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A LEVEL MATHS

YEAR 1 PURE

ANSWERS

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6 Solving Quadratic Equations

E/D

1 2 solutions

$x^2=1 \therefore x=\pm\sqrt{1}$

$x=\pm 1$

2 $(4x+3)(2x-1)=0$

$\therefore x=-\frac{3}{4}$ or $x=\frac{1}{2}$

3 Complete the Square

$(x-2)^2-4-8=0$

$(x-2)^2=12$

$x-2=\pm\sqrt{12}$

$x-2=\pm 2\sqrt{3}$

$x=2\pm 2\sqrt{3}$

$p=2,\ q=2,\ r=3$

N.B. You can use the formula here!

C/B

1 $4x-1=\pm\sqrt{25}$

$4x-1=\pm 5$

$4x-1=5$ | $4x-1=-5$

$4x=6$ | $4x=-4$

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

2 X through the equation by x such that:

$x^2-4x-12=0$

$(x-6)(x+2)=0$

$x=6,\ x=-2$

3 Use the formula

$a=4{\cdot}9,\ b=-1,\ c=-36$

$t=2{\cdot}81$ or $t=-2{\cdot}61$

$t=\dfrac{-(-1)+\sqrt{(-1)^2-4(4{\cdot}9)(-36)}}{2(4{\cdot}9)}$

A/A*

1 X by $\sqrt{x}$: $x-3=2\sqrt{x}$

$x-2\sqrt{x}-3=0$

$(\sqrt{x}-3)(\sqrt{x}+1)=0$

$\sqrt{x}-3=0$ | $\sqrt{x}\neq-1$

$\sqrt{x}=3$

$x=9$

2 Area of Parallelogram

$(x+6)(13-x)=$

$13x-x^2+78-6x=$

$78+7x-x^2$

Area of Square:

$(x+1)(x+1)=\underline{x^2+2x+1}$

$\therefore 78+7x-x^2-(x^2+2x+1)=74$

$-2x^2+5x+77=74$

$2x^2-5x-3=0$

$x=3 \quad x\neq-\frac{1}{2}$

$\therefore$ Area $=(3+1)^2=\underline{16}$

3 $16x^2=8x-1$

$16x^2-8x+1=0$

$(4x-1)^2=0$

$\therefore x=\frac{1}{4}$

(Square both sides!)

Year 1 Answers

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7 Completing the Square:

1. $(x+3)^2 - 9 - 8$ E/D
   $(x+3)^2 - 17$

2. $4[x^2 - 2x]$
   $4[(x-1)^2 - 1]$
   $4(x-1)^2 - 4$

3. $(x-5)^2 - 25 + 8 = 0$
   $(x-5)^2 - 17 = 0$
   $(x-5)^2 = 17$
   $x - 5 = \pm\sqrt{17}$
   $x = 5 \pm \sqrt{17}$
   $\therefore q = 17$

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1. $(x - \frac{5}{2})^2 - \frac{25}{4} + 1$ C/B
   $(x - \frac{5}{2})^2 - \frac{25}{4} + \frac{4}{4}$
   $(x - 5/2)^2 - \frac{21}{4}$

2. $-5[x^2 - 2x] + 7$
   $-5[(x-1)^2 - 1] + 7$
   $-5(x-1)^2 + 5 + 7$
   $-5(x-1)^2 + 12$
   $p = -5, r = -1, q = 12$

3. $(x - \frac{9}{2})^2 - \frac{81}{4} + 30 = 0$
   $(x - \frac{9}{2})^2 \neq \frac{-39}{4}$

Can't root - number for real solutions.
N.B You can use the discriminant if you know it too:
$b^2 - 4ac < 0$ for $x^2 - 9x + 30$

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1. $2[x^2 - 2px] + 1 = 0$
   $2[(x-p)^2 - p^2] + 1 = 0$
   $2(x-p)^2 - 2p^2 + 1 = 0$
   $(x-p)^2 = \frac{2p^2 - 1}{2}$
   $x - p = \pm\sqrt{\frac{2p^2 - 1}{2}}$
   $x = p \pm \sqrt{\frac{2p^2 - 1}{2}}$

o.e.

A few approaches:

A/A*

2. $-[x^2 + 3x] + 8$
   $-[(x + \frac{3}{2})^2 - \frac{9}{4}] + 8$
   $-(x + \frac{3}{2})^2 + \frac{9}{4} + 8$
   $-(x + \frac{3}{2})^2 + \frac{41}{4}$
   $\therefore \frac{41}{4}$

3. $(2x - 3)^2 = K - 8$
   $2x - 3 = \pm\sqrt{K - 8}$

$K - 8 > 0$ as you can't take the square root of a negative number to get a real solution.

