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MPM2D AM – Unit 3: Quadratic Relations

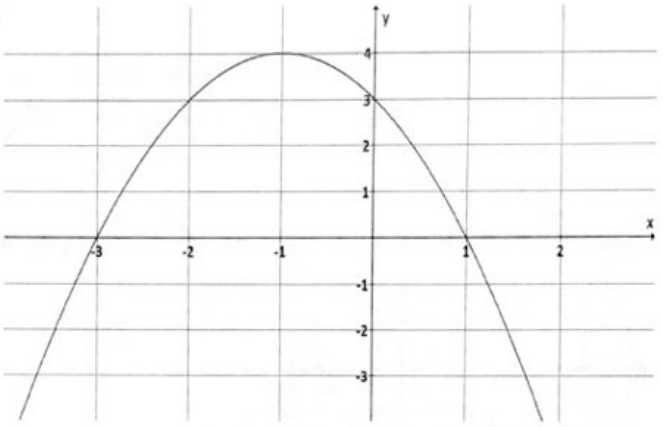
Name: Solutions

November 2022

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Part A (20 marks) – Attempt all questions in Part A before moving on to Part B

1. Use the given graph to state the: [7]



a) coordinates of the vertex: (-1, 4)

b) equation of the axis of symmetry: $x = -1$

c) zeros/x-intercepts: (-3, 0) and (1, 0)

d) y-intercept: (0, 3)

e) Is there a minimum or maximum value? (Circle answer)

f) What is the min/max value? $y = 4$

g) Equation of the parabola in

- Vertex Form: $y = -(x+1)^2 + 4$
- Factored Form: $y = -(x+3)(x-1)$

2. State whether each relation is linear, quadratic or neither. [3]

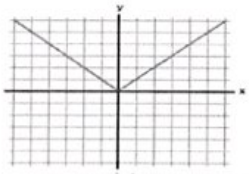
a) $y = 2x$

linear

b) $y = 5 - x^2$

quadratic

c)



neither

d)

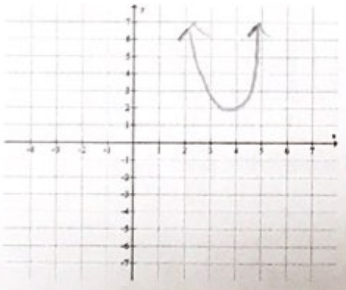
x	y	
-1	15	-7
0	8	-5
1	3	-3
2	0	-1
3	-1	

>2 >2 >2

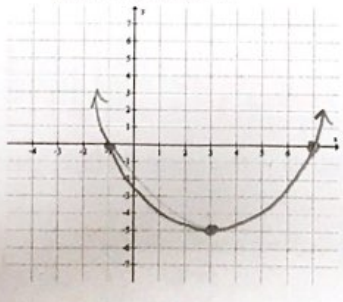
Quadratic

3. Sketch a parabola with the given properties. [4]

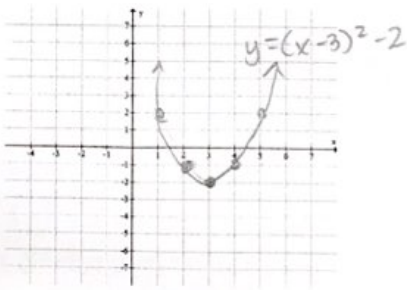
a) opens up with no zeros



b) zeros at -1 and 7 and a minimum at -5



c) $y = (x-3)^2 - 2$, (show 5 nice points)



4. State all transformations, in order, to the graph of $y = x^2$ required to get the given relation. [6]

a) $y = \frac{1}{2}(x+4)^2 - 7$ Compression by 2, translation left 4, down 7

b) $y = -3x^2 + 2$ reflection, stretch by 3, translation up 2

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Part B (23 marks) Attempt all question in Part A before trying Part B. Show your work for full marks.

