5.1 Stretching and Reflecting Quadratic Relations

1a) iv
b) iii
c) i
d) ii

2a) $(1,1)$, $a=5$ $\xrightarrow{\times 5}$ $(1,5)$

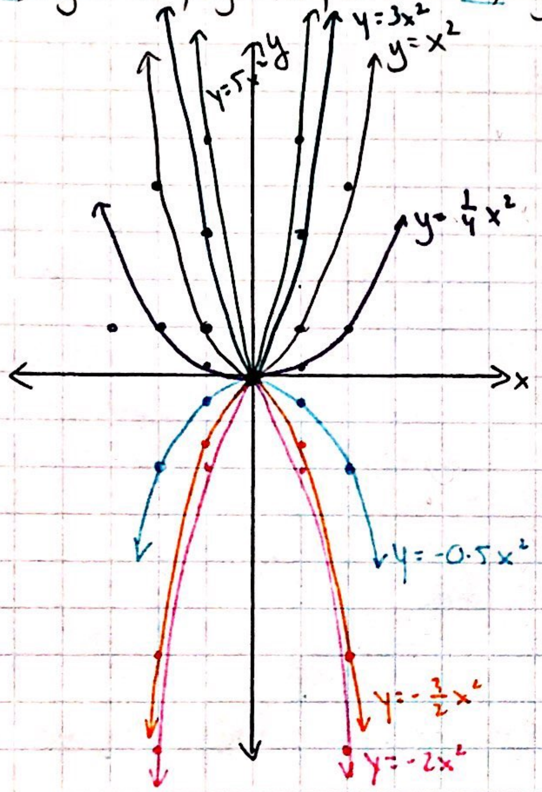
b) $(-2,4)$, $a=-3$ $\xrightarrow{\times -3}$ $(-2,-12)$

c) $(5,25)$, $a=-0.6$ $\xrightarrow{\times -0.6}$ $(5,15)$

d) $(-4,16)$, $a=\frac{1}{2}$ $\xrightarrow{\times \frac{1}{2}}$ $(-4,8)$

3a) $y=2x^2$, $y=4x^2$, etc b) $y=-\frac{1}{3}x^2$, $y=-\frac{1}{2}x^2$, etc c) $y=-4x^2$, $y=-5x^2$, etc

4.



		a)	b)	c)	d)	e)	f)
x	$y=x^2$	$y=3x^2$	$y=-0.5x^2$	$y=-2x^2$	$y=\frac{1}{4}x^2$	$y=-\frac{3}{2}x^2$	$y=5x^2$
-2	4	12	-2	-8	1	-6	20
-1	1	3	-0.5	-2	1/4	-3/2	5
0	0	0	0	0	0	0	0
1	1	3	-0.5	-2	1/4	-3/2	5
2	4	12	-2	-8	1	-6	20

5a) v.s. by a factor of 5, $y=5x^2$
b) v.c. by a factor of $\frac{1}{2}$, reflect over x; $y=-\frac{1}{2}x^2$
c) reflect over x-axis, v.s. by a factor of 2.5; $y=-2.5x^2$
d) v.c. by a factor of $\frac{1}{4}$; $y=\frac{1}{4}x^2$

6. Move over two and down $\frac{1}{2}$ from the vertex. Usually you would go over 2 and up 4. $4 \times -\frac{1}{8}$ is $-\frac{1}{2}$, so the equation is $y=-\frac{1}{8}x^2$.

7a) $y=ax^2$, point at $(3,-3)$
$-3=a(3)^2$
$-3=9a$
$-\frac{1}{3}=a$
$y=-\frac{1}{3}x^2$

b) $y=ax^2$, point at $(-3,-2)$
$-2=a(-3)^2$
$-2=9a$
$-\frac{2}{9}=a$
$y=-\frac{2}{9}x^2$

8.a) v.s. by a factor of 4.
$(2,4) \xrightarrow{(x,4y)} (2,16)$

b) v.c. by a factor of $\frac{2}{3}$, v. ref.
$(2,4) \xrightarrow{(x,-\frac{2}{3}y)} (2,-8/3)$

c) v.c. by a factor of 0.25
$(2,4) \xrightarrow{(x,0.25y)} (2,1)$

d) v. reflection, v.s. by a factor of 5
$(2,4) \xrightarrow{(2,-5y)} (2,-20)$

e) reflect over the x-axis
$(2,4) \xrightarrow{(x,-y)} (2,-4)$

f) v.c. by a factor of 1/5
$(2,4) \xrightarrow{(2,\frac{1}{5}y)} (2,4/5)$

10. a values of 1 or -1 result in the same shape.

11.

Equation	Opens	Stretch/compress	Wider/Narrower
a) $y=5x^2$	up	stretch	narrow
b) $y=0.25x^2$	up	compress	wide
c) $y=-\frac{1}{3}x^2$	down	compress	wide
d) $y=-8x^2$	down	stretch	narrow.

12a) $a<0$ means a is $\ominus$.
b) Multiplying by a proper fraction makes y smaller
c) No shift.

