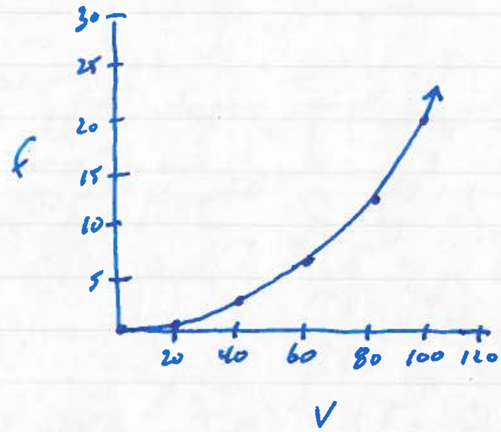
13. $f = 0.002v^2$ $\quad$ f: drag $\quad$ v: velocity

a) $0 \le v \le 120$

b)

v	f
0	0
20	0.8
40	3.2
60	7.2
80	12.8
100	20
120	28.8



c) not a straight line
not common difference
(changing slope)

d) when v doubles
f quadruples
(20, 0.8)
(40, 3.2)
(80, 12.8)

14. $C = 0.3n^2 - 48.6n + 13500$ $\quad$ C: cost $\quad$ n: units

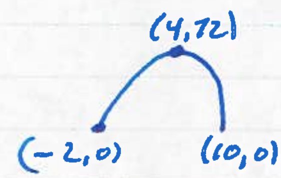
a) vertex at $\frac{48.6}{0.6}$ $\quad n = 81$ $\quad C = 11531.7$ $\quad$ (81, 11531.7)

↑ min at 81 units (81000) $\quad$ ↑ min cost

b) to minimize costs they should produce 81000 units

15 a) $A = (x+2)(20-2x)$ $\quad A = -2x^2 + 16x + 40$

b) vertex $\frac{-16}{-4}$ $\quad x = 4$ $\quad \ldots\ y = 72$ $\quad (4, 72)$



x int: $-2x^2 + 16x + 40 = 0$

$x^2 - 8x - 20 = 0$

$(x-10)(x+2) = 0$

$x = 10 \quad x = -2$

c) x int represent Area of 0 $\quad$ (−2 means 0 height, 10 means 0 width)

d) vertex: max area if $x = 4$, max area of 72

e) domain $-2 \le x \le 10$ $\quad$ range $0 \le y \le 72$

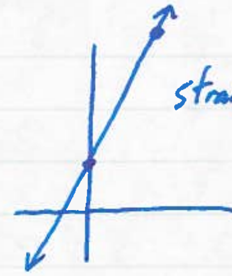
f) max value 72, min value 0

g) no minimum if taken out of context of question

16. $f(x) = 4x^2 - 3x + 2x(3-2x) + 1$

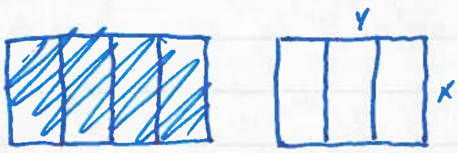
$= 4x^2 - 3x + 6x - 4x^2 + 1$

$= 3x + 1$ not quadratic



straight line / not quadratic

17a)



Fencing $4x + 2Y = 280$

$2Y = 280 - 4x$

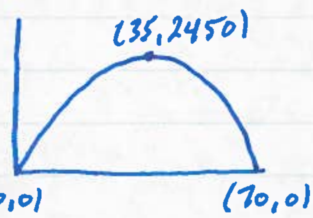
$Y = 140 - 2x$

Area $= xY$

$A = x(140 - 2x)$

$A = -2x^2 + 140x$ quadratic (degree 2)

b)



c) (35, 2450) max area if $x = 35$

max area $= 2450$

d) domain $0 \le x \le 70$ range $0 \le A \le 2450$

e) maximum of 2450 when $x = 35$

f) all fencing is used.

18a)

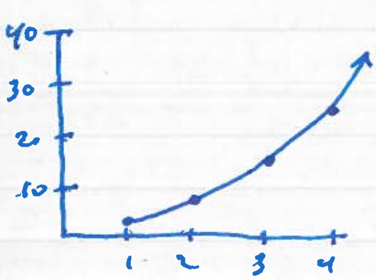
Diagram	1	2	3	4	5	6
shape	1x3	2x4	3x5	4x6	5x7	6x8
area	3	8	15	24	35	48

b) $Y = x^2 + 2x$ GDC stat → calc → quadreg

c) quadratic (degree 2)

d) domain $x \ge 1 \mid x \in N$ (discrete – no diagram 1.1 or 1.2 ...)

e)



19 a) $A = \pi r^2$

b) domain $r \geq 0$ range $A \geq 0$

c)

d) (0,0) if $r = 0$, $A = 0$ (minimum)

e) $x = 0$ ($r = 0$)

