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VCE Mathematical Methods ¾
Coordinate Geometry Exam Skills [1.6]
Homework

Homework Outline:

Compulsory Questions	Pg 2 – Pg 20
Supplementary Questions	Pg 21 – Pg 41

Section A: Compulsory Questions

Sub-Section [1.6.1]: Apply Midpoint to Find a Reflected Point

Question 1

Find the reflection of the point $(4, 2)$ about the line $x = 6$.

Question 2

The point $(2, 3)$ is reflected in the line $y = b$ to become the point $(2, 9)$. Find the value of b.

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Question 3

Find the perpendicular bisector between the points $(3, 6)$ and $(-2, -9)$.

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Sub-Section [1.6.2]: Apply Parallel and Perpendicular Lines to Geometric Problems

Question 4

Find the equation of the line that is parallel to $y = 2x + 3$ that passes through the point $(1, 4)$.

Question 5

Find the area of the triangle formed by the lines $y = x + 2$, $y = 8 - x$ and the y-axis.

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Question 6

Find the minimum distance between the line $y = 3 - x$ and the point $(4, 3)$.

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Sub-Section [1.6.3]: Solve Coordinate Geometry Problems With Transformations

Question 7

The area bounded by the lines $y = x$, $y = -x + 10$ and the x-axis is 25 square units. Use this to find the area bounded by:

a. The lines $y = 2x$, $y = -2x + 20$ and the x-axis.

b. The lines $y = x - 5$, $y = -x + 15$ and the x-axis.

c. The lines $y = \frac{2}{3}x$, $y = -\frac{2}{3}x + 20$ and the x-axis.

Question 8

Find the equation of the tangent line to the transformed graphs in the following scenarios.

a. The original function is $f(x) = x^3$, and the tangent line to the graph of $y = f(x)$ at $x = 1$ is $y = 3x - 2$. The graph of f is dilated by a factor 2 from the x-axis, then translated up by 4 units. Find the equation of the tangent to the transformed graph when $x = 1$.

b. The original function is $f(x) = \sqrt{x}$, and the tangent line to the graph of $y = f(x)$ at $x = 4$ is $y = \frac{1}{4}x + 1$. The graph of f is reflected about the y-axis, then translated 3 units to the left. Find the equation of the tangent line when $x = -7$.

c. Let $f(x) = (x-2)^2 + 1$, the graph of $y = f(x)$ has a tangent $y = 2x - 4$ when $x = 3$. Find the equation of the tangent to $y = \frac{1}{2}x^2 - 4x + 9$ when $x = 6$.

Question 9

a. Find the values of a such that the area bounded by the graphs of $y = x$, $y = -x + a$ and the x-axis is 9 square units.

b. Find the values of a such that the area bounded by the graphs of $y = 2x$, $y = -\frac{x}{2} + a$ and the x-axis is 20 square units.

c. Find the values of a such that the area bounded by the graphs of $y = x + 2$, $y = -x + a$ and the y-axis is 9 square units.

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Sub-Section: Exam 1 Questions

Question 10

Consider the simultaneous linear equations:

$$\frac{k}{2}x + 3y = 4$$

$$6x + (2k + 1)y = 12$$

where k is a real constant.

a. Find the values of k for which there is a unique solution to the simultaneous equations.

b. Find the value of k for which there are infinitely many solutions.

c. Find the value of k for which there are no solutions.

Question 11

Consider the line segment AB with coordinates $A(1, 0)$ and $B(7, 12)$.

a. Find the coordinates of M, the midpoint of AB.

b. Find the equation of the perpendicular bisector of the line segment AB.

c. Let D be the point $(16, 0)$. Find the area of the triangle AMD.

d. Let $E(2, 0)$, $F(8, 12)$ and $G(32, 0)$. Find the area of the triangle EFG.

Question 12

The point $P(2, 3)$ is reflected in the line $y = 7 - x$ to become the point P'.

a. Find the coordinates of P'.

b. The point P can also be mapped to P' if it undergoes a reflection in the line $x = a$, followed by a reflection in the line $y = b$. State the values of a and b.