5.2 Exploring Translations of Quadratic Relations

1a) $h=3$, $k=0$
$y=(x-3)^2$

b) $k=-4$, $h=0$
$y=x^2-4$

c) $h=-2$, $k=0$
$y=(x+2)^2$

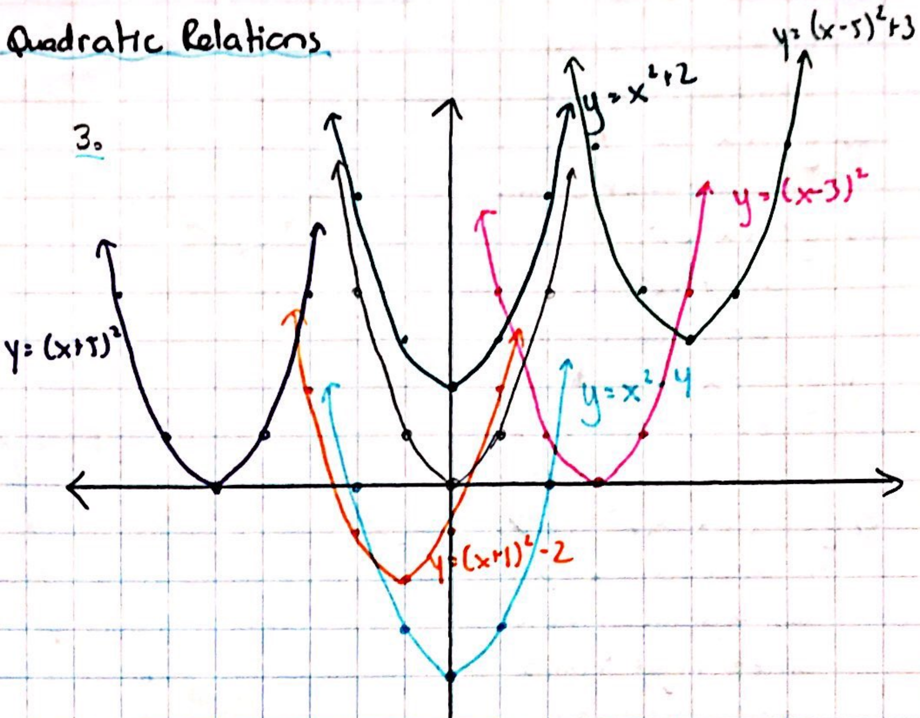
d) $k=5$, $h=0$
$y=x^2+5$

e) $k=-7$, $h=-6$
$y=(x+6)^2-7$

f) $h=2$, $k=5$
$y=(x-2)^2+5$

2a) (ii)
b) (v)
c) (i)
d) (v)

3.



4a) $y=x^2+5$
• shift up 5 units

b) $y=(x-3)^2$
• shift left 3 units

c) $y=-3x^2$
• reflect over x-axis
• v.s. by a factor of 3

d) $y=(x+7)^2$
• shift left 7 units

e) $y=\frac{1}{2}x^2$
• v.c. by a factor of $\frac{1}{2}$

f) $y=(x+6)^2+12$
• shift left 6 units and up 12 units.

5.

	Equation	Vertex	A of S
a)	$y=x^2+5$	(0,5)	$x=0$
b)	$y=(x-3)^2$	(3,0)	$x=3$
c)	$y=-3x^2$	(0,0)	$x=0$
d)	$y=(x+7)^2$	(-7,0)	$x=-7$
e)	$y=\frac{1}{2}x^2$	(0,0)	$x=0$
f)	$y=(x+6)^2+12$	(-6,12)	$x=-6$

5.3 Graphing Quadratics in Vertex Form

1a) $y=x^2-3$
• shift down 3 units

b) $y=(x+5)^2$
• shift left 5 units

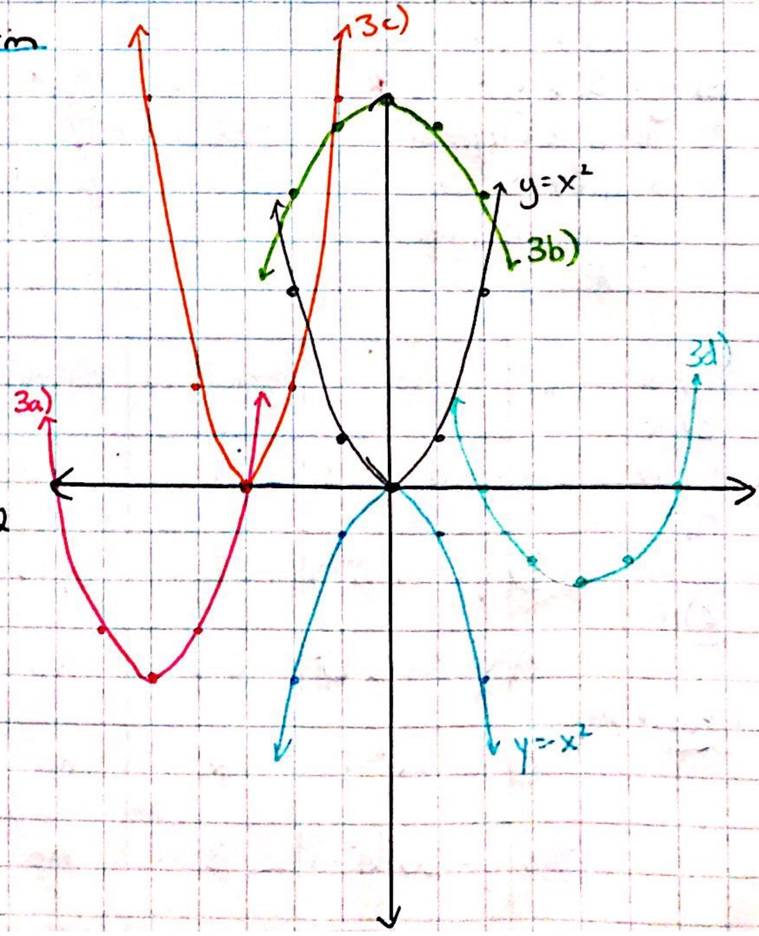
c) $y=-\frac{1}{2}x^2$
• reflect over x-axis
• v.c. by a factor of $\frac{1}{2}$

d) $y=4(x+2)^2-16$
• vs by a factor of 4
• shift left 2 units and down 16 units

2a) opens up, $(0,-3)$, $x=0$
b) opens up, $(-5,0)$, $x=-5$
c) opens down, $(0,0)$, $x=0$
d) opens up, $(-2,-16)$, $x=-2$

3.

x	$y=x^2$	$y=-x^2$	$y=-\frac{1}{2}x^2$	$y=2x^2$
-2	4	-4	-2	8
-1	1	-1	$-\frac{1}{2}$	2
0	0	0	0	0
1	1	-1	$-\frac{1}{2}$	2
2	4	-4	-2	8