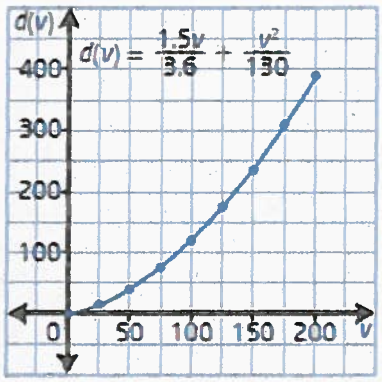
Section 3.2 Page 178 Question 20

a) Substitute $t = 1.5$ into $d(t) = \frac{vt}{3.6} + \frac{v^2}{130}$. Then, a function to model the stopping distance, d, for the vehicle and driver as a function of the pre-braking speed, v is

$d(v) = \frac{1.5v}{3.6} + \frac{v^2}{130}$.

b)

v	d
0	0
25	15
50	40
75	75
100	119
125	172
150	236
175	308
200	391



c) When the speed of the vehicle doubles, the stopping distance more than doubles. For example, when $v = 50$, $d = 40$, but when $v = 100$, $d = 119$.

d) Answers may vary. The argument aimed at convincing drivers to slow down should include the results from part c) and a graph.

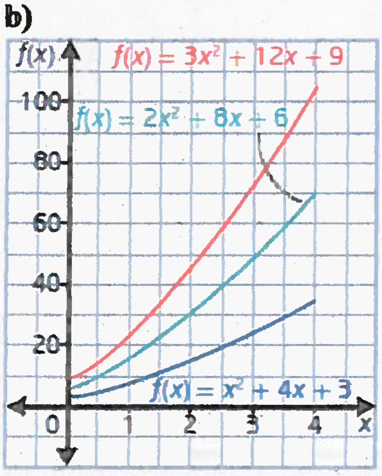
Section 3.2 Page 178 Question 21

a) A set of functions for part of the family defined by $f(x) = k(x^2 + 4x + 3)$ if $k = 1, 2, 3$ is

$f(x) = 1(x^2 + 4x + 3)$ $\quad$ $f(x) = 2(x^2 + 4x + 3)$ $\quad$ $f(x) = 3(x^2 + 4x + 3)$

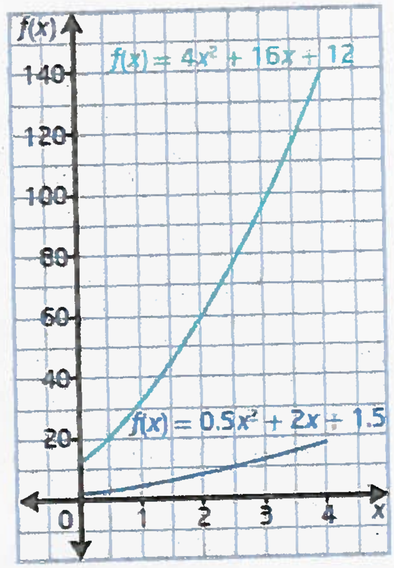
$f(x) = x^2 + 4x + 3$ $\quad$ $f(x) = 2x^2 + 8x + 6$ $\quad$ $f(x) = 3x^2 + 12x + 9$

b)

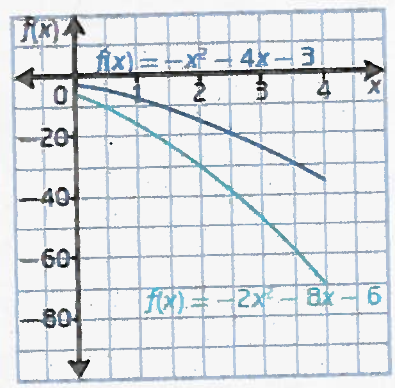


c) Answers may vary. Example: The graphs have similar shapes. They increasingly curve upward. The values of y on each graph for the same value of x are multiples of each other.

d) Answers may vary. Example: For $k = 4$, the graph would lie above the graph for $k = 3$, starting at (0, 4) with y-values that are 4 times those of the graph for $k = 1$. For $k = 0.5$, the graph would lie below the graph for $k = 1$, starting at (0, 0.5) with y-values that are 0.5 times those of the graph for $k = 1$.



e) Answers may vary. Example: The graphs for negative values of k will be reflections in the x-axis of the corresponding positive k-value graph.



f) The graph for $k = 0$ is line defined by $f(x) = 0$. The graph is a line on the x-axis.

g) Answers may vary. Example: Each member of the family of functions for $f(x) = k(x^2 + 4x + 3)$ has y-values that are multiples of the y-values of $f(x) = x^2 + 4x + 3$ for each corresponding x-value.

Section 3.2 Page 178 Question 22

Answers may vary. Example: The a in the quadratic function $f(x) = ax^2 + bx + c$ may appear to define the 'steepness' of the graph. For example, as positive a-values increase, the parabola rises faster and faster. However, it is not the slope since the graph is a curve with ever changing slope.

Section 3.2 Page 178 Question 23

a) **Substitute the coordinates of the given point (–2, 1) into $f(x) = -x^2 + bx + 11$ to find b.**

$1 = -(-2)^2 + b(-2) + 11$
$1 = -4 - 2b + 11$
$2b = 6$
$b = 3$

b) Substitute the coordinates of the given points (–1, 6) and then (2, 3) into $f(x) = 2x^2 + bx + c$. solve the resulting linear system of equations to find b.