Question 13

Consider a function $f(x)$, the graph of $y = f(x)$ has a tangent line given by $y = 2x - 5$ and a normal line given by $y = -\frac{1}{2}x + 10$, when $x = 6$.

a. Find the area bounded by the tangent line, normal line and the y-axis.

The graph of $y = f(x)$ is dilated by a factor of 2 from the y-axis and by a factor of $\frac{3}{2}$ from the x-axis. Let this tranformed graph be given by $y = g(x)$.

b. Find the equation of the tangent to the graph of $y = g(x)$ when $x = 12$.

c. Consider the graph of $y = g(x)$, a tangent and normal line are drawn to the graph at the point where $x = 12$. Find the area bounded by the tangent line, normal line, and the y-axis.

Sub-Section: Exam 2 Questions

Question 14

The perpendicular bisector of the points $(2, 4)$ and $(5, -2)$ is:

A. $y = 2x + 3$

B. $y = \frac{1}{2}x - \frac{3}{4}$

C. $y = -\frac{1}{2}x + 3$

D. $y = -2x + \frac{4}{3}$

Question 15

It is known that the lines $y = mx + 3$ and $y = 2x - 4$ make an angle of $45°$ when they intersect.

The possible values of m are:

A. $m = -\frac{1}{3}$ only

B. $m = 3$ only

C. $m = -3, \frac{1}{3}$

D. $m = -3, -\frac{1}{3}$

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Question 16

The tangent to the graph of $y = f(x)$ when $x = 2$ is $y = 3x - 2$. Find the equation of the tangent to the graph of $y = 2f\left(\frac{x}{3}\right)$ when $x = 6$.

A. $y = 6x - 10$

B. $y = 2x - 4$

C. $y = 3x - 2$

D. $y = 12x - 4$

Question 17

The simultaneous linear equations:

$$2x + (k + 3)y = 4$$

$$(2 - k)x + 2y = 1$$

where k is a real constant has infinitely many solutions for:

A. $k = 1$

B. $k = -2$

C. $k = -2, 1$

D. No value of k.

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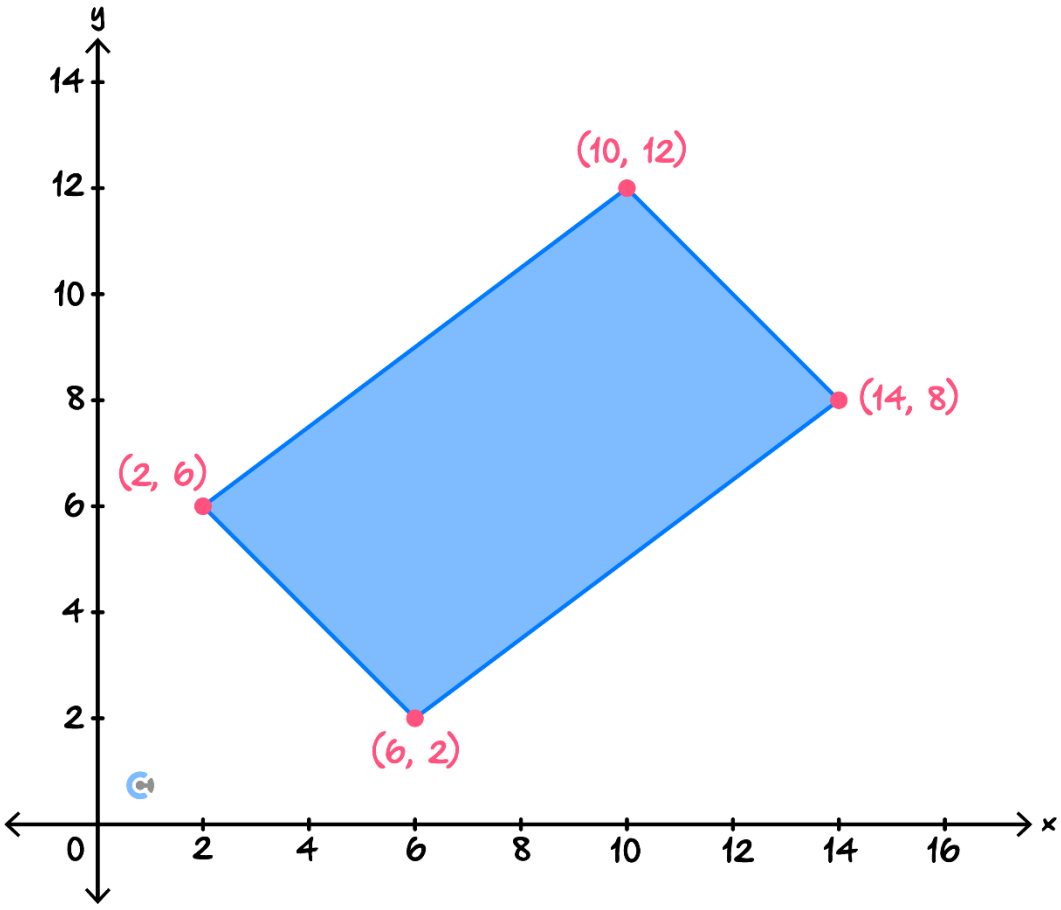
Question 18

