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Unit #4 Test – Vertex Form

VF1	I can identify the vertex and axis of symmetry and explain the roles of a, h, and k as transformations applied to the base curve $y = x^2$ to create $y = a(x - h)^2 + k$.	13

1. What are two things that "a" in the equation of a parabola tell us? **(2 marks)**

- If there is a stretch or compression
- The direction of opening

2. For the following equations of quadratics in vertex form, state the vertex and the axis of symmetry. **(4 marks)**

a. $y = (x + 3)^2 + 5$ b. $y = -6x^2 - 3$

Vertex: $(-3, 5)$ A.O.S. $x = -3$

Vertex $(0, -3)$ A.O.S. $x = 0$

3. For the following equations of quadratics in vertex form, describe the sequence of transformations that you would apply to the graph of $y = x^2$. **(7 marks)**

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

- Vertical compression, factor is $\frac{1}{2}$
- reflection in x-axis
- translated 3 units right
- translated 2 units up

4

b. b. $y = 3(x + 8)^2 + 9$

- Vertical stretch factor of 3
- translated 8 units left
- translated 9 units up

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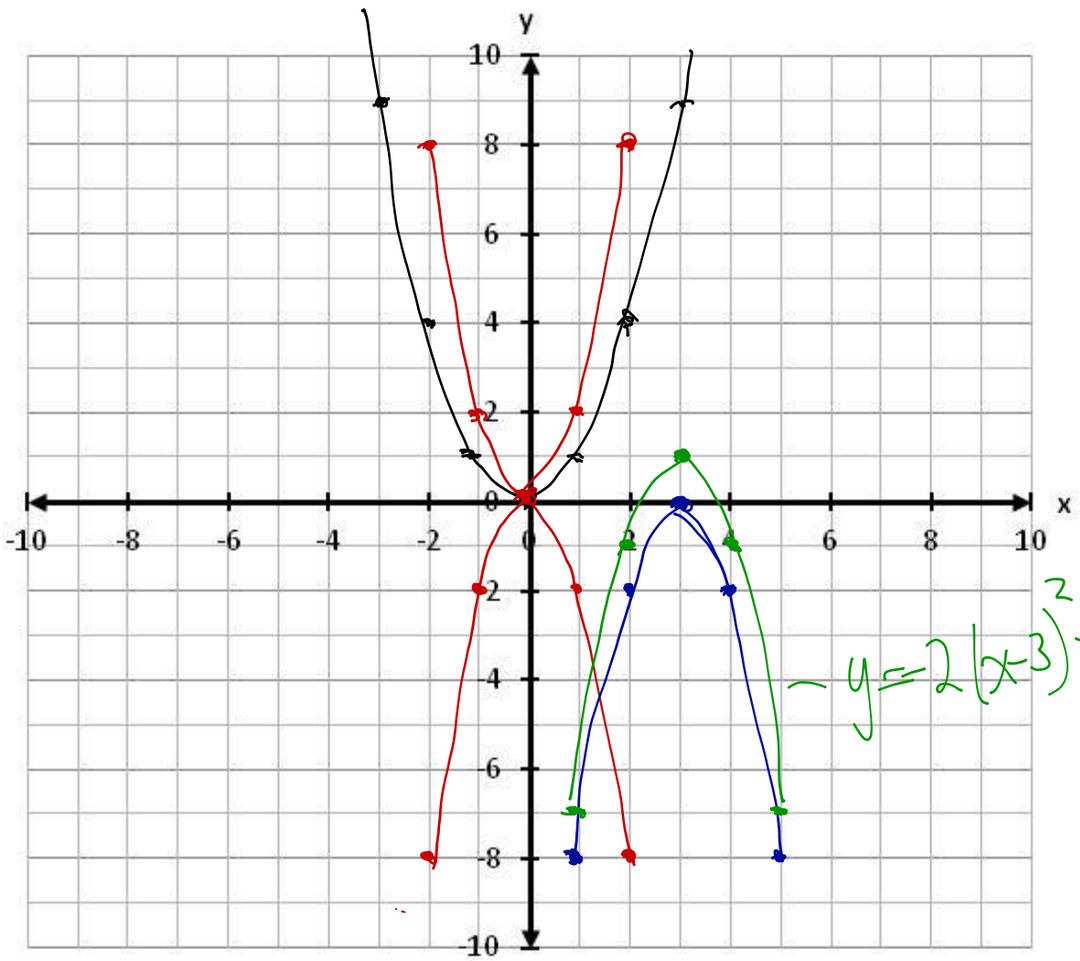
VF2	I can sketch the graph of $y = a(x - h)^2 + k$ by applying transformations to the graph $y = x^2$.	5

