IB A&I Maths

Mark Scheme Available here:

Voronoi Diagrams

Mixed Questions on Voronoi Diagrams.

www.addvancemaths.com/ibslai/voronoi/

Name:	
Score:	
Time:	

Instructions

- Use black or blue ball-point pen.
- Answer all the questions in the spaces provided.

Information

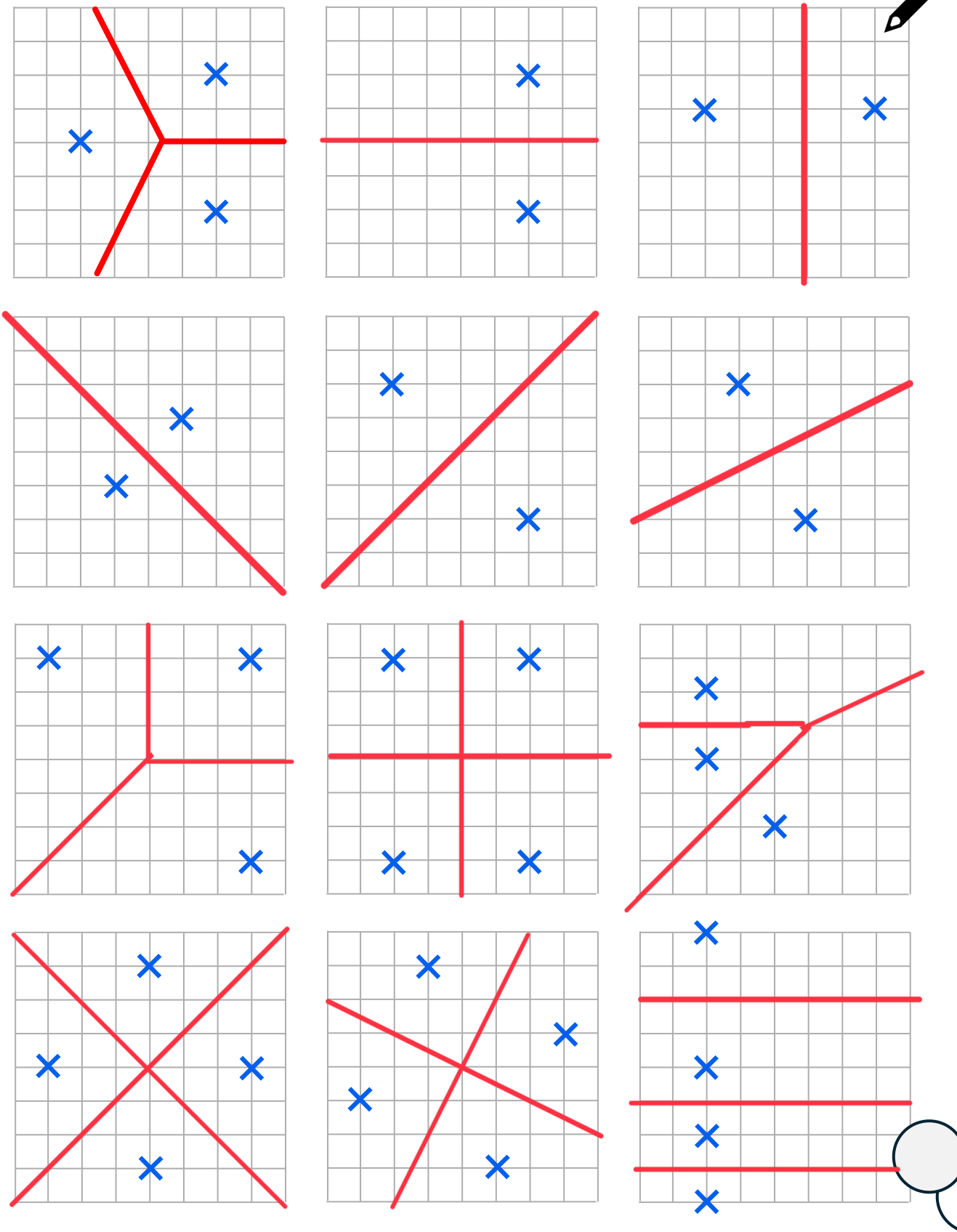
- The marks for each question are shown in the circles.
- You are allowed a calculator for this test. We recommend the Casio CG50.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Voronoi Diagrams

1. The following grids show coordinates of Voronoi Diagram.
Draw the perpendicular bisectors on the grids to complete the Voronoi Diagrams.
The first one has been done for you.



