

## Notations in Annexes:-

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<u>Notation used in the thesis</u>	<u>Notation used in equation solver</u>
$b'$	b
b	k
$\bar{c}_h$	r
$\bar{c}_f$	s
$\bar{b}$	m
$\tau$	t

## Annex 3.1

Equation  $((2*a*s*t^2-r*t^2)*(-2*s*t-2*r*t)/9*b)+2*((a-2*s*t^2+r*t^2)*(-4*s*t+2*r*t))/9*b=0$  solved for t

[solution 1](#)

$$t = -\sqrt{2}*\sqrt{a*s/(3*s^2-2*r*s+r^2)}$$

$$t = -\sqrt{2}\sqrt{\frac{a*s}{3*s^2-2*r*s+r^2}}$$

[Edit expression](#)

[solution 2](#)

$$t = \sqrt{2}*\sqrt{a*s/(3*s^2-2*r*s+r^2)}$$

$$t = \sqrt{2}\sqrt{\frac{a*s}{3*s^2-2*r*s+r^2}}$$

[Edit expression](#)

[solution 3](#)

$$t = 0$$

$$t = 0$$

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## Annex 3.2

Equation  $((a-2*r*t^2+s*t^2)^2/9*k)-3*((2*a*r*t^2-r^2*t^4)/8*b)=0$  solved for t

[solution 1](#)

$$t = -\sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

$$t = -\sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

[Edit expression](#)

[solution 2](#)

$$t = \sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

$$t = \sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

[Edit expression](#)

[solution 3](#)

$$t = -\sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

[Edit expression](#)

[solution 4](#)

$$t = \sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

$$t = \sqrt[3]{\frac{3^{\frac{3}{2}} a \sqrt{-16 b k r s + 24 b k r^2 + 27 b^2 r^2}}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} - \frac{8 a k s}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{16 a k r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2} + \frac{27 a b r}{8 k^2 s^2 - 32 k r s + 32 k r^2 + 27 b r^2}}$$

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## Annex 4.1

Equation  $((2*a*s*t^2-r*t^2)*(-2*s*t-2*r*t)/9*b)+2*((a-2*s*t^2+r*t^2)*(-4*s*t+2*r*t))/9*b+(2*m*t*(2*a*s*t^2-r*t^2)/3*b)+((m*t^2-d)*(-2*s*t+2*r*t))/3*b=0$  solved for t

[solution 1](#)

$$t = -\sqrt{\frac{-d*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)+2*a*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-d*r/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-2*a*m/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} + \frac{2*a*s}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{d*r}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{2*a*m}{3*s^2-2*r*s-2*m*s+r^2-2*m*r}}$$

[Edit expression](#)

[solution 2](#)

$$t = \sqrt{\frac{d*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)+2*a*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-d*r/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-2*a*m/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} + \frac{2*a*s}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{d*r}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{2*a*m}{3*s^2-2*r*s-2*m*s+r^2-2*m*r}}$$

[Edit expression](#)

[solution 3](#)

$$t = 0$$

$$t = 0$$

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## Annex 4.2

Equation  $2*(a-2*r*t^2+s*t^2)*(2*s*t-4*r*t)/9*b-3*(a-r*t^2)*r*t/2*b-r*t*(m*t^2-d)/b-r*t^2*(m*t)/b=0$  solved for t

[solution 1](#)

$$t = -\sqrt{-8*a*b^2*s/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)-18*d/r/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)+43*a*b^2*r/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)}$$

$$t = -\sqrt{-\frac{8 a b^2 s}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r} - \frac{18 d r}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r} + \frac{43 a b^2 r}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r}}$$

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[solution 2](#)

$$t = \sqrt{-8*a*b^2*s/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)-18*d/r/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)+43*a*b^2*r/(8*b^2*s^2-32*b^2*r*s+59*b^2*r^2-36*m*r)}$$

$$t = \sqrt{-\frac{8 a b^2 s}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r} - \frac{18 d r}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r} + \frac{43 a b^2 r}{8 b^2 s^2 - 32 b^2 r s + 59 b^2 r^2 - 36 m r}}$$

[Edit expression](#)

[solution 3](#)

$$t = 0$$

$$t = 0$$

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# Annex 4.3

Equation  $2*(a-2*r*t^2+s*t^2)*(2*s*t-4*r*t)/9*b-3*(a-r*t^2)*r*t/2*b-r*t*(m*t^2-d)/b-r*t^2*(m*t)/b+(m*t^2-d)*(2*s*t-4*r*t)/3*b+2*(m*t)*(a-2*r*t^2+s*t^2)/3*b=0$  solved for t

solution 1

$$t = -\sqrt{12*b^2*d*s/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-8*a*b^2*s/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-24*b^2*d*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)+18*d*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)+43*a*b^2*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-12*a*b^2*m/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)}/b$$

$$t = -\sqrt{\frac{12 b^2 d s}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{8 a b^2 s}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{24 b^2 d r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} + \frac{18 d r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} + \frac{43 a b^2 r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{12 a b^2 m}{8 s^2-32 r s+24 m s+59 r^2-48 m r}}{b}$$

Edit expression

solution 2

$$t = \sqrt{12*b^2*d*s/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-8*a*b^2*s/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-24*b^2*d*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)+18*d*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)+43*a*b^2*r/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)-12*a*b^2*m/(8*s^2-32*r*s+24*m*s+59*r^2-48*m*r)}/b$$

$$t = \sqrt{\frac{12 b^2 d s}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{8 a b^2 s}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{24 b^2 d r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} + \frac{18 d r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} + \frac{43 a b^2 r}{8 s^2-32 r s+24 m s+59 r^2-48 m r} - \frac{12 a b^2 m}{8 s^2-32 r s+24 m s+59 r^2-48 m r}}{b}$$

Edit expression

solution 3

$$t = 0$$

## Annex 4.4

Equation  $((2*a*s*t^2-r*t^2)*(-2*s*t-2*r*t)/9*b)+2*((a-2*s*t^2+r*t^2)*(-4*s*t+2*r*t))/9*b+(2*m*t*(2*a-s*t^2-r*t^2)/3*b)+((m*t^2-d)*(-2*s*t+2*r*t))/3*b=0$  solved for t

[solution 1](#)

$$t = -\sqrt{-\frac{d*s}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} + \frac{2*a*s}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{d*r}{3*s^2-2*r*s-2*m*s+r^2-2*m*r} - \frac{2*a*m}{3*s^2-2*r*s-2*m*s+r^2-2*m*r}}$$

[Edit expression](#)

[solution 2](#)

$$t = \sqrt{\frac{d*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)+2*a*s/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-d*r/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)-2*a*m/(3*s^2-2*r*s-2*m*s+r^2-2*m*r)}{3*s^2-2*r*s-2*m*s+r^2-2*m*r}}$$

[Edit expression](#)

[solution 3](#)

$$t = 0$$

$$t = 0$$

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