If $K = 8$ then there is one solution.
For 2 solutions $K - 8 > 0$

Steve Blades

8 Function Notation

1. $f(1.5) = 3 - (1.5)^2$
$= \frac{3}{4}$

2. $\frac{16}{a^2} = 4$ just sub in $x = a$ and solve

$\frac{16}{4} = a^2$

$4 = a^2$

$\pm 2 = a$

$\therefore a = 2$

E/D

3. Set them equal and solve:

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

$x^2 - 3x - 10 = 0$

$(x-5)(x+2) = 0$

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

$\therefore \underline{x = 5}$

1. roots, just solve the equation $= 0$.

$x(x^2 - 4) = 0$

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

$\therefore x = 0, x = -2, x = 2$

2. Complete the square

$(x+6)^2 - 36$

$\therefore$ min $= 36$

@ $x = -6$

C/B

3. Set them equal

$x^3 - 7 = x(x+1)(x-2)$

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

$\cancel{x^3} - 7 = \cancel{x^3} - x^2 - 2x$

$0 = -x^2 - 2x + 7$

$0 = x^2 + 2x - 7$

$0 = (x+1)^2 - 1 - 7$

$8 = (x+1)^2$

$\pm 2\sqrt{2} = x + 1$

$x = -1 \pm 2\sqrt{2}$

N.B.: You can use the equation here! instead of completing the square.

1. $a^{-3/2} + 1 = 28$

$a^{-3/2} = 27$

$a = 27^{-\frac{2}{3}}$

$a = \left(\frac{1}{27}\right)^{\frac{2}{3}}$

$a = \frac{1}{9}$

A/A*

2. $(x^2 + 8)(x^2 - 1) = 0$

$x^2 + 8 \neq 0$ for real solutions

$\therefore x^2 - 1 = 0$

$x^2 = 1$

$x = \pm 1$

3. $(x+1)^2 = 0$

$\therefore x = -1$

$x^2 - 3 = 0$

$x^2 = 3$

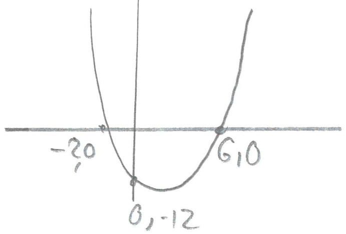
$\therefore x = \pm\sqrt{3}$

Roots in ascending order.

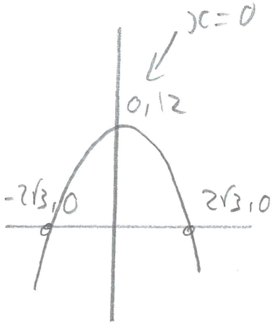
$-\sqrt{3}, -1, \sqrt{3}$.

9 Quadratic Graphs

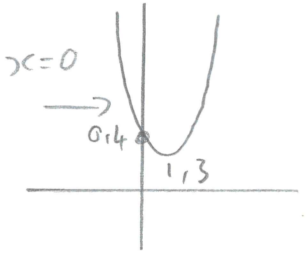
1. when $x=0$, $y=-12$
   when $y=0$, $0=(x-6)(x+2)$
   $\therefore x=6$ or $x=-2$



2. $0=-x^2+12$
   $x^2=12$
   $x=\pm\sqrt{12}$
   $x=\pm 2\sqrt{3}$

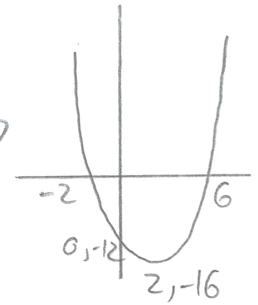


3. $y=(x-1)^2-1+4$
   $y=(x-1)^2+3$



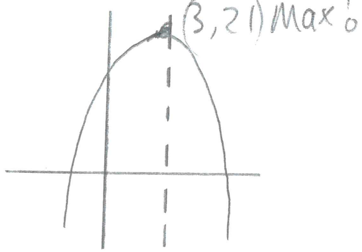
E/D

1. $y=(x-2)^2-4-12$
   $y=(x-2)^2-16$



Same as Q1 before but complete the square for min point

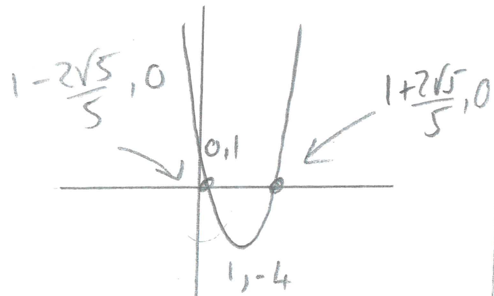
2. $y=-[x^2-6x]+12$
   $-[(x-3)^2-9]+12$
   $-(x-3)^2+9+12$
   $-(x-3)^2+21$



$x=3$ is the axis of symmetry!

