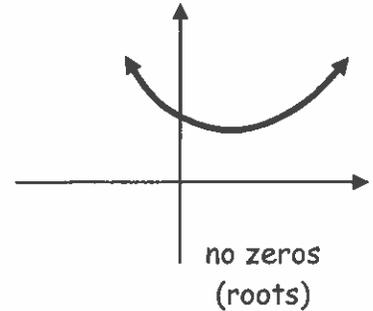
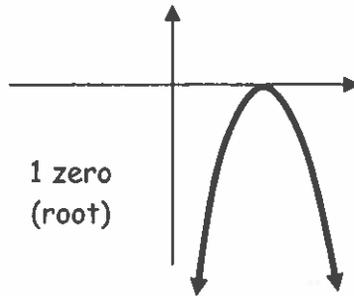
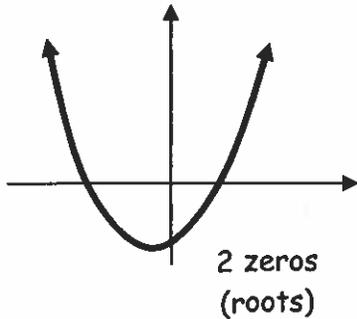


# The Nature of Roots

- Quadratic functions may have:



- If a quadratic relation has no roots, it can't be solved.
- With only a single root, the vertex is the zero (solution).
- If it has 2 roots, there are 2 solutions, both of which may be possible, or 1 may be inadmissible.

- To determine the number of roots, examine its form.
- If it is in factored form, there are only two choices: 2 different zeros, or just a single zero.

Ex/ Determine the number of roots for the following quadratics.

a)  $y = 2(x-3)(x+5)$

↙ ↘  
2 different roots

b)  $y = -0.2(x+4)^2$

↓  
same root twice  
(one root)

- If the relation is in standard form,  $y = ax^2 + bx + c$ , we can use the discriminant to determine the number of roots.

Discriminant:  $D = b^2 - 4ac$

- If  $D > 0$  (positive) there will be 2 roots.
  - If  $D = 0$  there will be a single root.
  - If  $D < 0$  (negative) there are no roots.

Ex/ Determine the number of real roots for the following functions.

a)  $y = 2x^2 - 4x + 6$   
a    b    c

$D = b^2 - 4ac$   
 $= (-4)^2 - 4(2)(6)$   
 $= -32$   
↑ No roots

b)  $y = -2x^2 + 6x - 4.5$

$D = 6^2 - 4(-2)(-4.5)$   
 $= 0$

∴ One root

c)  $y = x^2 + 7x$

$D = 7^2 - 4(1)(0)$

positive → 49  
∴ Two roots

- The discriminant allows us to check if problems are solvable. If a quadratic equation is rearranged so that it equals zero, the discriminant will tell us how many solutions there are.

Ex/ Use the discriminant to determine the number of solutions each equation has.

a)  $2x^2 - 5x = 3x + 2$

$2x^2 - 5x - 3x - 2 = 0$  ← make equal zero

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

$D = (-8)^2 - 4(2)(-2)$   
 $= 80$

∴ 2 solutions

b)  $4x(x+2) = 3x - 10$

$4x^2 + 8x - 3x + 10 = 0$

$4x^2 + 5x + 10 = 0$

$D = 5^2 - 4(4)(10)$   
 $= -135$

∴ No solutions

Ex/ Studies have shown that 500 people attend a high school basketball game when the admission price is \$2.00. In the championship game admission prices will increase. For every 10¢ increase, 2 fewer people will attend. To break even, organizers need to bring in \$2500. Is it possible to break even?

$R = (500 - 2x)(2 + 0.1x)$   $x = \# \text{ of changes}$

$2500 = 1000 + 50x - 4x - 0.2x^2$

$0 = -0.2x^2 + 46x + 1000 - 2500$

$0 = -0.2x^2 + 46x - 1500$

check if it has solutions  
 $D = 46^2 - 4(-0.2)(-1500)$   
 $= 916$

↑  
 Has solutions, so is possible

Ex/ The height of a trampoline jumper,  $h$ , in metres, can be modeled by  $h = -6.1t^2 + 9.17t + 1.997$ , where  $t$  is the time in seconds. Does the jumper reach a height of 6 m?

$6 = -6.1t^2 + 9.17t + 1.997$

$0 = -6.1t^2 + 9.17t + 1.997 - 6$

$0 = -6.1t^2 + 9.17t - 4.003$

$D = 9.17^2 - 4(-6.1)(-4.003)$   
 $= -13.58$

Can't solve, so never reaches 6 m.