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# VCE Mathematical Methods ½
## Linear & Coordinate Geometry Exam Skills [1.2]
## Homework

### Homework Outline:

## Section A: Compulsory Questions

### Sub-Section [1.2.1]: Applying Midpoint to Find Reflected Points

**Question 1**

Find the reflection of the point $(10, 5)$ about the line $x = 2$.

**Question 2**

The point $(1, 2)$ is reflected in the line $x = b$ and becomes the point $(5, 2)$. Find the value of $b$.

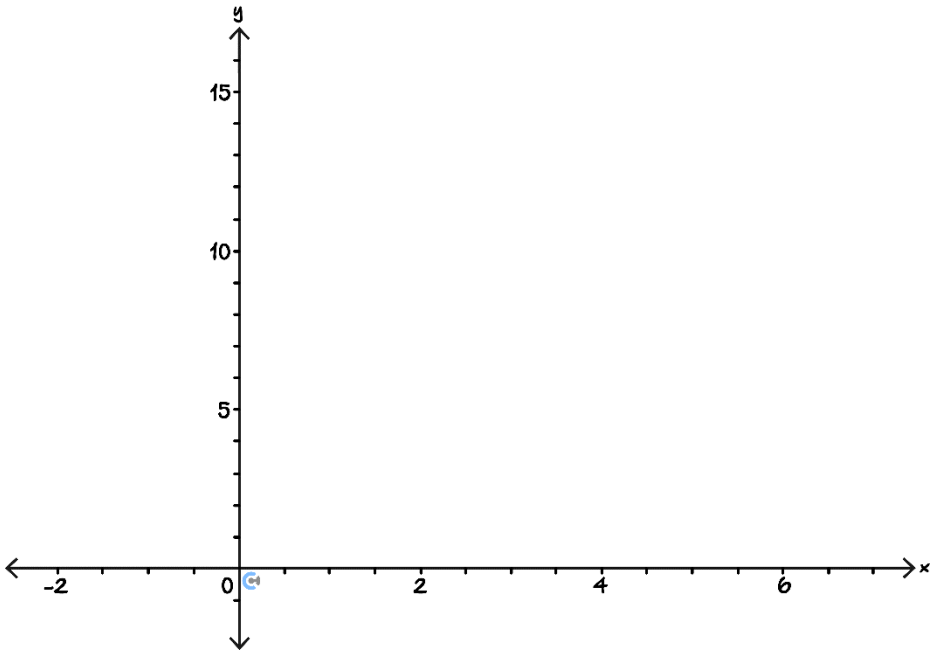
**Question 3**

Consider the function $f(x) = x^2$.

**a.** Let $x' = 4 - x$, find $x$ in terms of $x'$.

**b.** Find $f(4 - x')$.

**c.** Sketch the graphs of $y = x^2$ and $y = (4 - x)^2$ on the axes below.




**d.** Hence, determine the line that $y = x^2$ is reflected in to obtain $y = (x - 4)^2$.

**e.** $y = x^2$ is reflected in the line $x = b$ and becomes $y = (x - 6)^2$. What is the value of $b$?

# Sub-Section [1.2.2]: Find Vertical and Horizontal Distance Between Functions

**Question 4**

Find the vertical distance between $f(x) = x + 1$ and $g(x) = 2x + 5$ when $x = 2$.

**Question 5**

Find the horizontal distance between the function $f(x) = 3x$ and $g(x) = x^2$ when $y = 4$ and $x > 0$.

**Question 6**

Consider the functions $y = 3x_1 - 2$ and $y = x_2 + 1$.

**a.** Make $x_1$ and $x_2$, the subject of their respective equations.

**b.** Hence, create a function in terms of $y$ that gives the horizontal distance between the two functions when $x_2 > x_1$.