Find the area, in square units, of the parallelogram shown below:



A. 48

B. 72

C. 56

D. 54

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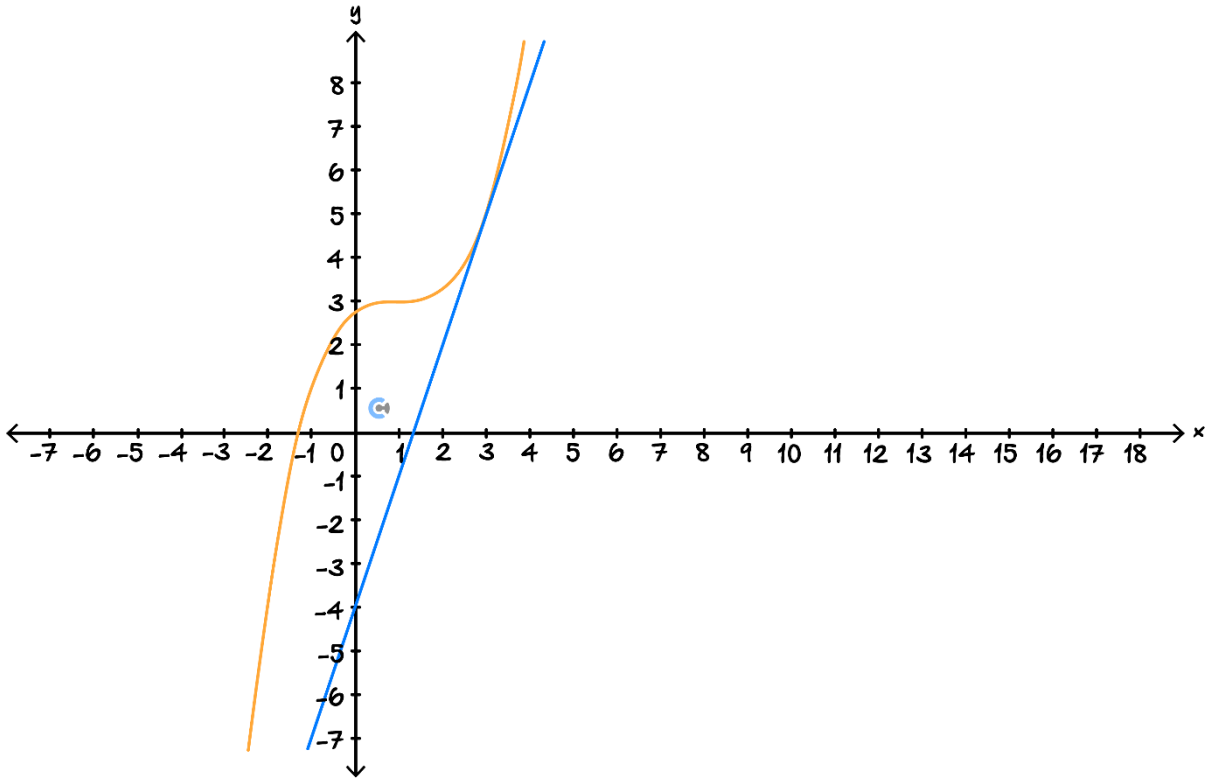
Question 19

