

Q1 If one real root of the quadratic equation  $49x^2+kx+64=0$  is the square of the other root, then find  $k$ .

Solution:

- Let roots be  $\alpha$  and  $\alpha^2$ .
  - Sum of roots =  $-k/49$ .  $\alpha+\alpha^2=-k/49$ .
  - Product of roots =  $64/49$ .  $\alpha\cdot\alpha^2=\alpha^3=64/49$ .
  - So,  $\alpha^3=64/49 \implies \alpha=4493$ .
  - Substitute into sum:  $\alpha+\alpha^2=4493+164923$ .
  - Hence,  $k=-49(\alpha+\alpha^2)$ .
  - Ans:  $k=-49(4493+164923)$ .
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Q2 If  $3+2i$  is one root of  $x^3-7x^2+kx-15=0$ , find the real root.

Solution:

- Complex roots occur in conjugate pairs  $\rightarrow$  other root is  $3-2i$ .
- Product of roots = constant term / coefficient of  $x^3 = (-15)/1 = -15$ .
- So,  $(3+2i)(3-2i)(\text{real root}) = -15$ .
- $(3+2i)(3-2i) = 9+4 = 13$ .
- $13\cdot(\text{real root}) = -15$ .
- Real root =  $-15/13$ .
- Ans: Real root =  $-15/13$ .

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Q3 If  $x^2+3x+2=0$  and  $ax^2+bx+c=0$  have a common root, find  $a:b:c$ .

Solution:

- Roots of first equation:  $-1, -2$ .
  - Suppose common root =  $-1$ .
  - Substitution:  $a(-1)^2+b(-1)+c=0 \Rightarrow a-b+c=0$ .
  - Ratio condition: choose  $a=1, b=1, c=0$ .
  - So  $a:b:c=1:1:0$ .
  - Ans:  $a:b:c=1:1:0$ .
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Q4 If  $\alpha^2=4\alpha-2$  and  $\beta^2=4\beta-2$ , find equation whose roots are  $\alpha/\beta$  and  $\beta/\alpha$ .

Solution:

- Equation:  $x^2-(\alpha/\beta+\beta/\alpha)x+1=0$ .
- From given:  $\alpha^2-4\alpha+2=0$ .
- Roots:  $\alpha=2\pm 2$ .
- Similarly,  $\beta=2\pm 2$ .
- Take distinct roots:  $\alpha=2+2, \beta=2-2$ .
- Compute:  $\alpha/\beta+\beta/\alpha=(2+2)^2+(2-2)^2(2+2)(2-2)$ .
- Numerator =  $(6+4^2)+(6-4^2)=12$ .

- Denominator =  $(4-2)=2$ .
- So sum =  $12/2=6$ .
- Equation:  $x^2-6x+1=0$ .
- Ans:  $x^2-6x+1=0$ .

Q5 If p and q are roots of  $x^2+2x+3=0$ , then find possible values of p,q.

Solution:

- Equation:  $x^2+2x+3=0$ .
- Roots:  $-2 \pm \sqrt{4-12} = -2 \pm \sqrt{-8}$ .
- =  $-2 \pm 2\sqrt{2}i = -1 \pm 2i$
- Ans:  $p=-1+2i, q=-1-2i$ .

Q.6 Equation  $49x^2+kx+64=0$  Condition: One root is the square of the other.

Step 1: Let roots be  $\alpha$  and  $\alpha^2$ .

Step 2: Relations

- Sum of roots =  $-k/49$ .  $\alpha + \alpha^2 = -k/49$ .
- Product of roots =  $64/49$ .  $\alpha \cdot \alpha^2 = \alpha^3 = 64/49$ .

Step 3: Solve for  $\alpha$   $\alpha^3 = 64/49 \implies \alpha = 4/7$ .

Step 4: Substitute in sum  $\alpha + \alpha^2 = 4493 + 164923$ .

Step 5: Find k  $k = -49(\alpha + \alpha^2)$ .

Ans:  $k = -49(4493 + 164923)$ .

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Q.7 Equation  $x^3 - 7x^2 + kx - 15 = 0$ . Given root:  $3 + 2i$ .

Step 1: Conjugate root Other root =  $3 - 2i$ .

Step 2: Product of roots Product of all roots = constant term / coefficient of  $x^3$ .  $(-15)/1 = -15$ .

Step 3: Multiply complex roots  $(3 + 2i)(3 - 2i) = 9 + 4 = 13$ .

Step 4: Real root  $13 \cdot (\text{real root}) = -15 \implies \text{real root} = -15/13$ .

Ans: Real root =  $-15/13$ .

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Q.8 Given:  $\alpha^2 = 4\alpha - 2$ ,  $\beta^2 = 4\beta - 2$ . Find equation with roots  $\alpha/\beta$  and  $\beta/\alpha$ .

Step 1: Roots of quadratic  $\alpha^2 - 4\alpha + 2 = 0$ .  $\alpha = 2 \pm \sqrt{2}$ . Similarly,  $\beta = 2 \pm \sqrt{2}$ .

Step 2: Take distinct roots  $\alpha=2+2i, \beta=2-2i$ .

Step 3: Compute sum  $\alpha/\beta+\beta/\alpha=(2+2i)^2+(2-2i)^2(2+2i)(2-2i)$ . Numerator =  $6+4i^2+6-4i^2=12$ .  
Denominator =  $4-2i^2=2$ . So sum =  $12/2=6$ .

Step 4: Equation  $x^2-6x+1=0$ .

Ans:  $x^2-6x+1=0$ .

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Q.9 Equation:  $x^2+2x+3=0$ . Find roots.

Step 1: Quadratic formula  $x=\frac{-2\pm\sqrt{4-12}}{2}=\frac{-2\pm\sqrt{-8}}{2}=\frac{-2\pm 2\sqrt{2}i}{2}=-1\pm\sqrt{2}i$ .

Ans: Roots are  $p=-1+\sqrt{2}i, q=-1-\sqrt{2}i$ .

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