5. Complete the following table of values for the quadratic relation $y = -x^2 - 4x + 3$. [2]

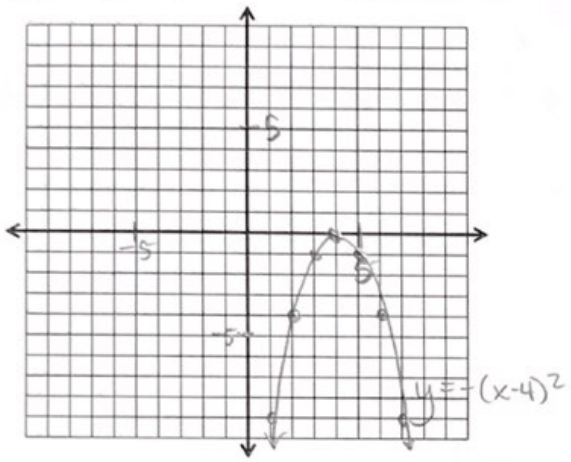
x	y
-2	7
4	-25

$y = -(-2)^2 - 4(-2) + 3$
$= -4 + 8 + 3$
$= 7$

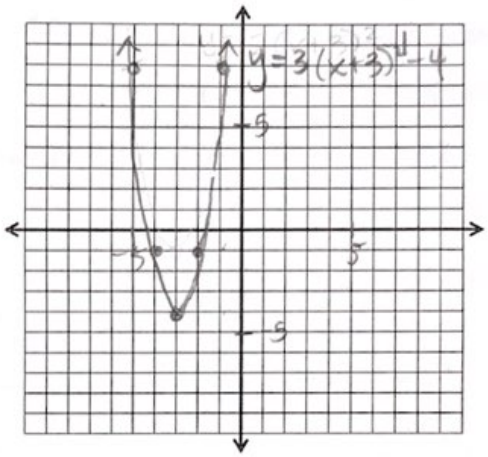
$y = -(4)^2 - 4(4) + 3$
$= -16 - 12 + 3$
$= -25$

6. Sketch the following parabolas on the grids provided. State the vertex and show at least 5 good points. [6]

a) $y = -(x-4)^2$ Vertex: (4,0)



b) $y = 3(x+3)^2 - 4$ Vertex: (-3,-4)



7. a) Given the quadratic relation $y = 2(x+1)(x-3)$, calculate the vertex. [2]

x-int: $x = -1$ and $x = 3$

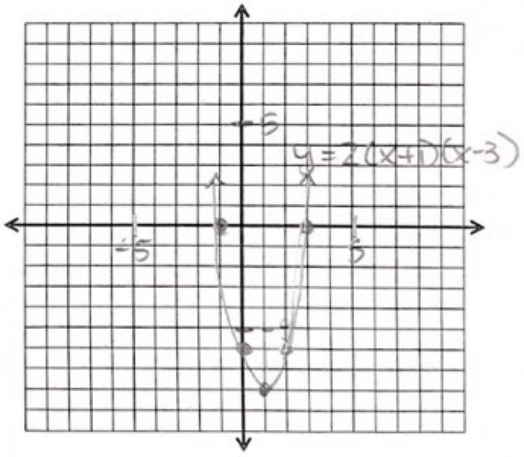
Vertex

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

$x = 1$

$y = 2(1+1)(1-3)$
$= 2(2)(-2)$
$= -8$

b) Graph the parabola from part a), showing the zeros, the vertex and at least two other exact points. [2]



8. Determine algebraically the equation of the parabola with a vertex at (5,2), passing through the point (10,-3). [3]

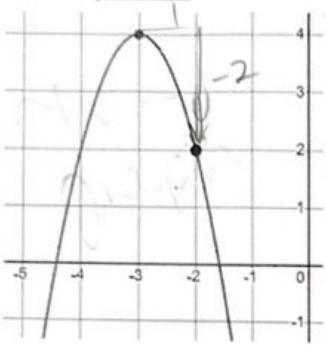
$y = a(x-h)^2 + k$
$-3 = a(10-5)^2 + 2$
$-3-2 = a(5)^2$
$\frac{-5}{25} = \frac{a(25)}{25}$
$-\frac{1}{5} = a$

