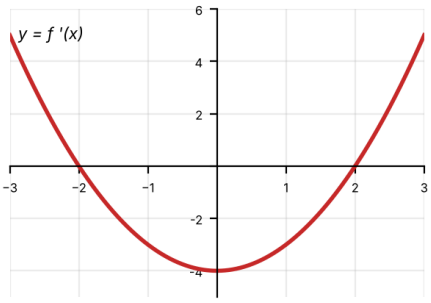
(c)



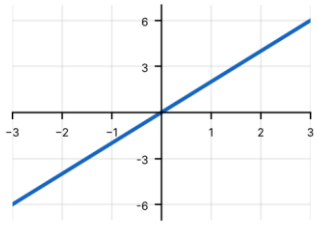
(d)



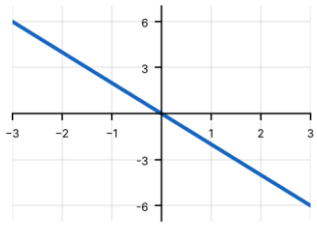
5 **The figure shows the graph of the first derivative $y = f'(x) = x^2 - 4$. Which of the following is the graph of the second derivative $y = f''(x)$?**



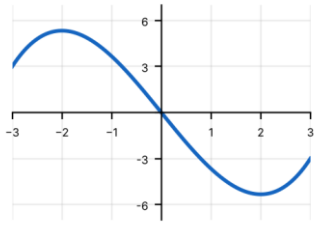
(a)



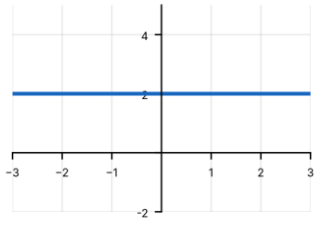
(b)



(c)



(d)



6 **The function $f(x) = |x|$ is not differentiable at $x = 0$ because**

(a) **the function is not continuous at $x = 0$**

(b) **the left-hand derivative -1 is not equal to the right-hand derivative 1**

(c) **$f(0)$ is undefined**

(d) **the tangent line at $x = 0$ is horizontal**

7 If $f(x) = x^4$, then $f''(x)$ equals

(a) $12x^2$

(b) $4x^3$

(c) $24x$

(d) $12x^3$

8 If $f(x)$ is an even function, i.e. $f(-x) = f(x)$ for all x , then $f'(x)$ is

(a) neither even nor odd

(b) odd

(c) symmetric about the line $y = x$

(d) even

9 If $f(x)$ is an odd function, i.e. $f(-x) = -f(x)$ for all x , then $f'(x)$ is

(a) odd

(b) symmetric about the line $y = x$

(c) neither even nor odd

(d) even

10 If the graph of a differentiable function f is symmetric about the line $x = a$, then the graph of $f'(x)$ is

(a) symmetric about the line $x = -a$

(b) symmetric about the line $y = x$

(c) symmetric about the point $(0, a)$

(d) symmetric about the point $(a, 0)$

11 If the graph of a differentiable function f is symmetric about the line $x = 3$, then the graph of $f'(x)$ is

(a) symmetric about the point $(3, 0)$

(b) symmetric about the line $x = -3$

(c) symmetric about the point $(0, 3)$

(d) symmetric about the point $(0, -3)$

Related to Question 10 : Find the derivative of a function at a given point

1 Find $\lim\limits_{h\to 0}\frac{(3+h)^2-9}{h}$

(a) 9

(b) 6

(c) 3

(d) 0

2 Find $\lim\limits_{h\to 0}\frac{\sqrt{4+h}-2}{h}$

(a) 2

(b) $\frac{1}{4}$

(c) 0

(d) $\frac{1}{2}$

3 The limit $\lim\limits_{h\to 0}\frac{(2+h)^3-8}{h}$ represents $f'(a)$ where

(a) $f(x)=(2+x)^3,\ a=0$

(b) $f(x)=x^3,\ a=8$

(c) $f(x)=x^3,\ a=2$

(d) $f(x)=x^3-8,\ a=0$

4 Let $f(x)=x^2$. Find $\lim\limits_{x\to 5}\frac{f(x)-f(5)}{x-5}$

(a) 10

(b) 5

(c) -5

(d) -10

5 Let $f(x)=x^3$. Find $\lim\limits_{x\to 5}\frac{f'(x)-f'(5)}{x-5}$

(a) 125

(b) 15

(c) 75

(d) 30

Related to Question 11 : Find the derivative of a function using the Power Rule at a given point