**c.** Find the horizontal distance between the two functions when $y = 5$.

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## Sub-Section [1.2.3]: Finding Distance Between a Point and a Function

**Question 7**

Find the distance between the point $(1, 2)$ and the function $y = x^2$ when $x = 2$.

**Question 8**

Find the positive $x$-value for which the point $(2, 4)$ has a distance $\sqrt{26}$ from the line $y = 4x + 5$.

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**Question 9**

Find the point(s) on the line $y = 2x - 1$ which have a distance of 2 from the point $(-2, -3)$.

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## Sub-Section: Exam 1 Questions

**Question 10**

Let the coordinates of the point $X$ be $(4, 2)$. Find the coordinates of $X'$, which is the point $X$ reflected across the lines $x = -\frac{1}{2}$ and $y = 3$.

**Question 11**

**a.** The point $A$ is the midpoint of $(-1, -3)$ and $(3, 7)$. Find the coordinates of $A$.

**b.** Find the equation of the line parallel to $y = -2x - 2$ that passes through the point $A$.

**Question 12**

Consider the functions $f(x) = 2x - 3$ and $g(x) = x^2$ when $x > 0$.

**a.** Find the vertical distance between $f$ and $g$ when $x = 3$.

**b.** Find the horizontal distance between $f$ and $g$ when $y = 4$.

**c.** Find the distance between the point $(-1, 4)$ and $g(x)$ when $x = 1$.

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**Question 13**

Consider the simultaneous linear equations:

$$\frac{m}{2}x + y = 9,$$

$$x + my = -2,$$

Where $m$ is a real constant.

**a.** Find the values of $m$ for which there is a unique solution to the simultaneous equations.

**b.** If possible, determine the value(s) of $m$ for which there are infinitely many solutions.

**c.** If possible, determine the value(s) of $m$ for which there are no solutions.

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**Question 14**

Jacob is standing at the point $(3, -1)$ and he wants to walk to the road, which is described by the line $y = 6 - x$.

**a.** Find the line perpendicular to $y = 6 - x$ that passes through the point $(3, -1)$. Call this line $D$.

**b.** Find the points of intersection between the line $y = 6 - x$ and the line $D$, from **part a**.

**c.** Hence, find the minimum distance that Jacob can walk to reach the road.

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## Sub-Section: Exam 2 Questions

**Question 15**

The horizontal distance between the function $f(x) = x^3 + 2$ and $g(x) = x - 2$, when $y = 3$ is:

**A.** 3

**B.** 4

**C.** 5

**D.** 6

**Question 16**

The angle that the line $y = \sqrt{3x} + 4$ makes with the positive $x$-axis is:

**A.** 45°

**B.** 135°

**C.** 60°

**D.** 30°

**Question 17**

Solve the following simultaneous equations:

$$x + 2y = 1$$
$$4x - y = 5$$

**A.** $x = \frac{8}{9}, y = -\frac{2}{9}$

**B.** $x = \frac{4}{9}, y = \frac{7}{9}$

**C.** $x = \frac{11}{9}, y = -\frac{1}{9}$

**D.** $x = \frac{5}{9}, y = \frac{1}{9}$

**Question 18**

The point $(2, k)$ has a vertical distance of 3 units from the line $y = 3x - 4$. A possible value of $k$ is:

**A.** $-1$

**B.** 1

**C.** 3

**D.** 4

**Question 19**

Given that the distance between the point $A(4, 1)$ and $B(-3, k)$ is 7 units, the value of $k$ is:

**A.** $-2$

**B.** $-1$

**C.** 1

**D.** 2

**Question 20**

Consider the points $A(3, 2)$ and $C(9, 6)$.

**a.** Find the equation of the line segment $AC$.

**b.** Find the coordinates of $M$, the midpoint of the line segment $AC$.

**c.** Find the equation of the perpendicular bisector of the line segment $AC$.

**d.** The point $B$ is obtained by reflecting the point $A$ about the line $y = 4$. Find the horizontal distance between the points $B$ and $C$.