4. Graph $y = -2(x-3)^2 + 1$ by applying the transformations to the base curve $y = x^2$ in the correct order. **(5 marks)**



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VF3	I can determine the equation, in vertex form $y = a(x - h)^2 + k$, of a given parabola.	
		21

5. Determine the equation of a quadratic relation in vertex form given that the vertex is at (5, 6) and it passes through the point (1, 18). Show your work. **(4 marks)**

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

$18 = a(1-5)^2 + 6$

$18 = a(-4)^2 + 6$

$18 = 16a + 6$

$18 - 6 = 16a$

$12 = 16a$

$\frac{12}{16} = a$

$\frac{3}{4} = a$

$0.75 = a$

$y = 0.75(x-5)^2 + 6$

6. Express $y = -5(x + 1)^2 + 9$ in standard form. Show your work. **(3 marks)**

Expand & simplify

$y = -5(x+1)^2 + 9$

$y = -5(x+1)(x+1) + 9$

$= -5(x^2 + 1x + 1x + 1) + 9$

$= -5(x^2 + 2x + 1) + 9$

$= -5x^2 - 10x - 5 + 9$

$y = -5x^2 - 10x + 4$

7. A campground charges $20.00 to camp for one night. They average 56 people each night. A recent survey indicated that for every $1.00 decrease in the nightly price, the number of camping sites rented increases by seven. What price will maximize nightly revenue? What is the greatest revenue? Show your work. **(4 marks)**

Let x represent # of $1 price decreases

$R = (\#\text{ of people})(\text{price per person})$

$R = (56 + 7x)(\$20 - \$1x)$

$56 + 7x = 0$

$7x = -56$

$x = -8$

$20 - 1x = 0$

$20 = 1x$

$x = 20$

A.O.S. $x = \frac{20 - 8}{2}$

$$x = \frac{20-8}{2}$$

$$x = \frac{12}{2}$$

$$x = 6$$

$$R = \underbrace{(56+7(6))}_{\#\text{ of people}}\underbrace{(20-1(6))}_{\text{price}}$$

$$= (56+42)(20-6)$$

$$= (98)(14)$$

$$= \$1372$$

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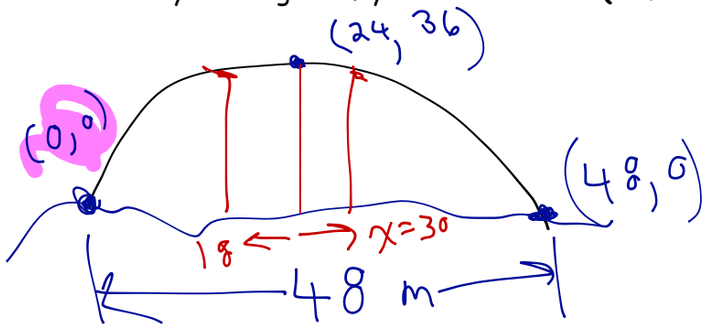
8. The underside of a bridge forms a parabolic arch. The arch has a maximum height of 36 m and a width of 48 m. Can a sailboat pass under the bridge, 6 m from the axis of symmetry, if the top if its mast is 33 m above the water? Justify your solution by showing all of your calculations. **(5 marks)**