Consider the function $f(x) = \frac{1}{4}(x-1)^3 + 3$. The graph of $y = f(x)$ and it tangent line at the point where $x = 3$ is sketched on the axes below. The tangent line has a y-intercept at $(0, -4)$.



a. State the equation of the tangent line to the graph of $y = f(x)$ when $x = 3$.

_____

_____

_____

b. State the angle that this tangent line makes with the positive x-axis, correct to the nearest degree.

_____

_____

c. Find the equation of the normal line to the graph of $y = f(x)$ when $x = 3$, and sketch it on the axes at the start of this question.

d. Find the area of the triangle bounded by the tangent line, the normal line, and the y-axis.

e. The graph of $y = f(x)$ undergoes a dilation by factor 2 from the y-axis, a dilation by factor 3 from the x-axis, and is translated 2 units to the right. A tangent and normal line are drawn to this new graph at the point where $x = 8$.

Find the area of the triangle bounded by this tangent line, normal line, and the x-axis.

Question 20

A soccer field in the shape of a parallelogram is being constructed. As part of the planning phase, the field is modelled on the cartesian plane.

Two adjacent sides of the field are modelled by the equations $y = x + 35$ and $y = \frac{305}{6} - \frac{7x}{12}$.

The corner diagonally opposite to the corner formed by these two lines is the point $C(140, 80)$. All measurements are in metres.

a. Show that the field has vertices $A(10, 45)$, $B(80, 115)$ and $D(70, 10)$.

b. Find the exact dimensions of the field.

c. Find the angle $\angle BAD$ in degrees, correct to two decimal places.

d. Find the area of the soccer field.

e. The vertices that make up the soccer field are all dilated by a factor of 2 from the x-axis and by a factor of 2 from the y-axis. What is the area of the field formed from these tranformed vertices?

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Section B: Supplementary Questions

Sub-Section [1.6.1]: Apply Midpoint to Find a Reflected Point

Question 21

The point $(-1, 5)$ is reflected in the line $y = 2$. Find the coordinates of the reflected point.

Question 22

The point $(2, -3)$ is reflected about a line to become the point $(-10, -3)$. State the equation of the line.

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Question 23

Find the perpendicular bisector of the line segment joining the points $(4, -2)$ and $(-1, 0)$.

Question 24

The point $(1, -6)$ is reflected in a line to become the point $(5, -4)$. Find the equation of the line.

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Sub-Section [1.6.2]: Apply Parallel and Perpendicular Lines to Geometric Problems

Question 25

Find the equation of the line that passes through the point $(-2, 3)$ and is perpendicular to $y = x + 7$.

Question 26

Find the area of the triangle formed by the lines $y = 2x - 8$, $y = 6x - 4$, and $y = 2$.

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Question 27

Find the distance between the point $(2, 7)$ and the line $y = 3x - 1$.

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Question 28

Consider the points $A(2,1)$, $B(1,-2)$, $C(5,0)$ and $D(m,n)$, where $m, n \in \mathbb{R}^+$. It is known that $\angle ABC = 45°$. Find the values of m and n such that $\angle BCD = 135°$.