**e.** The point $D$ is obtained by reflecting the point $A$ about the line $x = 6$. Find the vertical distance between the points $D$ and $C$.

**f.** Find the area of the rectangle $ABCD$.

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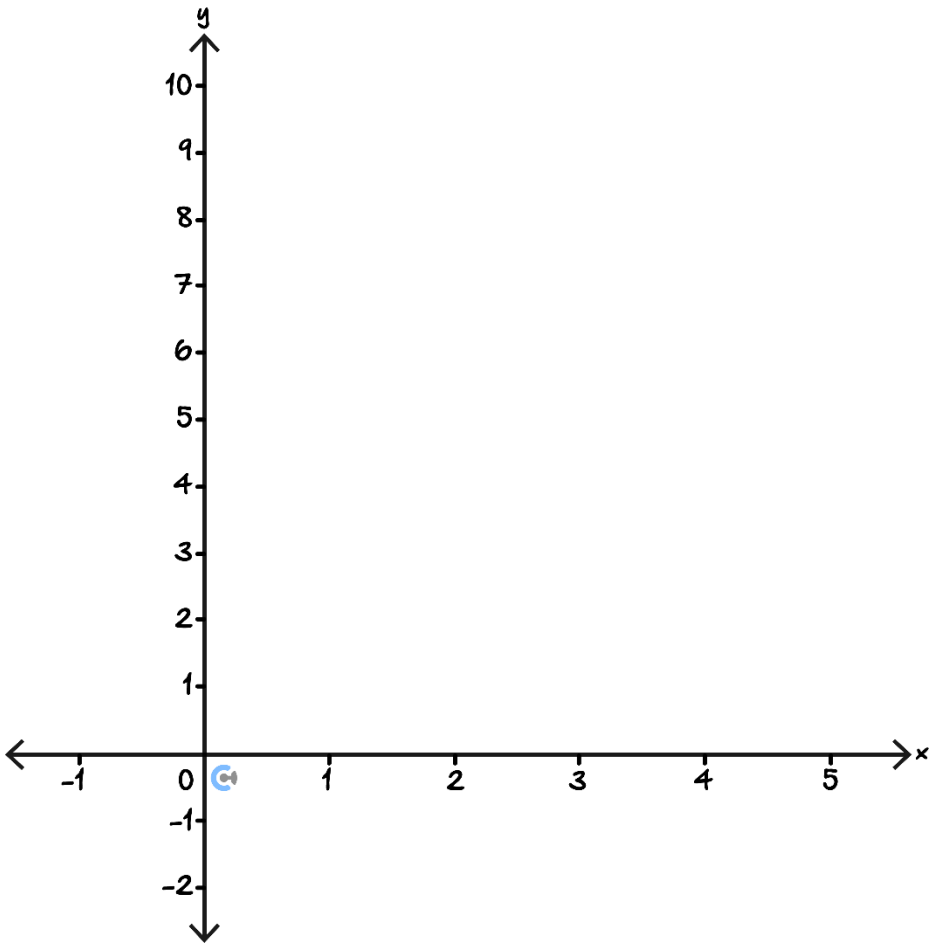
**Question 21**

Consider the functions $f(x) = 2x$ and $g(x) = 8 - 2x$.

**a.** Sketch the graphs of $y = f(x)$ and $y = g(x)$ on the axis below. Label all points of intersection and axis intercepts with coordinates.




**b.** The graph of $y = g(x)$ is the reflection of $y = f(x)$ in the line $x = b$. State the value of $b$.

_____

_____

**c.** Let $\theta_1$ be the angle that $f(x)$ makes with the positive $x$-axis and let $\theta_2$ be the angle that $g(x)$ makes with the positive $x$-axis.