Vertex (h,k)
$(24,36)$

Point (x,y)
$(0,0)$

$x = \frac{0+48}{2}$

$x = 24$

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

$0 = a(0-24)^2 + 36$

$0 = 576a + 36$

$-36 = 576a$

$-36/576 = a$ $\quad a = -0.0625$

$\therefore y = -0.0625(x-24)^2 + 36$

$y = -0.0625(30-24)^2 + 36$

$y = -0.0625(6)^2 + 36$

$y = -0.0625(36) + 36$

$y = -2.25 + 36$

$y = 33.75$

$33.75 > 33$

$\therefore$ Sailboat fits

9. Express $y = 5x^2 - 10x + 8$ in vertex form using partial factoring. Show your work. **(5 marks)**

$y = 5x^2 - 10x + 8$

Let $y = 0$

$0 = 5x^2 - 10x + 8$

$0 - 8 = 5x^2 - 10x$

$0 = 5x^2 - 10x$

$0 = 5x(x-2)$

$5x = 0$ $\quad x - 2 = 0$

$x = 0$ $\quad x = 2$

$(0,8)$ $\quad (2,8)$

A.o.s. $x = \frac{0+2}{2}$

$x = 1$

y coord.

$x = 1$

$y = 5x^2 - 10x + 8$

$y = 5(1)^2 - 10(1) + 8$

$y = 5 - 10 + 8$

$y = 3$

Vertex $(1,3)$

$y = 5(x-1)^2 + 3$

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SQ2	I can express $y = ax^2 + bx + c$ in the form $y = a(x - h)^2 + k$ by completing the square in situations involving no fractions.	7

10. Complete the square to write the quadratic relation **$y = 7x^2 - 56x + 16$** in vertex form. **(4 marks)**

$y = 7x^2 - 56x + 16$

$y = 7(x^2 - 8x) + 16$

$\left(\frac{-8}{2}\right)^2 = (-4)^2 = 16$

$y = 7(x^2 - 8x + 16 - 16) + 16$

$y = 7(x^2 - 8x + 16) - 112 + 16$

$y = 7(x - 4)^2 - 96$

Vertex $(4, 96)$

11. Suppose the quadratic relation $y = 4x^2 + 3x + 9$ was written in the form $y = a(x - h)^2 + k$. What is the value of a? **(1 mark)**

$a = 4$

12. What values would you add and subtract to make the expression **$x^2 + 28x$** a perfect square? **(2 marks)**

$\left(\frac{28}{2}\right)^2 = 14^2 = 196$

add and subtract 196

SQ3	I can develop the quadratic formula and use it to interpret real or non-real roots of quadratic equations.	6

13. Use the quadratic formula to determine the solutions to the equation **$8x^2 - 2x - 16 = 0$. (6 marks)**

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = 8$, $b = -2$, $c = -16$

$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(8)(-16)}}{2(8)}$

$x = \frac{2 \pm \sqrt{4 - (-512)}}{16}$

$x = \frac{2 \pm \sqrt{4 + 512}}{16}$

$x = \frac{2 \pm \sqrt{516}}{16}$

$x = \frac{2 \pm 22.7}{16}$

$x = \frac{2 + 22.7}{16}$ $\quad x = \frac{2 - 22.7}{16}$

$x = \frac{24.7}{16}$ $\quad x = \frac{-20.7}{16}$

$x = 1.54$ $\quad x = -1.3$

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Unit 7: Trigonometry–Quiz #14

TR2	I can define the sine, cosine, and tangent ratios and use them and the Pythagorean theorem to solve for side lengths and angles in right triangles.	10

1. Solve for x to one decimal place. **(3 marks)**

a) $\sin 39° = \frac{x}{7}$ $x = 7(\sin 39°)$ $x \doteq$ 4.4

b) $\cos 65° = \frac{x}{10}$ $x = 10(\cos 65°)$ $x \doteq$ 4.2

c) $\tan 49° = \frac{31}{x}$ $x = \frac{31}{\tan 49°}$ $x \doteq$ 26.9

2. Solve for $\angle A$ to the nearest degree. **(3 marks)**

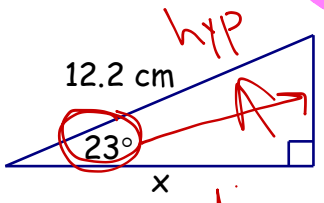
a) $\sin A = \frac{5}{8}$ $\angle A = \sin^{-1}(5/8)$ $\angle A \doteq$ 39°