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4a) $y = -x^2 + 9$ ★
- reflect over x-axis
- shift up 9 units

b) $y = (x-3)^2$ ★
- shift right 3 units

c) $y = (x+2)^2 - 1$ ★
- shift left two units and down 1 unit.

d) $y = -x^2 - 6$ ★
- reflect over x-axis
- shift down 6 units

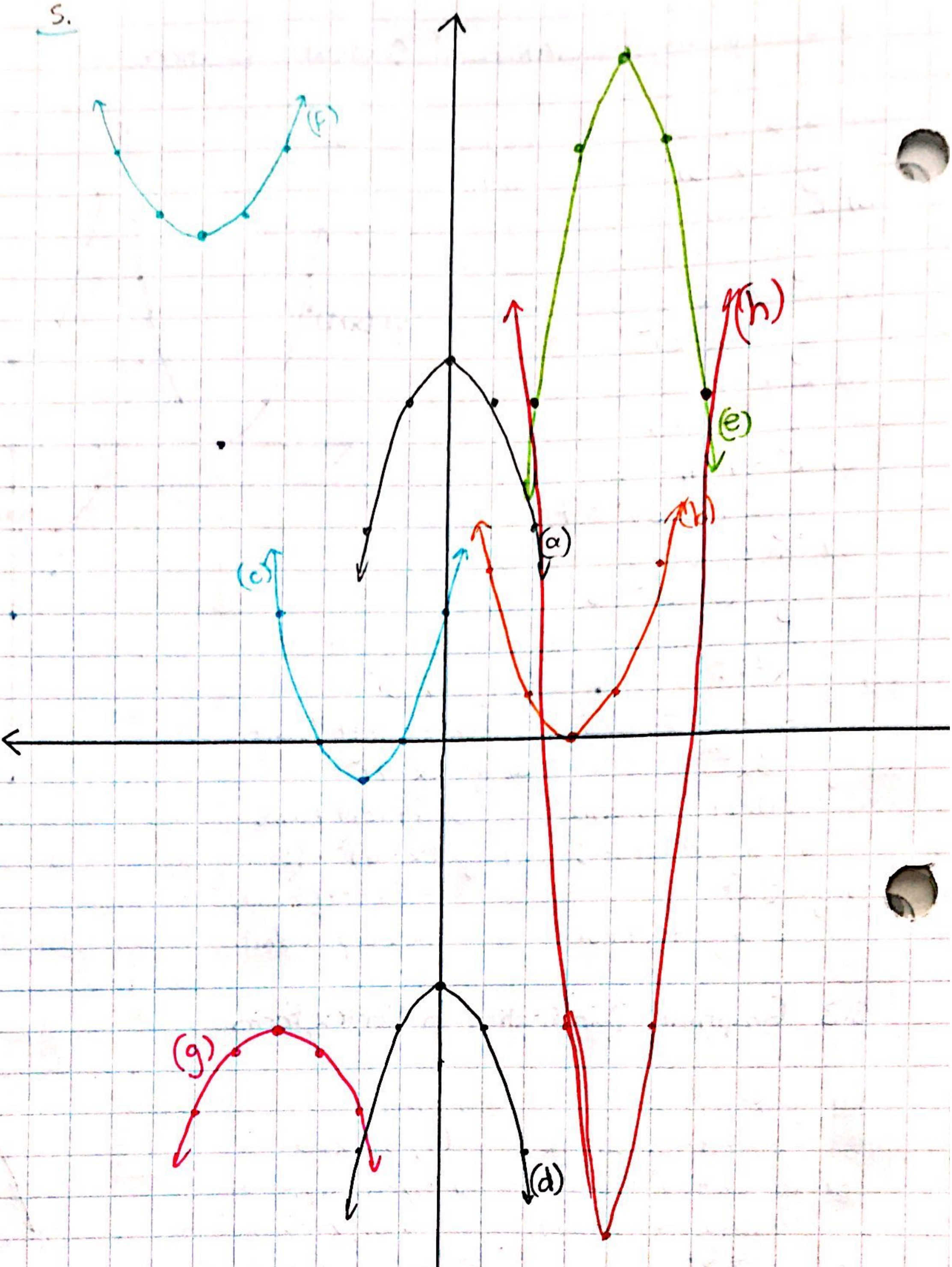
e) $y = -2(x-4)^2 + 16$ ★
- reflect over x-axis
- v.s. by a factor of 2
- shift right 4 units and up 16 units

f) $y = \frac{1}{2}(x+6)^2 + 12$ ★
- v.c. by a factor of $\frac{1}{2}$
- shift left 6 units + up 12 units.

g) $y = -\frac{1}{2}(x+4)^2 - 7$ ★
- reflect over x-axis
- v.c. by a factor of $\frac{1}{2}$
- shift 4 units left and 7 units down

h) $y = 5(x-4)^2 - 12$ ★
- v.s by a factor of 5
- shift 4 units right + 12 units down.

5.