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Sub-Section [1.6.3]: Solve Coordinate Geometry Problems With Transformations

Question 29

The area bound by the lines $y = 2x - 4$, $y = -1 - x$, and $y = \frac{1}{2}x + 2$ is $\frac{27}{2}$ square units. Hence, find the area bound by:

a. The lines $y = 8x - 4$, $y = -1 - 4x$ and $y = 2x + 2$.

b. The lines $y = -2x + 4$, $y = 1 + x$ and $y = -\frac{1}{2}x - 2$.

c. The lines $y = 6x - 4$, $y = 5 - 3x$, $y = \frac{3}{2}x + 14$.

Question 30

a. The original function is $f(x) = \frac{2}{(x-5)^2} - 16$, and the tangent line to the graph of $y = f(x)$ at $x = 6$ is $y = -4x + 8$. The graph of $f(x)$ is reflected in the x-axis, translated 2 units down, then dilated by a factor of $\frac{1}{2}$ from the x axis. Find the equation of the tangent to the transformed graph when $x = 6$.

b. The graph of $f(x) = 2x^2 - 3x + 1$ has a tangent line at $x = -1$ with an equation of $y = -7x - 1$. $f(x)$ undergoes a translation 3 units right, followed by a dilation by a factor of 4 from the x-axis. Find the equation of the tangent to the transformed graph when $x = 2$.

c. Consider the graph $f(x) = x^2 - 6x + 4$. The line $y = 2x - 12$ is a tangent to $f(x)$ at $x = 4$. Find the equation of the tangent to $y = 4x^2 - 28x + 32$ at $x = 4$.

Question 31

a. Find the value of a such that the area bound by the graphs $y = x - 2$, $y = ax + a$ and the y axis is 2 square units.

b. It is known that the triangle formed by the lines $y = 2x + 6$, $y = -x - a$, and the x-axis has an area of 5. Find the values of a.

c. Find the values of a where the area between the lines $y = ax$, $y = x - 4$ and the y axis is 12.

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Question 32

a. The shape bound by the lines $y = -\frac{1}{2}x - 1$, $y = x + 5$ and $y = ax - 1$ has an area of 8 square units. Find the value of a if $a \in (-\infty, 1)$.

b. Hence or otherwise, find the values of m and c such that the area bound by the graphs $y = -2x + 2$, $y = 4x + 8$, and $y = mx + c$ is 2 square units. Assume $m, c \in (1, \infty)$.

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Sub-Section: Exam 1 Questions

Question 33

Consider the simultaneous linear equations:

$$2ax - (a+1)y = -1$$

$$\frac{x}{2a+1} + 3y = 4a + 5$$

where a is a real constant.

a. Find the values of a for which there is a unique solution to the set of equations.

b. Find the value of a for which there are no unique solutions.

c. Find the value of a for which there are infinitely many solutions.

Question 34

Consider the points $A(8,-2)$ and $B(2,6)$.

a. Find the equation of the line that is parallel to the line segment AB, and also contains the point $C(6,9)$.

b. Find the equation of the perpendicular bisector of AB.

c. Find the coordinates of D, the point of intersection between the lines found in **part a.** and **b**.

d. Find the area of the quadrilateral $ABCD$.

e. Let $E\left(\frac{8}{3}, -4\right)$, $F\left(\frac{2}{3}, 12\right)$, $G(2, 18)$, and $H(3, 10)$. Find the area of $EFGH$.

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Question 35

The point $P(4, 1)$ is reflected in the line $y = 2x - 2$ to become the point P'.

a. Find the coordinates of P'.

b. Find the point of intersection between the lines $y = 2x - 2$ and $y = 7x - 27$.

c. The line $y = 7x - 27$ is reflected in the line $2x - 2$. Find the equation of the new line.

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Question 36

At $x = -2$, the graph $y = f(x)$ has a tangent line with the equation $y = 3 - 2x$, and a normal line given by $y = \frac{1}{2}x + 8$.

a. Find the area bounded by the tangent line, normal line, and the x-axis.

The graph of $f(x)$ is translated down 3 units, dilated by a factor of 2 from the x-axis, and dilated by a factor of 5 from the y-axis to become the graph $g(x)$.

b. Find the equation of the normal line to $y = g(x)$ at $x = -4$.

c. Find the area bounded by the x-axis, the tangent line and normal line of the graph $y = g(x)$ at $x = -4$.