**i.** Find $\theta_1$ in degrees correct to the two decimal places.

**ii.** Find $\theta_2$ in degrees correct to the two decimal places.

**iii.** Write $\theta_1$ in terms of $\theta_2$.

**iv.** Hence, or otherwise, determine the acute angle between the lines $y = f(x)$ and $y = g(x)$. Give your answer correct to the two decimal places.

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## Section B: Supplementary Questions

### Sub-Section [1.2.1]: Applying Midpoint to Find Reflected Points

**Question 22**

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

**Question 23**

The point $(3, 2)$ is reflected in the line $y = b$, and to become the point $(3, -6)$. Find the value of $b$.

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**Question 24**

Consider the function $f(x) = x^2 + 1$.

**a.** The point $A(1, 1)$ on the graph of $y = f(x)$ is reflected about the line $y = 0$. Find the coordinates of the reflected points' position.

**b.** The entire graph of $y = f(x)$ is reflected about the line $y = 0$. Find the equation of this new graph.

**Question 25**

The function $y = (x - 1)^2 + 3$ is reflected about the line $x = 3$ and then reflected about the line $y = 2$. Find the equation of the graph after these reflections.

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# Sub-Section [1.2.2]: Find Vertical and Horizontal Distance Between Functions

**Question 26**

Find the vertical distance between $f(x) = 3x + 1$ and $g(x) = x + 3$ when $x = 2$.

**Question 27**

Find the horizontal distance between the function $f(x) = x + 1$ and $g(x) = x^2 - 1$ when $y = 8$.

**Question 28**

Consider the functions $y = x + 3$ and $y = x^2 + 1$.

**a.** Solve the inequality $x + 3 > x^2 + 1$.

**b.** Hence, determine the vertical distance between the two functions when $x = 1$.

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## Sub-Section [1.2.3]: Finding Distance Between a Point and a Function

**Question 29**

Find the distance between the point $(1, 2)$ and the function $y = x^2$, when $x = 3$.

**Question 30**

The distance between the point $A(4, 1)$ and the point $B(-3, m)$ is 7, find the possible value(s) of $m$.

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**Question 31**

Find the point(s) on the line $y = 3x + 3$ which have a distance of 5 from the point $(1, 1)$.

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## Sub-Section: Exam 1 Questions

**Question 32**

Let the coordinates of the point $X$ be $(a, b)$. Find the coordinates of $X'$, which is the point on $X$ reflected across the lines $x = 1$ and $y = -3$. Give your answer in terms of $a$ and $b$.

**Question 33**

Find the equation of the line that is parallel to $y = -3x - 4$ and passes through the point $(7, 5)$.

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**Question 34**

Solve the simultaneous linear equations:

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

$$\frac{5}{4}x - \frac{5}{4}y = -\frac{5}{4}.$$

**Question 35**

Consider the functions $f(x) = 2x + 3$ and $g(x) = (x + 2)^2$.

**a.** Find the vertical distance between $f$ and $g$, when $x = 2$.

**b.** Find the horizontal distance between $f$ and $g$, when $y = 4$.

**c.** Find the distance between the point $(2, 4)$ and $g(x)$, when $x = 14$.

**Question 36**

Consider the simultaneous linear equations:

$$\frac{m}{3}x - y = m,$$

$$4x + my = -7,$$

Where $m$ is a real constant.

**a.** Find the values of $m$ for which there is a unique solution to the simultaneous equations.

**b.** If possible, determine the value(s) of $m$ for which there are infinitely many solutions.

**c.** If possible, determine the value(s) of $m$ for which there are no solutions.

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**Question 37**

Cam is standing at the point $(1, 6)$ when a bus goes past him. The bus' path is described by the line $2y - 3x = 4$. Find the shortest distance between Cam and the bus.