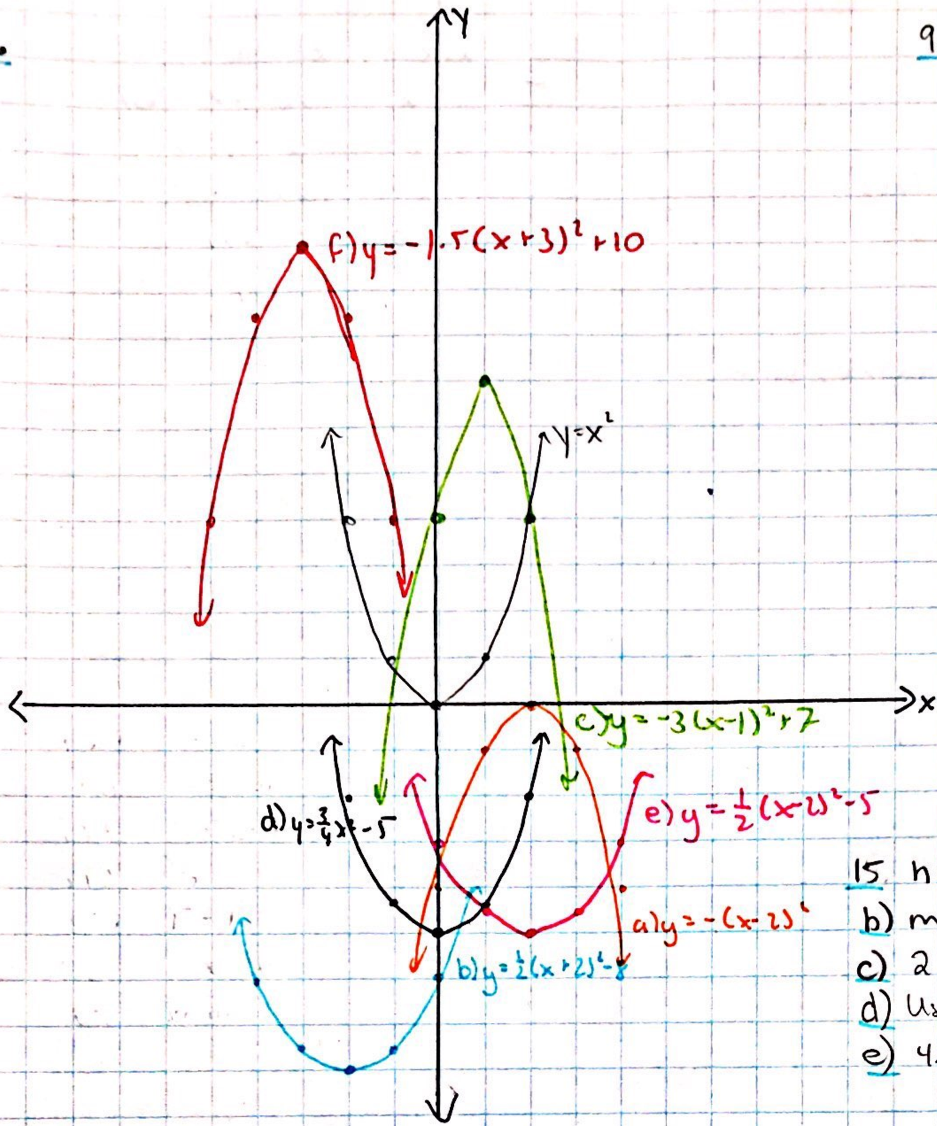
6a) ii
b) v
c) iv
d) vi
e) i
f) iii)

7 → next page

8.

	Relation	Stretch/Comp Factor	Reflection?	Translation	Vertex	A of S
a)	$y=4(x+2)^2-3$	4	no	←2, ↓3	$(-2,-3)$	$x=-2$
b)	$y=-(x-1)^2+4$	1	yes	→1, ↑4	$(1,4)$	$x=1$
c)	$y=0.8(x-6)^2$	0.8	no	→6	$(6,0)$	$x=6$
d)	$y=2x^2-5$	2	no	↓5	$(0,-5)$	$x=0$
Top	$y=3(x-2)^2-5$	3	no	→2, ↓5	$(2,-5)$	$x=2$

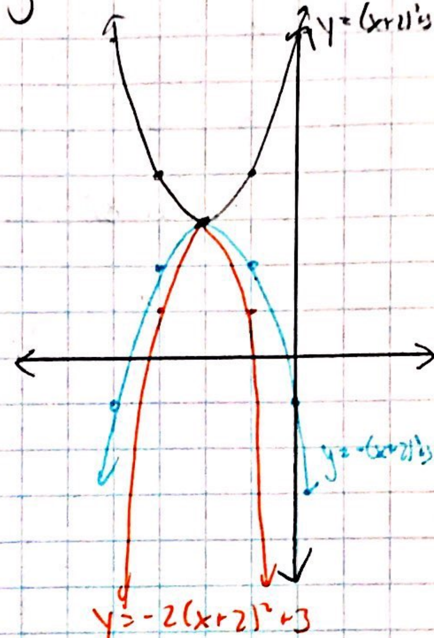
7.



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

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

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



15. $h=-5(t-2)^2+21$

b) max height is 21m

c) 2 seconds

d) Use your graph to estimate

e) 4.05 seconds.

10. $h=-0.5(g-r)t^2+t$

$g=9.8$

$r_1=0.6$ (bedsheet)

$r_2=2.1$ (car tarp)

$r_3=8.9$ (parachute)

a) Bed sheet

$h=-0.5(9.2)t^2+100$

$h=-4.6t^2+100$

Car tarp

$h=-0.5(7.7)t^2+100$

$=-3.85t^2+100$

Parachute

$h=-0.5(0.9)t^2+100$

$=-0.45t^2+100$

b) yes, but the parachute would need to be much closer to the ground.

11a) $y=-x^2+5$

b) $y=5(x+2)^2$

c) $y=\frac{1}{5}x^2-6$

d) $y=-6(x-3)^2+4$

13. $y=-\frac{2}{3}(x-3)^2+5$

Vertex: (3, 5)

Opens down

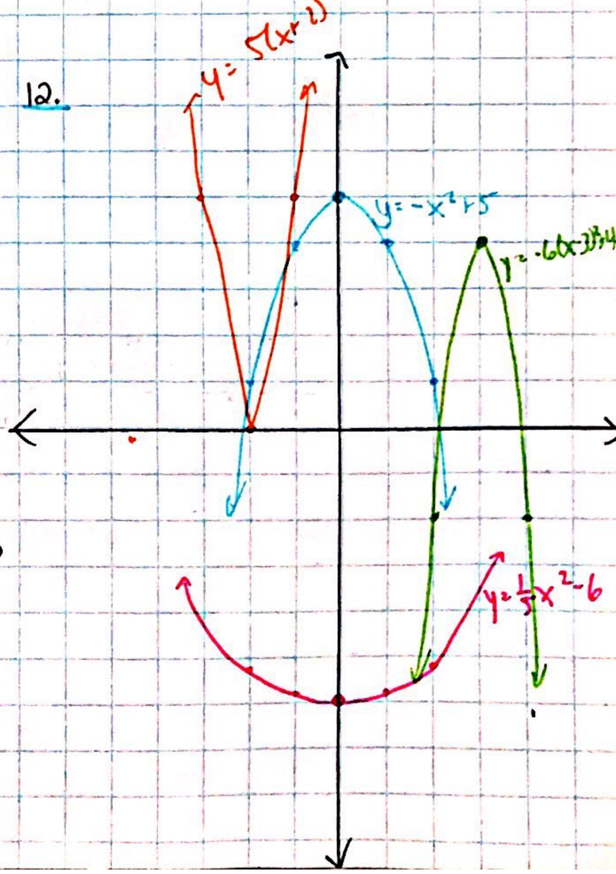
Compressed.