Sub-Section: Exam 2 Questions

Question 37

The set of simultaneous equations:

$$\frac{5}{3k-4}y-\frac{x}{2}=\frac{3}{8}k+\frac{3}{2}$$

$$(k-6)x+2ky=\frac{4}{3}-k$$

has no solutions for:

A. $k=3$ or $k=-\frac{10}{3}$

B. $k=-\frac{10}{3}$

C. $k=3$

D. $k\neq-\frac{2}{3}$ or $k\neq-\frac{10}{3}$

Question 38

The area of the triangle formed by the points $(2,3)$, $(-4,7)$ and $(4,6)$ is:

A. 13 square units.

B. 25 square units.

C. 26 square units.

D. 19 square units.

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Question 39

The graph $f(x) = x^2 - 4x + 3$ has a tangent line and normal line constructed at $x = 1$. The area bound by the tangent line, the normal line, and the y-axis is $\frac{5}{4}$ square units. The area bound by the y-axis, tangent line, and normal line to the graph $y = -\frac{1}{2}x^2 + 4x - 3$ at $x = -2$ is:

A. $\frac{5}{8}$ square units.

B. $\frac{5}{4}$ square units.

C. 5 square units.

D. 8 square units.

Question 40

The acute angle formed between the lines $y = 3x - 1$ and $y = mx + 5$ is at least $45°$ when:

A. $m \in \left[\frac{1}{2}, \infty\right)$

B. $m \in \left[-2, \frac{1}{2}\right]$

C. $m \in (-\infty, -2] \cup \left[\frac{1}{2}, \infty\right)$

D. $m \in \left[-2, 0\right) \cup \left(0, \frac{1}{2}\right]$

Question 41

The equation of the tangent line to $f(x)$ at $x = 2$ is $y = 1 - 4x$. The equation of the normal line to $f(x)$ at $x = 2$ is:

A. $y = \frac{1}{4}x - \frac{15}{2}$

B. $y = -\frac{1}{4}x + 1$

C. $y = 4x - 2$

D. Cannot be determined

Question 42

Consider the points $A(6, -2)$ and $B(3, 4)$.

a. Find the perpendicular bisector of AB.

b. Find the values of m such that the line $y = mx$ forms a 45° angle with the line segment AB.

c. Point $C(m, n)$ and point $D(p, q)$ are different points that lie on the perpendicular bisector of AB, where m, $n \in \mathbb{R}^+$. Find the coordinates of C and D such that the triangles ABC and ABD are both right angle triangles.

d. The point C can be mapped onto point D by a reflection in the line $y = a$ followed by a reflection in the line $x = b$. State the values of a and b.

e. Find the area of $ACBD$.

f. Find the area of the square that has opposite corners at $(7, -4)$ and $(1, 8)$.

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Question 43

The function $f(x) = 2(x+3)^2 - 5$ has a tangent line with the equation $y = 4x + 5$.

a. Show that $y = 4x + 5$ is a tangent to $f(x)$ at the point $(-2, -3)$.

b. Find the equation of the normal line to $f(x)$ at $x = -2$.

c. State the obtuse angle formed between the line $y = 4x + 5$ and the x-axis, correct to 2 decimal places.

d. Find the area enclosed by the tangent line, the normal line, and the x-axis.

The graph of $y = f(x)$ is translated 4 units right, dilated by a factor of 4 from the x-axis, and dilated by a factor of $\frac{2}{3}$ from the y-axis to become the graph $y = g(x)$.

e. Find the equation of the tangent line to $y = g(x)$ at $x = \frac{4}{3}$.

f. State the obtuse angle formed between the new tangent of $y = g(x)$ at $x = \frac{4}{3}$, correct to 2 decimal places.

g. Find the area of the triangle formed between the x-axis, the tangent, and normal line to $y = g(x)$ at $x = \frac{4}{3}$.

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