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## Sub-Section: Exam 2 Questions

**Question 38**

The vertical distance between the function $x^2 + 2$ and the $x$-axis is 3 when $x$ is equal to:

**A.** 1

**B.** 1 and $-1$

**C.** 3

**D.** 3 and $-3$

**Question 39**

The distance between points $A(1, 2)$ and $B(4, 6)$ is:

**A.** 25 units.

**B.** 16 units.

**C.** 9 units.

**D.** 5 units.

**Question 40**

The image of the point $(a, 3)$ after being reflected about the line $y = 2$ is:

**A.** $(a, 1)$

**B.** $(2 - a, 3)$

**C.** $(4 - a, 3)$

**D.** $(a, -1)$

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**Question 41**

The acute angle between the line $3y + \sqrt{3}\,x = 1$ and the $x$-axis is equal to:

**A.** 30°

**B.** 60°

**C.** 150°

**D.** 120°

**Question 42**

Consider the following pair of simultaneous equations.

$$ay + x = 1$$

$$2y + (3 - a)x = 1$$

For what value(s) of $a$ do the equations have infinitely many solutions?

**A.** $a = 1$

**B.** $a = 2$

**C.** $a = 1, 2$

**D.** $a \in \mathbb{R}\backslash\{1, 2\}$

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**Question 43**

Consider the line $l: y = 2x + 3$ and the point $p(1, 0)$.

The shortest distance between $p$ and $l$ is the distance between $p$, and a point $q$ on the line $l$ for which the line segment $pq$ is perpendicular to $l$.

**a.**

**i.** Find the vertical distance between $l$ and $p$.

**ii.** Find the horizontal distance between $l$ and $p$.

**b.** The line $m$ is perpendicular to $l$ and goes through the point $p$. Find the equation of $m$.

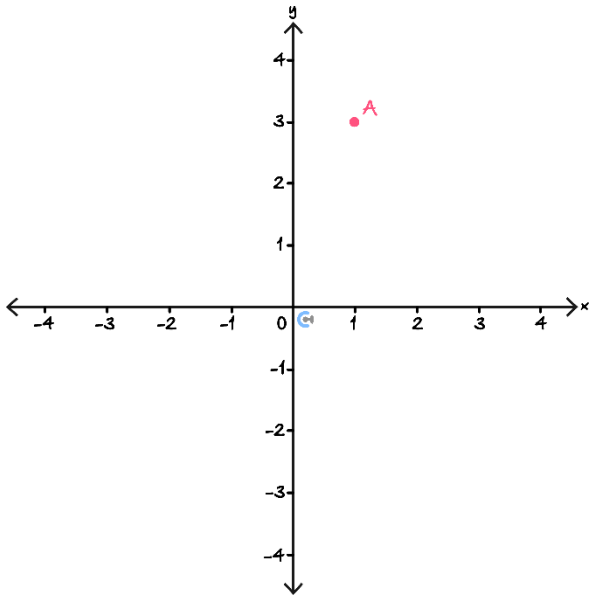
**c.** The point $q$ is the point of intersection between lines $l$ and $m$.
Show, by solving simultaneous equations, that the coordinates of $q$ are $(-1, 1)$.

**d.** Hence, find the shortest distance between the point $p$ and the line $l$.

**e.** Find the image of the point $p$ after being reflected by the line $l$.

**Question 44**

Consider the point $A(1, 3)$, drawn on the axis below.




**i.** The point $B$ is the image of $A$, when reflected in the line $x = -1$.
**ii.** The point $C$ is the image of $A$, when reflected in the line $y = 2$.

**a.** Label the points $B$ and $C$ on the axis above.

**b.** Find the equation of the line going through $B$ and $C$.

**c.** The line $l : y = -\frac{1}{2}x + 2$ is parallel to the line segment $BC$.

**i.** Find the angle $l$ makes with the positive direction of the $x$-axis, correct to the 2 decimal places.

**ii.** Find the acute angle between the line segments $BC$ and $AC$ correct to the 2 decimal places.

**d.** The line $m$ is the image of $l$ after it is reflected along the line going through $A$ and $B$. Find the equation of $m$.

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