14. $h=-5(t-4)^2+2500$

a) 4 seconds

b) 2500m

12.



17. $y = 2(x-4)(x+10)$

Vertex:

$x = \frac{4-10}{2}$ $y = 2(-7)(7)$

$= -98$

$x = -3$

$y = 2(x+3)^2 - 98$ (vertex form)

$y = 2(x-4)(x+10)$
$= 2(x^2 + 10x - 4x - 40)$
$= 2(x^2 + 6x - 40)$
$= 2x^2 + 12x - 80$
(standard form)

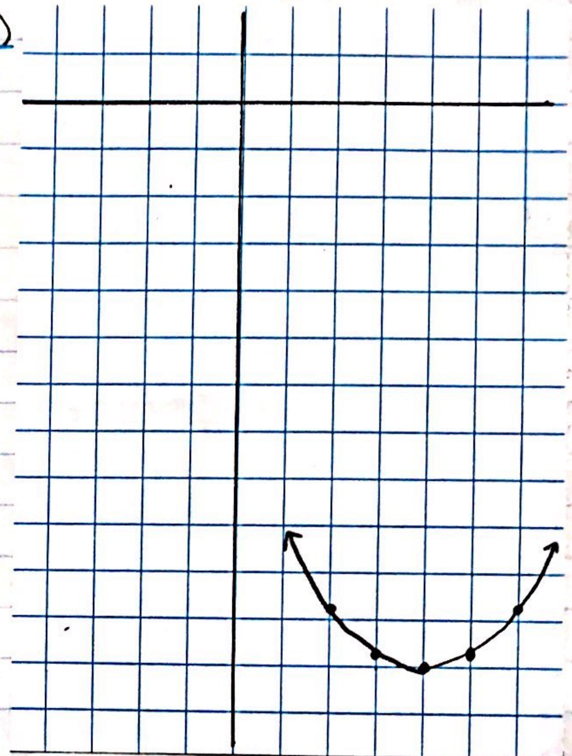
5.4 Quadratic Models Using Vertex Form

1a) iii
b) iv
c) i
d) ii

2a) $y = a(x-4)^2 - 12$
b) $15 = a(13-4)^2 - 12$
$27 = 81a$
$\frac{1}{3} = a$
c) $y = \frac{1}{3}(x-4)^2 - 12$

d) • v.s. by a factor of $\frac{1}{3}$
• shift right 4 units + down 12 units

e)



3a) $y = \frac{1}{4}x^2$ (step pattern)
b) vertex $(-1, 0)$, point $(-2, 2)$
$2 = a(-2+1)^2 + 0$
$2 = a$
$y = 2(x+1)^2$
c) vertex $(0, 4)$, point $(2, 0)$
$0 = a(2-0)^2 + 4$
$-4 = 4a$
$-1 = a$
$y = -x^2 + 4$
d) vertex $(1, 2)$ point $(-1, -2)$
$-2 = a(-1-1)^2 + 2$
$-4 = 4a$
$-1 = a$
$y = -(x-1)^2 + 2$
e) vertex $(2, 4)$, point $(3, 1)$
$1 = a(3-2)^2 + 4$
$-3 = a$
$y = -3(x-2)^2 + 4$
f) vertex $(-2, -3)$, point $(-3, 2)$
$2 = a(-3+2)^2 - 3$
$5 = a$

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

4a) $y = 4x^2$
b) $y = (x+3)^2$
c) $y = -x^2 + 2$
d) $y = \frac{1}{2}x^2$
e) $y = (x-5)^2 - 4$
f) $y = -2(x-1)^2$

5a) $y = x^2 + 4$
b) $y = -(x-5)^2$
c) $y = -2(x-2)^2 - 3$
d) $y = -\frac{1}{2}(x+3)^2 + 5$
e) $y = 2(x-4)^2 - 3$
f) $y = -\frac{1}{2}(x-3)^2 - 4$

6a) $1 = a(-4+2)^2 + 3$

$-2 = 4a$

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

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

b) $1 = a(0+1)^2 - 1$

$2 = a$

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

c) $6 = a(-5+2)^2 - 3$

$9 = 9a$

$1 = a$

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

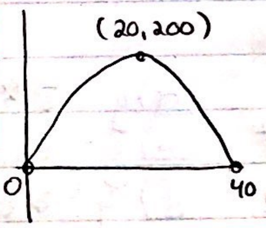
d) $-4 = a(1+2)^2 + 5$

$-9 = 9a$

$-1 = a$

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

14.



- find an equation in factored form
- find an equation in vertex form.

18. $a = 3$, so

$y = 3(x+1)^2 + 4$

$y = 3(x^2 + 2x + 1) + 4$

$= 3x^2 + 6x + 7$

so $b = 6$, $c = 7$

7a) $x = 5$

$y = -4(x-5)^2 + 3$

8. vertex: $(3,2)$, point $(6,0)$

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

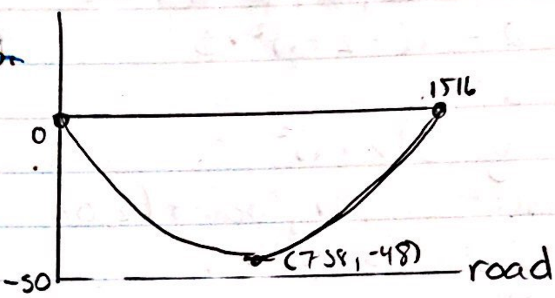
$0 = a(6-3)^2 + 2$

$-2 = 9a$

$-2/9 = a$

$y = -2/9(x-3)^2 + 2$

13.