Voronoi Diagrams

2. Calculate the midpoint of the following coordinate pairs.

$(5,6)$, $(7,10)$	(6 , 8)	$(10,6)$, $(10,8)$	(10 , 7)
$(0,2)$, $(8,0)$	(4 , 1)	$(-7,12)$, $(7,10)$	(0 , 11)
$(-2,10)$, $(2,-10)$	(0 , 0)	$(1,5)$, $(2,4)$	(1.5 , 4.5)
$(-1,-7)$, $(3,-9)$	(1 , −6)	$(100,80)$, $(200,70)$	(150 , 75)

8

3. For each of the follow coordinate pairs, state the gradient between them and the perpendicular gradient.
The first one has been done for you.

Coordinates	Gradient	Perpendicular Gradient
$(5,6)$, $(7,14)$	$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{14-6}{7-5} = 4$	$m_p = -1 \div 4 = \frac{-1}{4}$
$(0,0)$, $(7,14)$	$m = 2$	$m_p = -\frac{1}{2}$
$(2,5)$, $(5,20)$	$m = 5$	$m_p = -\frac{1}{5}$
$(-3,3)$, $(5,-5)$	$m = -1$	$m_p = 1$
$(-3,12)$, $(2,-8)$	$m = -4$	$m_p = \frac{1}{4}$
$(1,2)$, $(3,1)$	$m = \frac{-1}{2}$	$m = 2$

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Voronoi Diagrams

4. What is the distance between the following coordinate pairs?

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

a) $(1,2)$, $(4,6)$ Distance = 5

b) $(0,2)$, $(12,-3)$ Distance = 13

c) $(-1,-3)$, $(6,-3)$ Distance = 7

d) $(10,2)$, $(9,8)$ Distance = 6.08...

e) $(11,-1)$, $(12,-3)$ Distance = 2.24

5

5. A line has a gradient of 2 and passes through coordinate $(0,5)$.

a) What is the equation of this line?
Give your answer in the form $y = mx + c$.

$y = 2x + 5$

b) What is the coordinate if the x −intercept?

$(-2.5, 0)$

2

6. A line has a gradient of -1 and passes through coordinate $(4,-1)$.

a) What is the equation of this line?
Give your answer in the form $y = mx + c$.

$y = -x + c$ $\quad -1 = -(4) + c$ $\quad c = 3$

$y = -x + 3$

b) What is the coordinate of the midpoint between the x and y axes intercepts?

$(0,3)$ $\quad (3,0)$

$(1.5, 1.5)$

3

Voronoi Diagrams

7. A line passes through the midpoint of $(3,7)$ and $(9,5)$, and it is perpendicular to $y = 5 - \frac{1}{3}x$.

(6,6)

a) What is the equation of this line?

$m = 3$ $\quad y = 3x + c$

$6 = 3(6) + c \quad c = 12$

$y = 3x + 12$

b) This line passes through the coordinate $(3, k)$.
What is the value of k?

$y = 3x + 12$

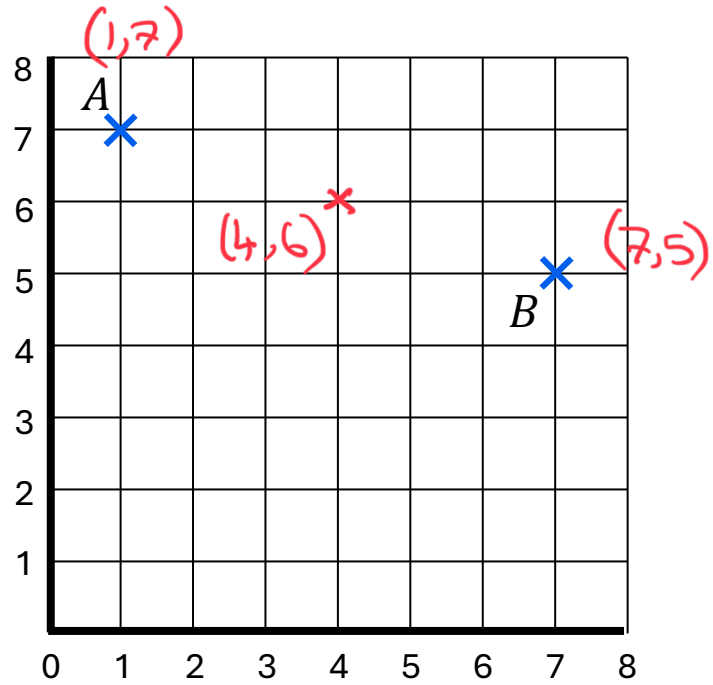
$k = 3(3) + 12$

$k = 21$

$k = 21$

4

8. Look at the graph.



a) What is the distance between A and B?