1 The values of x at which the slope of the tangent line to $f(x) = x^3$ equals 12 are

(a) $x = \pm 2$

(b) $x = \pm 4$

(c) $x = 4$

(d) $x = 2$

2 Find all values of x at which the tangent line to $y = x^3 - 2x + 1$ makes an angle of $45°$ with the x-axis (the angle measured counterclockwise)

(a) $x = -1,\ x = 1$

(b) $x = -\sqrt{2},\ x = \sqrt{2}$

(c) $x = 1,\ x = \sqrt{2}$

(d) $x = -\sqrt{2},\ x = -1$

Related to Question 14 : Find the derivative of an inverse function using the Chain Rule

1 If $f(3) = 5$, $f'(3) = 4$ and $g = f^{-1}$, then $g'(5)$ equals

(a) $\frac{3}{5}$

(b) 4

(c) $\frac{1}{4}$

(d) $\frac{1}{5}$

2 If $f(x) = e^x + x$ and $g = f^{-1}$, then $g'(1)$ equals

(a) 1

(b) $\frac{1}{2}$

(c) 2

(d) $\frac{1}{e+1}$

Related to Question 15 : Find the derivatives of trigonometric functions using differentiation rules

1 An equation of the tangent line to $y = sinx$ at $x = 0$ is

(a) $y = -x$

(b) $y = 1$

(c) $y = x + 1$

(d) $y = x$

2 If $f(x) = sinx$, then $f''(x)$ equals

(a) $cosx$

(b) $sinx$

(c) $-sinx$

(d) $-cosx$

Related to Question 17 : Find the derivatives of natural logarithmic functions

1 The derivative of $f(x) = ln|x|$ is

(a) $\frac{1}{|x|}$

(b) $\frac{|x|}{x}$

(c) $\frac{1}{x}$

(d) lnx

2 The derivative of $f(x) = ln\left(\frac{x+1}{x-1}\right)$ is

(a) $\frac{-2}{x^2-1}$

(b) $\frac{x-1}{x+1}$

(c) $\frac{2x}{x^2-1}$

(d) $\frac{2}{x^2-1}$

Related to Question 18 : Find derivatives implicitly

1 If $siny = x$, then y' equals

(a) $cosy$

(b) $\frac{1}{cosy}$

(c) $\frac{1}{siny}$

(d) $-\frac{1}{cosy}$

2 If $e^y = x + 1$, then y' equals

(a) $\frac{1}{e^x}$

(b) e^y

(c) $x + 1$

(d) $\frac{1}{x+1}$

Related to Question 19 : Use implicit differentiation to find derivatives of inverse trigonometric functions

1 The derivative of $f(x) = (sin^{-1}x)^2$ is

(a) $2sin^{-1}x$

(b) $\frac{1}{1-x^2}$

(c) $\frac{2}{\sqrt{1-x^2}}$

(d) $\frac{2sin^{-1}x}{\sqrt{1-x^2}}$

Related to Question 20 : Recall the hypotheses of Rolle's Theorem

1 Rolle's Theorem does not apply to $f(x) = |x - 1|$ on $[0, 2]$ because

(a) the function is not differentiable at $x = 1$

(b) the function is undefined at $x = 1$

(c) $f(0) \neq f(2)$

(d) the function is not continuous on the interval

2 Rolle's Theorem does not apply to $f(x) = \frac{1}{x^2}$ on $[-1, 1]$ because

(a) the derivative is never zero

(b) the function is not continuous at $x = 0$

(c) the function is decreasing

(d) $f(-1) \neq f(1)$

3 If f satisfies the hypotheses of Rolle's Theorem on $[a, b]$, then there is a number c in (a, b) such that

(a) $f(c) = 0$

(b) $f(a) = 0$

(c) $f'(c) = \frac{f(b)}{b-a}$

(d) $f'(c) = 0$

B) Free-Response Questions

Related to Question 21 : a) Determine the continuity of a function at a given point b) Use the continuity properties to study the continuity of a function or a composition of functions at a given point

1 Determine whether $f(x) = \begin{cases} x^2, & x < 1 \\ 2, & x = 1 \\ 2x - 1, & x > 1 \end{cases}$ is continuous at $x = 1$ using the three conditions of continuity. If it is not, state the type of discontinuity.