$0 = a(0-758)^2 - 48$

$48 = 574564a$

$\frac{12}{143641} = a$

$y = \frac{12}{143641}(x-758)^2 - 48$

15. $(75, 1600)$ vertex $(50, 1225)$ point

$1225 = a(50-75)^2 + 1600$

$-375 = 625a$

$-\frac{3}{5} = a$

$y = -\frac{3}{5}(x-75)^2 + 1600$

17a) $y = 2(x-1)^2 - 1$

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

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

d) $y = 12(x-1)^2 - 1$

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

19. $a(x-h)^2 + k = 0$

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

$(x-h)^2 = -k/a$

$x - h = \pm\sqrt{-k/a}$

$x = \pm\sqrt{-k/a} + h$

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5.5 Solving Problems Using Quadratic Relations

1a) $y = 2x^2 + 3$
b) $y = 3(x-2)^2$
c) $y = -(x-3)^2 - 2$
d) $y = 0.5(x+3.5)^2 + 18.3$

2a) $y = 3$ (min)
b) $y = 0$ (min)
c) $y = 2$ (max)
d) $y = 18.3$ (min)

3a) $-1.5 = a(5)^2$
$-\frac{3}{50} = a$
$y = -\frac{3}{50}x^2$
b) The values of 'a' are equal.

4a) $-5 = a(2-0)^2 + 3$
$-5 = 4a + 3$
$-8 = 4a$
$-2 = a$
$y = -2x^2 + 3$

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

c) $14 = a(-1+3)^2 + 2$
$12 = 4a$
$3 = a$
$y = 3(x+3)^2 + 2$

d) $-8 = a(1-5)^2 - 3$
$-5 = 16a$
$-5/16 = a$
$y = -5/16(x-5)^2 - 3$

5a) $0 = a(1+1)^2 - 4$
$4 = 4a$
$1 = a$
$y = (x+1)^2 - 4$

b) $6 = a(6-4)^2 - 2$
$8 = 4a$
$2 = a$
$y = 2(x-4)^2 - 2$

c) $0 = a(6-4)^2 + 4$
$-4 = 4a$
$-1 = a$
$y = -(x-4)^2 + 4$

d) $2 = a(0-2)^2 + 4$
$-2 = 4a$
$-\frac{1}{2} = a$
$y = -\frac{1}{2}(x-2)^2 + 4$

6a) $y = (x+1)(x+1) - 4$
$= x^2 + 2x + 1 - 4$
$= x^2 + 2x - 3$

b) $y = 2(x-4)(x-4) - 2$
$= 2(x^2 - 8x + 16) - 2$
$= 2x^2 - 16x + 30$

c) $y = -(x-4)(x-4) + 4$
$= -(x^2 - 8x + 16) + 4$
$= -x^2 + 8x - 12$

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

7. $y = a(x-r)(x-s)$
$8 = a(0-8)(0+2)$
$8 = -16a$
$-\frac{1}{2} = a$
$y = -\frac{1}{2}(x-8)(x+2)$
$y = -\frac{1}{2}(3-8)(3+2)$
$= -\frac{1}{2}(-5)(5)$
$= \frac{25}{2}$
$\therefore y = -\frac{1}{2}(x-3)^2 + \frac{25}{2}$

Vertex:
$x = \frac{-2+8}{2}$
$x = 3$

8. $y = 2(x+4)^2 - 7$
$y = 2(x-1)^2 - 10$
minimum is $y = -10$

9a) $y = (x-4)(x-4) - 1$
$= x^2 - 8x + 15$
$= (x-5)(x-3)$

b) $y = 2(x+1)(x+1) - 18$
$= 2(x^2 + 2x + 1) - 18$
$= 2x^2 + 4x - 16$
$y = 2(x^2 + 2x - 8)$
$= 2(x-2)(x+4)$

9c) $y = -(x+5)(x+5) + 1$
$= -(x^2 + 10x + 25) + 1$
$= -x^2 - 10x - 24$
$y = -(x^2 + 10x + 24)$
$= -(x+6)(x+4)$

d) $y = -3(x+3)(x+3) + 75$
$= -3(x^2 + 6x + 9) + 75$
$= -3x^2 - 18x + 48$
$y = -3(x^2 + 6x - 16)$
$= -3(x+8)(x-2)$

10a) $y = 2x^2 - 12x$

$y = 2x(x-6)$

zeros: $(0,0) + (6,0)$

vertex: $x = 3$

$y = 2(3)^2 - 12(3)$

$= 18 - 36$

$= -18$

Vertex: $(3, -18)$

$y = 2(x-3)^2 - 18$

b) $y = -2x^2 + 24x - 64$

$= -2(x^2 - 12x + 32)$

$= -2(x-8)(x-4)$

vertex: $x = 6$

$y = -2(6-8)(6-4)$

$= 8$

Vertex $(6, 8)$

$y = -2(x-6)^2 + 8$

c) $y = 2x^2 - x - 6$

$= (2x+3)(x-2)$

zeros: $(-\frac{3}{2}, 0), (2, 0)$

vertex: $x = \frac{1}{4}$

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

$= (\frac{7}{2})(-\frac{7}{4})$

$= -\frac{49}{8}$

$y = 2(x - \frac{1}{4})^2 - \frac{49}{8}$

d) $y = (2x+5)^2$

zero: $(-\frac{5}{2}, 0)$

Vertex is the zero

$y = 4(x + \frac{5}{2})^2$

11. Let x be the number of \$0.50 price increases.

$y = (5 + 0.5x)(300 - 30x)$ zeros: $-10 + 10$

Vertex: $(0, 1500)$

∴ The current price of \$5 maximizes the revenue.