For (–1, 6),
$6 = 2(-1)^2 + b(-1) + c$
$6 = 2 - b + c$
$4 = -b + c$ ①

For (2, 3),
$3 = 2(2)^2 + b(2) + c$
$3 = 8 + 2b + c$
$-5 = 2b + c$ ②

Solve the system by elimination.

$4 = -b + c$ ①
$\underline{-5 = 2b + c}$ ②
$9 = -3b$ ① – ②
$b = -3$

Then, substitute $b = -3$ into ① to find c.
$4 = -(-3) + c$
$c = 1$

Section 3.2 Page 179 Question 24

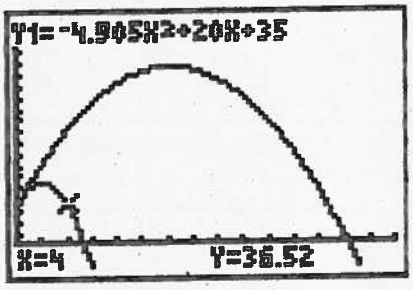
a) Scenario 1: For an object launched from an initial height of 35 m above ground with an initial vertical velocity of 20 m/s, substitute $h_0 = 35$ and $v_0 = 20$ into $h(t) = -0.5gt^2 + v_0t + h_0$.
For the situation on Earth use $g = 9.81$ and for the moon use $g = 1.63$.
Earth: $h(t) = -4.905t^2 + 20t + 35$
Moon: $h(t) = -0.815t^2 + 20t + 35$

Scenario 2: For a flare that is shot into the air with an initial velocity of 800 ft/s from ground level, substitute $h_0 = 0$ and $v_0 = 800$ into $h(t) = -0.5gt^2 + v_0t + h_0$. For the situation on Earth use $g = 32$ and for the moon use $g = 5.38$.
Earth: $h(t) = -16t^2 + 800t$
Moon: $h(t) = -2.69t^2 + 800t$

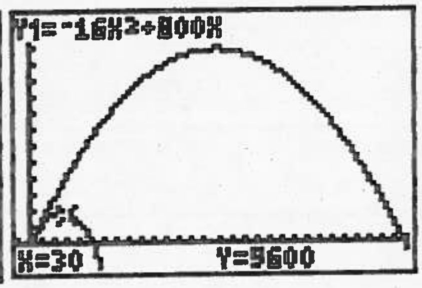
Scenario 3: For a rock that breaks loose from the top of a 100-m-high cliff and starts to fall straight down, substitute $h_0 = 100$ and $v_0 = 0$ into $h(t) = -0.5gt^2 + v_0t + h_0$. For the situation on Earth use $g = 9.81$ and for the moon use $g = 1.63$.
Earth: $h(t) = -4.905t^2 + 100$
Moon: $h(t) = -0.815t^2 + 100$

b) Use a graphing calculator to graph each pair of functions from part a).

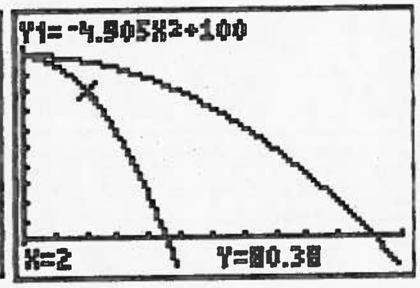
Scenario 1:



Scenario 2:



Scenario 3:



c) Answers may vary. Example: In scenario 1, the graphs have the same y-intercept of 35 but different maximum values (about 55 and 158) and x-intercepts (about 5 and 26). In scenario 2, the graphs have the same y-intercept of 0 and one x-intercept of 0 but different maximum values (10 000 and about 59480) and second x-intercepts (50 and about 297). In scenario 3, the graphs have the same y-intercept and maximum value of 100 but different x-intercepts (about 5 and 11).

d) Answers may vary. Example: Every projectile on the moon had a higher trajectory and stayed in the air longer than when on Earth.

Section 3.2 Page 179 Question 25

Answers may vary. Examples:

a) For a quadratic function with vertex at (m, n) and a y-intercept of r, the function is of the form $y = a(x - m)^2 + n$ and a point on the graph is $(0, r)$. Use symmetry to find another point on the parabola. Assume that the given point is to the left of axis of symmetry, $x = m$. Then, the horizontal distance to the point is $m - 0$, or m. The x-coordinate of the corresponding point on the other side of the axis of symmetry is $m + m$, or $2m$. So, another point on the parabola is $(2m, r)$.

b) For a quadratic function with axis of symmetry of $x = j$ and passing through the point $(4j, k)$, the function is of the form $y = a(x - j)^2 + q$. Use symmetry to find another point on the parabola. Assume that the given point is to the right of axis of symmetry. Then, the horizontal distance to the point is $4j - j$, or $3j$. The x-coordinate of the corresponding point on the other side of the axis of symmetry is $j - 3j$, or $-2j$. So, another point on the parabola is $(-2j, k)$.