$\therefore y = -\frac{1}{5}(x-5)^2 + 2$

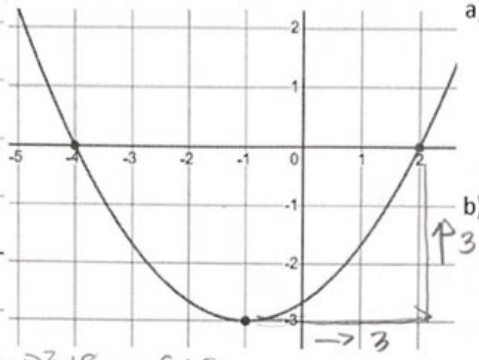
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9. Determine the equation for each quadratic relation, in the form indicated. [4]

GRAPH 1



GRAPH 2



a) GRAPH 1, Equation in Vertex Form

$y = a(x-h)^2 + k$

$y = -2(x+3)^2 + 4$

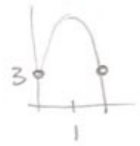
b) GRAPH 2, Equation in Factored Form

$y = a(x-r)(x-s)$

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

$-5(0-1)^2 + 8 = -5+8$

10. The equation $h = -5(t-1)^2 + 8$ models the height, h, of a diver above the water, in meters, t seconds after the diver leaves the springboard. [4]



a) When does the diver reach the ~~peak~~ of the dive? 1 second

b) What is the maximum height the diver reaches? 8 m

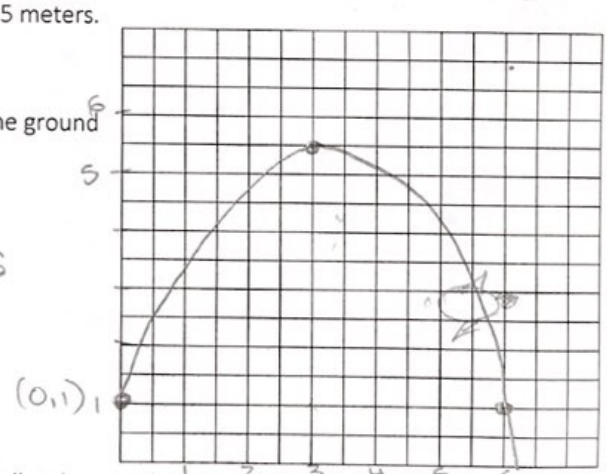
c) How high above the water is the diver at the instant she leaves the springboard? 3m

d) At what time is the diver at this same height again? 2s

Part C (6 marks) Attempt all question in Part B before trying Part C. Show your work for full marks.

11. The height of a ball is tracked in meters above the ground versus horizontal distance travelled, also measured in meters. The ball is thrown into the air from a height of 1 meter, and returns to a height of 1 meter after travelling 6 meters horizontally. The ball reaches a maximum height of 5.5 meters.

a) Sketch the situation on the grid provided. [1]



b) Algebraically determine the equation of the ball's height above the ground with respect to horizontal distance, in vertex form. [3]

$y = a(x-h)^2 + k$

$1 = a(0-3)^2 + 5.5$

$1 - 5.5 = a(9)$

$\frac{-4.5}{9} = \frac{a(9)}{9}$

$a = -\frac{1}{2}$

$y = -\frac{1}{2}(x-3)^2 + 5.5$

c) A bird is flying a horizontal distance of 5 meters from where the ball is thrown. If the bird is 4 meters above the ground, will the ball hit the bird? Prove algebraically. [2] (5, 4)

$y = -\frac{1}{2}(5-3)^2 + 5.5$

$= -\frac{1}{2}(2)^2 + 5.5$

$= -2 + 5.5$

$= 3.5$ m.

∴ The ball will not hit the bird (it travels lower than the bird).