12. $y = -2(x+5)^2 + 8$

Zeros: Let $y = 0$

$-8 = -2(x+5)^2$

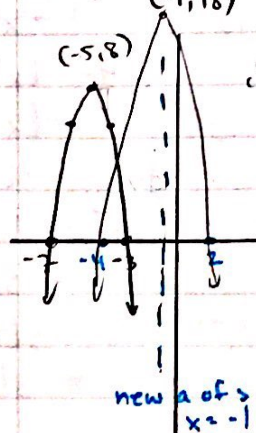
$4 = (x+5)^2$

$\pm 2 = x + 5$

$x = 2 - 5$ $x = -2 - 5$

$= -3$ $= -7$

Original zeros were $(-3, 0)$ and $(-7, 0)$



∴ The graph was moved 4 units right and 10 units up.

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

$y = -2(-1+4)(-1-2)$

$y = -2(3)(-3)$

New vertex: $(-1, 18)$

13. $C = 0.06t^2 - 0.27t + 5.36$

$x = \frac{-b}{2a}$

$= \frac{0.27}{0.12}$

$= \frac{9}{4}$

$C = 0.06(\frac{9}{4})^2 - 0.27(\frac{9}{4}) + 5.36$

$= \frac{3}{50}(\frac{81}{16}) - \frac{243}{400} + \frac{536}{100}$

$= \frac{243}{800} - \frac{243}{400} + \frac{2144}{400}$

$= \frac{243}{800} + \frac{1901}{400}$

$= \frac{4045}{800}$

a) 1997

b) $t = 3$ $C = 0.06(3)^2 - 0.27(3) + 5.36$

$= \$5.09$

c) $t = 15$

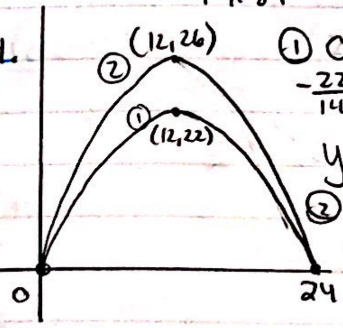
$C = 0.06(15)^2 - 0.27(15) + 5.36$

$=$

d) $y = 0.06(x - \frac{9}{4})^2 + 5.05625$

$= \$14.81$

14.



① $0 = a(0-12)^2 + 22$

$-\frac{22}{144} = a$

$y = -\frac{11}{72}(x-12)^2 + 22$

② $0 = a(0-12)^2 + 26$

$-\frac{26}{144} = a$

$y = -\frac{13}{72}(x-12)^2 + 26$

15. $P = 20(15-x)(11+x)$

a) $x = \frac{15-11}{2}$

$= 2$

$P = 20(15-2)(11+2)$

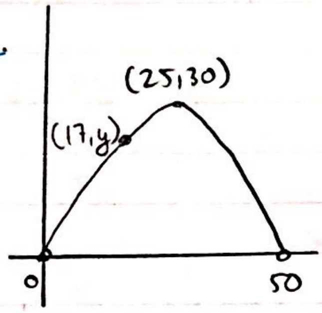
$= 20(13)(13)$

$= 338$

$P = 20(x-2)^2 + 338$

b) ∴ They maximize profit at \$13, and sell 338 tickets.

16.



$0 = a(0-25)^2 + 30$

$\frac{-30}{625} = a$

$-\frac{6}{125} = a$

$y = -\frac{6}{125}(x-25)^2 + 30$

Let $x = 17$:

$y = -\frac{6}{125}(17-25)^2 + 30$

$= -\frac{6}{125}(64) + 30$

$= -\frac{384}{125} + \frac{3750}{125}$

$= \frac{3366}{125}$

$= 26.9\text{m}$

∴ The sailboat will not fit!

17. $y = ax^2 + bx + c$, $c = -4$

① $8 = a(-2)^2 + b(-2) - 4$

$8 = 4a - 2b - 4$

$12 = 4a - 2b$

① ÷ 2 → $6 = 2a - b$

② $-1 = a(1)^2 + b(1) - 4$

$3 = a + b$

Use elimination / substitution:

$2a - b = 6$

$+\ a + b = 3$

$3a = 9$

$a = 3$

$b = 0$

∴ $y = 3x^2 - 4$

vertex $(0,-4)$

★ You can also draw it + use the step pattern!