$d = \sqrt{(7-1)^2 + (5-7)^2}$

$= 6.32$

b) What is the equation of the perpendicular bisector between A and B?

$m = \frac{5-7}{7-1} = \frac{-2}{6} = -\frac{1}{3}$

$m_p = -1 \div -\frac{1}{3} = 3$

Midpoint $= (4,6)$ $\quad y = 3x + c$

$6 = 3(4) + c$

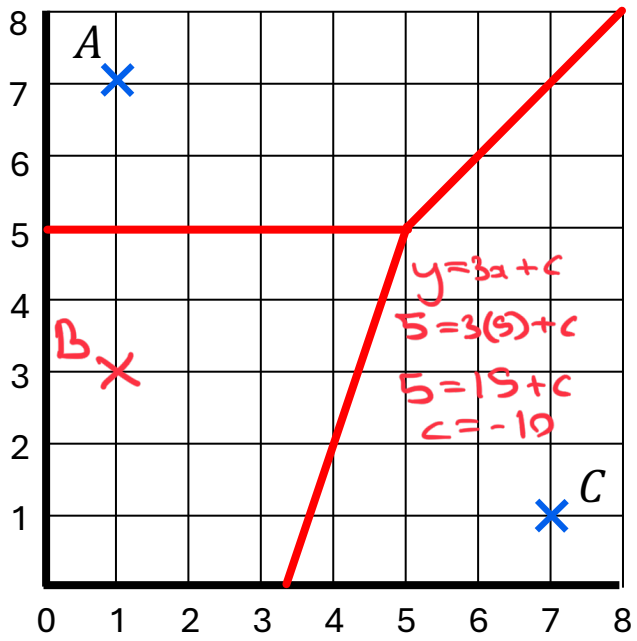
$c = 6$

$y = 3x - 6$

4

Voronoi Diagrams

9. Below is a Voronoi Diagram. Point B is missing.



a) Draw a cross ✕ to indicate the location of point B.

b) What is the equation of the three red lines?

$y = 5$

$y = x$

$y = 3x - 10$

c) Below are some coordinates.
Write the letter of the point closest to each coordinate:

(7,6) C

(3,1) B

(6,4) C

(5,8) A

d) What is the distance between Points A and C?

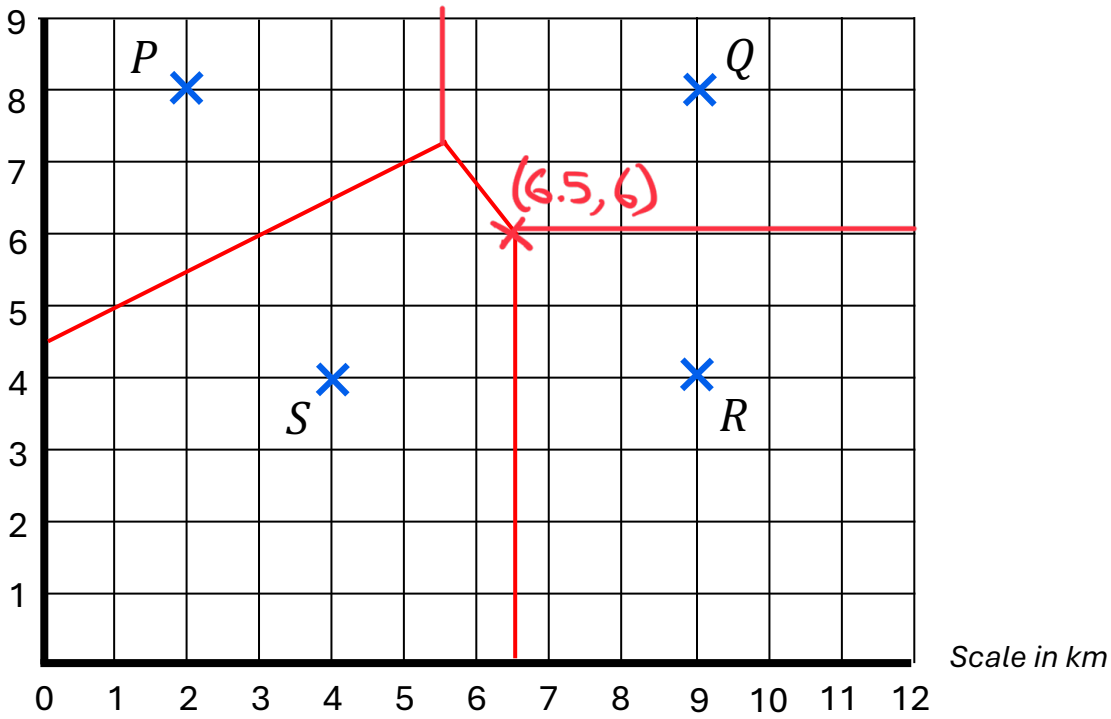
$d = \sqrt{(7-1)^2 + (1-7)^2}$

$d = 8.49$

8.49

Voronoi Diagrams

10. The Voronoi diagram is part of a map which represents the location of helicopters near a national park. If someone is hurt, the mountain rescue service needs to know the fastest helicopter available to support some at any specific location.