2 **Find the values of x at which $f(x) = \frac{x^2-1}{x^2-3x+2}$ is discontinuous, and classify each discontinuity (removable or not).**

3 **Use the continuity properties to determine the intervals on which $h(x) = ln(x^2 - 4x + 3)$ is continuous.**

4 **Find the value of the constant k that makes $f(x) = \begin{cases} kx^2, & x < 2 \\ 2x + k, & x \geq 2 \end{cases}$ continuous at $x = 2$**

5 **Find the value of c that makes $f(x) = \begin{cases} \frac{sin3x}{x}, & x \neq 0 \\ c, & x = 0 \end{cases}$ continuous at $x = 0$**

6 Find the values of a and b that make $f(x) = \begin{cases} x+1, & x<1 \\ ax+b, & 1 \le x < 2 \\ 3x, & x \ge 2 \end{cases}$ continuous for all x

7 Find all values of k that make $f(x) = \begin{cases} k^2x, & x<1 \\ 3kx-2, & x \ge 1 \end{cases}$ continuous at $x = 1$

8 Find the values of a and b that make $f(x) = \begin{cases} \frac{x^2+ax-6}{x-2}, & x \neq 2 \\ b, & x = 2 \end{cases}$ continuous at $x = 2$

9 **Find the values of the constants a and b that make $f(x) = \begin{cases} \frac{2sinx}{x}, & x < 0 \\ a, & x = 0 \\ bcosx, & x > 0 \end{cases}$ continuous**

10 **Find the values of the constants a and b that make $f(x) = \begin{cases} ae^x + 1, & x < 0 \\ sin^{-1}\frac{x}{2}, & 0 \leq x \leq 2 \\ x^2 - x + b, & x > 2 \end{cases}$ continuous**

11 **Find the values of a and b that make $f(x) = \begin{cases} \frac{x^2-4}{x-2}, & x < 2 \\ ax^2 - bx + 3, & 2 \le x < 3 \\ 2x - a + b, & x \ge 3 \end{cases}$ continuous on $(-\infty, \infty)$**

Related to Question 22 : Find horizontal, vertical, and slant asymptotes using limits

1 **Find the horizontal asymptotes of $f(x) = \frac{3x}{\sqrt{x^2+1}}$**

2 **Find the asymptotes of $f(x) = \frac{x-2}{x^2-4}$, and explain why there is no vertical asymptote at $x = 2$**

Related to Question 23 : Apply the Product Rule on derivatives

1 If the quantity sold is $Q(t) = 1000 + 50t$ and the unit price is $P(t) = 20 - 0.5t$, and the revenue is $R(t) = Q(t)\,P(t)$, find $R'(4)$ and interpret it.

2 Suppose that the current price of a product is 25 dirhams, with the price increasing at a rate of 2 dirhams per year. At the current price, consumers buy 150 thousand items, but the number sold is decreasing at a rate of 8 thousand items per year. At what rate is the total revenue $R(t) = Q(t)\,P(t)$ changing? Is the total revenue increasing or decreasing?

Related to Question 24 : Find the derivatives of trigonometric functions using differentiation rules

1 Find the second derivative of $f(x) = sin2x$

2 Find an equation of the tangent line to $y = tanx$ at $x = \frac{\pi}{4}$

Related to Question 25 : Solve real-life problems using derivatives of exponential and logarithmic functions

1 The population of a city is $P(t) = 5000e^{0.03t}$, where t is in years. Find the rate of population growth at $t = 10$, then find the relative growth rate $\frac{P'(t)}{P(t)}$

2 The amount of a drug in the blood (mg) after t hours is $A(t) = 100e^{-0.2t}$. Find the rate of change of the amount at $t = 5$ and interpret its sign.

Related to Question 26 : Understand the Mean Value Theorem and use it in applications

1 **A car travels 120 km in 1.5 hours. Use the Mean Value Theorem to show that the speedometer read 80 km/h at some instant.**

2 **Explain why the Mean Value Theorem does not apply to $f(x) = x^{\frac{2}{3}}$ on $[-1, 8]$**