18. No! Vertex form → vertex

Factored form → zeros

Standard form → y-intercept

Hilary

5.6 Connecting Standard and Vertex Form

1. $x = \frac{2-6}{2}$

$x = -2$

2. $y = 4x(x-3) + \overset{y\text{-int}}{5}$

$x=0 \qquad x=3$

$(0,5) \qquad (3,5)$

3. $y = 2x^2 - 10x + 11$

$y = 2x(x-5) + 11$

$x=0 \qquad x=5$

$x = \frac{0+5}{2} \qquad y = 2(2.5)^2 - 10(2.5) + 11$

$\qquad = -3/2$

$x = 2.5 \qquad$ Vertex $\left(\frac{5}{2}, -\frac{3}{2}\right)$

4a) $x = \frac{3+7}{2}$

$x = 5$

b) $-24 = a(9-3)(9-7)$

$-24 = a(6)(2)$

$-2 = a$

$y = -2(x-3)(x-7)$

When $x = 5$,

$y = -2(5-3)(5-7)$

$= -2(2)(-2)$

$= 8$

Vertex: $(5,8)$

5a) $y = (x-1)(x+7)$

i) $(1,0)$ + $(-7,0)$

ii) $x = \frac{1-7}{2} \qquad y = (-3-1)(-3+7)$

$x = -3 \qquad = -16$

iii) Vertex $(-3,-16)$

iv) $y = (x+3)^2 - 16$

b) $y = x(x-6) - 8$

i) $x=0 \qquad x=6$

$(0,-8) \qquad (6,-8)$

ii) $x = 3$

iii) $y = 3(3-6) - 8$

$= 3(-3) - 8$

$= -17$

$(3,-17)$

iv) $y = (x-3)^2 - 17$

c) $y = -2(x+3)(x-7)$

i) $(-3,0)$, $(7,0)$

ii) $x = \frac{-3+7}{2}$

$x = 2$

iii) $y = -2(2+3)(2-7)$

$= -2(5)(-5)$

$= 50$

$(2,50)$

iv) $y = -2(x-2)^2 + 50$

5d) $y = x(3x+12) + 2$

i) $x=0$ $(0,2) \qquad x=-4$ $(-4,2)$

ii) $x = -2$

iii) $y = -2(3(-2)+12) + 2$

$= -2(6) + 2$

$= -10$

$(-2,-10)$

iv) $y = 3(x+2)^2 - 10$

e) $y = x^2 + 5x$

i) $y = x(x+5)$

$x=0$ $(0,0) \qquad x=-5$ $(-5,0)$

ii) $x = -2.5$

iii) $y = \left(-\frac{5}{2}\right)^2 + 5\left(-\frac{5}{2}\right)$

$= \frac{25}{4} - \frac{25}{2}$

$= -\frac{25}{4}$

$\left(-\frac{5}{2}, -\frac{25}{4}\right)$

iv) $y = \left(x + \frac{5}{2}\right)^2 - \frac{25}{4}$

6. $y = -(x-4)^2 + 2$

7a) $y = x^2 - 6x + 5$

$y = x(x-6) + 5$

$x=0$, $x=6$

$x = 3$

$y = (3)^2 - 6(3) + 5$

$= 9 - 18 + 5$

$= -4$

$(3,-4)$

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

b) $y = x(x-4) - 11$

$x=0 \qquad x=4$

$x = 2$

$y = (2)^2 - 4(2) - 11$

$= -15$

$y = (x-2)^2 - 15$

7c) $y = -2x(x-6) - 11$

$x=0 \qquad x=6$

$x = 3$

$y = -2(3)^2 + 12(3) - 11$

$= -18 + 36 - 11$

$= 7$

$y = -2(x-3)^2 + 7$

7d) $y = -x(x+6) - 13$

$x=0$ $\quad x=-6$

$x = -3$

$y = -(-3)^2 - 6(-3) - 13$

$= -9 + 18 - 13$

$= -4$

$(-3, -4)$

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

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

$x=0$ $\quad x=4$

$x = 2$

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

$= -2 + 8 - 3$

$= 3$

$(2, 3)$

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

f) $y = 2x(x-5) + 11$

$x=0$ $\quad x=5$

$x = \frac{5}{2}$

$y = 2(\frac{5}{2})^2 - 10(\frac{5}{2}) + 11$

$= 2(\frac{25}{4}) - 25 + 11$

$= \frac{25}{2} - 14$

$= -\frac{3}{2}$

$(\frac{5}{2}, -\frac{3}{2})$

$y = 2(x - \frac{5}{2})^2 - \frac{3}{2}$

12. $h = -5t^2 + 9t + 1$

$t = \frac{-9}{-10}$

$= \frac{9}{10}$

$h = -5(\frac{9}{10})^2 + 9(\frac{9}{10}) + 1$

$= -\frac{81}{20} + \frac{81}{10} + 1$

$= 5\frac{1}{20}$ The max ht is 5.05 m.

8. ① Factor

$y = -2(x^2 - 8x + 12)$

$= -2(x-6)(x-2)$

zeros: $(6,0), (2,0)$

a of s: $x = 4$

② $x = -b/2a$

$x = -16/2(-2)$

$= \frac{-16}{-4}$

$x = 4$

Option 2 is faster!

9. $y = ax^2 + bx + 7$ ← point $(0,7)$

$y = a(x-4)^2 + 5$

$7 = a(0-4)^2 - 5$

$12 = 16a$

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

$y = \frac{3}{4}(x-4)^2 - 5$

$= \frac{3}{4}(x^2 - 8x + 16) - 5$

$= \frac{3}{4}x^2 - 6x + 7$

10. $8 = a(0-1)^2 + 7$

$1 = a$

$y = (x-1)^2 + 7$

$= x^2 - 2x + 8$

11. $h = -5t^2 + 150t$

$t = \frac{-b}{2a}$ $\quad h = -5(15)^2 + 150(15)$

$= \frac{-150}{-10}$ $\quad = 1125$ m

$= 15$ s $\quad$ ∴ The max height is 1125 m

13. $P = -30t^2 + 450t - 790$

$t = \frac{-450}{-60}$

$= \frac{15}{2}$

∴ \$7.50 will maximize profit.

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14. $G = 1492 - 76t + 5.2t^2$

a) $t = \frac{76}{2(5.2)}$

$= 7.3$

$\therefore$ The minimum production occurred in 1977.

b) $G = 1492 - 76(7.31) + 5.2(7.31)^2$

$= 1214.1$ tonnes

c) $t = 15$

$G = 1492 - 76(15) + 5.2(15)^2$

$= 1522$ tonnes

17. Let x be the number of \$0.05 price increases.

$R = (1.75 + 0.05x)(9450 - 210x)$

Zeros: $0.05x = -1.75$ $\quad$ $210x = 9450$

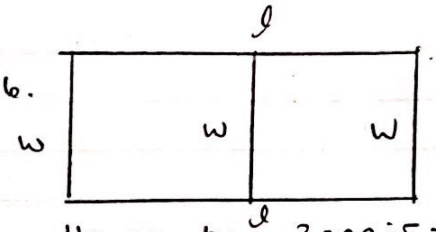
$x = -35$ $\quad$ $x = 45$

$x = \frac{45 - 35}{2}$

$= 5 \leftarrow$ price increases (\$0.25)

The need to charge \$2.00, and they will lose 1050 customers.

16.



He can buy $3000 \div 5 = 600$ m of fencing

$2l = -3w + 600$

$2l + 3w = 600 \rightarrow ① \; l = -\frac{3}{2}w + 300$

② $A = lw$

$A = -\frac{3}{2}w^2 + 300w$

$w = \frac{-300}{-3}$ $\quad$ $l = 150$

$= 100$

$A = -\frac{3}{2}(100)^2 + 300(100)$

$= 15000 \text{ m}^2$

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