b) $\cos A = \frac{13}{22}$ $\angle A = \cos^{-1}(13/22)$ $\angle A \doteq$ 54°

c) $\tan A = \frac{19}{25}$ $\angle A \doteq$ 37°

$\angle A = \tan^{-1}(19/25)$

3. Calculate x to the nearest tenth of a centimetre. Show your work. **(2 marks)**



hyp, opp, adj

1 decimal place

SOH CAH TOA

hyp = 12.2

adj = x

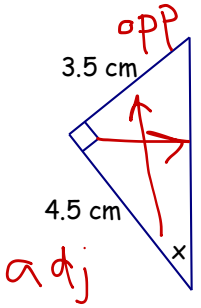
$\cos 23° = \frac{adj}{hyp}$

$\cos 23° = \frac{x}{12.2}$

$x = 12.2(\cos 23°)$

$x = 11.2$ cm

4. Calculate x to the nearest degree. Show your work. **(2 marks)**



opp, hyp, adj

SOH CAH TOA

opp = 3.5

adj = 4.5

$\tan x = \frac{opp}{adj}$

$\tan x = \frac{3.5}{4.5}$

$\angle x = \tan^{-1}\left(\frac{3.5}{4.5}\right)$

$\angle x = 38°$

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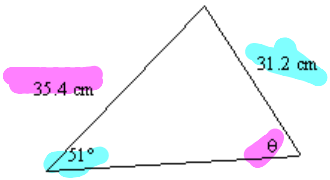
TR3	I can explore the development of the sine law and cosine law within acute triangles and use them to solve for side lengths and angles.	
		10

1. Find the measure of angle θ to the nearest degree. Show your work. **(3 marks)**



2 side lengths + 1 opp angle ∴ sin law

$\frac{\sin\theta}{35.4} = \frac{\sin 51^\circ}{31.2}$

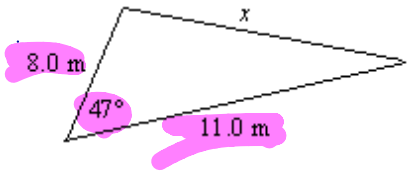
$\sin\theta = \frac{(35.4)(\sin 51^\circ)}{31.2}$

$\sin\theta = 0.88176$

$\theta = \sin^{-1}(0.88176)$

$\theta = 62^\circ$

2. Find the length of x to the nearest tenth of a metre. Show your work. **(3 marks)**



2 sides & 1 angle between

Cosine law

$a^2 = b^2 + c^2 - 2bc(\cos A)$

$x^2 = 8^2 + 11^2 - 2(8)(11)(\cos 47^\circ)$

$x^2 = 64 + 121 - 120$

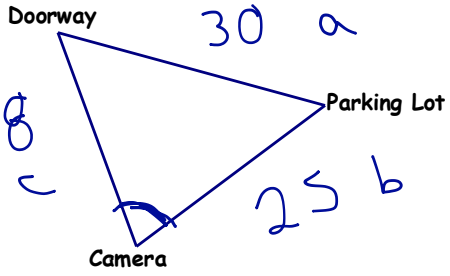
$x^2 = 185 - 120$

$x^2 = 65$

$x = \sqrt{65}$

$x \doteq 8.1\text{m}$

3. A security camera needs to be set so that its angle of view includes the area from a doorway to the edge of a parking lot. The doorway is 18 m from the camera. The edge of the parking lot is 25 m from the camera. The doorway is 30 from the edge of the parking lot. What angle of view is needed from the camera? **(4 marks)**



$a^2 = b^2 + c^2 - 2bc(\cos A)$

$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

$\cos A = \frac{25^2 + 18^2 - 30^2}{2(25)(18)}$

$\cos A = 49/900$

$\angle A = \cos^{-1}(49/900)$

$\angle A = 87^\circ$

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