a) Two lines are missing from the Voronoi diagram. Use a ruler and pencil to complete the Voronoi diagram.

b) A mountaineer needs assistance at the map coordinate (7,7). Which helicopter should be dispatched to assist?

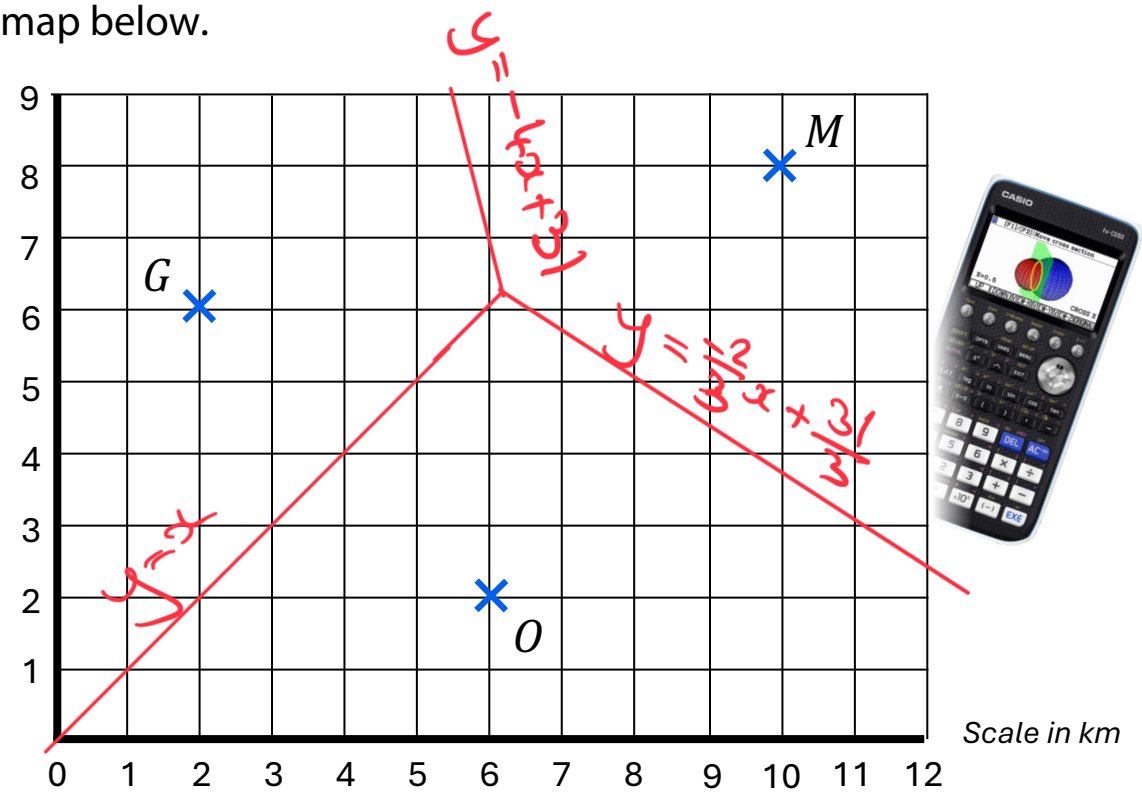
Q

c) A new helicopter base is to be built to cover the area in the triangle SQR. Suggest the coordinate of the new base to have the highest chance of saving more lives. *Justify your answer.*

(6.5, 6) because this is the point furthest from points S, Q and Q.

Voronoi Diagrams

11. Jerry likes going to the gym and shopping. He also goes to work every day at the office.
The locations of the gym (G), shopping mall (M) and office (O) are marked on the map below.



Scale in km

By considering the equations perpendicular bisectors, suggest the coordinate that Jerry should buy a house such that he is equidistance from all three locations.

Give your coordinates to 3 significant figures.

$y = x$ $y = -4x + 31$ $y = -\frac{2}{3}x + 31\frac{1}{3}$

By G-Solve on CG50

(6.2, 6.2)

End of Sheet