(3,21) is a maximum

3. $y=5[x^2-2x]+1$
   $y=5[(x-1)^2-1]+1$
   $y=5(x-1)^2-4$



Roots are when $y=0$. Solve using equation.

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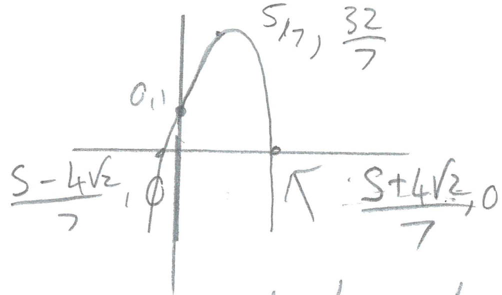
1. $\underline{c=1}$ $\therefore y=2x^2+bx+1$
   Sub in $(-2,-7)$
   $-7=2(4)+b(-2)+1$
   $-7=-2b+9$
   $-16=-2b$
   $\therefore b=+8 \Rightarrow y=2x^2+8x+1$
   roots are $x=\frac{-4\pm\sqrt{14}}{2}$

2. $y=-7[x^2-\frac{10}{7}x]+1$
   $y=-7[(x-\frac{5}{7})^2-\frac{25}{49}]+1$
   $y=-7(x-\frac{5}{7})^2+\frac{25}{7}+1$
   $y=-7(x-\frac{5}{7})^2+\frac{32}{7}$



Find the roots by solving the quadratic:
$x=\frac{5\pm 4\sqrt{2}}{7}$

3. You can do this with the discriminant too!

$y=(x+\frac{p}{2})^2-\frac{p^2}{4}+q$

$-\frac{p^2}{4}+q>0$

$q>\frac{p^2}{4}$

$4q>p^2$

Steve Blades
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10 The Discriminant

E/D

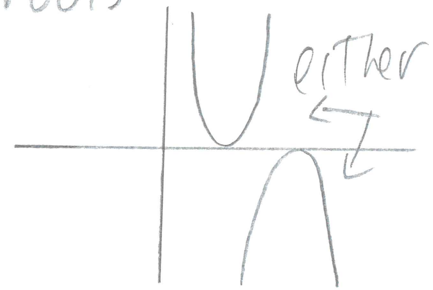
1 No real roots

2 $a=1,\ b=6,\ c=5$

b^2-4ac

$36-4(1)(5)=16$

$\therefore >0$ and 2 real roots

3 

C/B

1 Repeated root $\therefore$

$b^2-4ac=0$

$a=1,\ b=k,\ c=16$

$k^2-4(1)(16)=0$

$k^2-64=0$

$k=\pm\sqrt{64}$

$k=\pm 8$

2 $a=6,\ b=4k\ c=5$

$(16k^2)-4(6)(5)=-56$

$16k^2=64$

$k^2=4$

$k=\pm\sqrt{4}$

$k=\pm 2$

$\therefore k=-2$

3 $b^2-4ac<0$ for no real roots

$a=k,\ b=5k,\ c=-3$

$25k^2-4(k)(-3)<0$

$25k^2+12k<0$

$k(25k+12)<0$

$k\neq 0\ \therefore k<-\frac{12}{25}$

A/A*

1 $y=3$ and $y=x^2+kx+10$

$\therefore x^2+kx+10=3$

$x^2+kx+7=0$

If they don't intersect $b^2-4ac<0$

$a=1,\ b=k,\ c=7$

$k^2-4(1)(7)<0$

$k^2-28<0$

$(k+\sqrt{28})(k-\sqrt{28})<0$

$(k+2\sqrt{7})(k-2\sqrt{7})<0$

$\therefore -2\sqrt{7}<k<2\sqrt{7}$

2 $b^2-4ac=0$ for repeated root

$a=4k,\ b=4k,\ c=4$

$(4k)^2-4(4k)(4)=0$

$16k^2-64k=0$

$k^2-4k=0$

$k(k-4)=0$

$k\neq 0,\ k=4$ ✓

3 Sub in points:

$(0,-1)\ \therefore q=-1$

$y=x^2+px-1$

$(3,-10)$

$-10=9+3p-1$

$p=-6$

$\therefore y=x^2-6x-1$

$a=1,\ b=-6,\ c=-1$

b^2-4ac

$(-6)^2-4(1)(-1)$

$=36+4$

$=40$