# Crack the Code — Roots of Polynomials

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| **A** | A quadratic has roots $\alpha$ and $\beta$. Given that $\alpha + \beta = 7$ and $\alpha\beta = -4$, find the value of $\frac{1}{\alpha} + \frac{1}{\beta}$ | **B** | A quadratic has roots $\alpha$ and $\beta$. Given that $\alpha + \beta = -5$ and $\alpha\beta = 2$, find the value of $\alpha^2 + \beta^2$ |
| **C** | $\alpha$ and $\beta$ are roots of the equation $2z^2 + 7z - 8 = 0$. Find the value of $\alpha^2\beta^2$. | **D** | A cubic has roots $\alpha$, $\beta$ and $\gamma$. Given that $\alpha + \beta + \gamma = -2$, $\alpha\beta + \beta\gamma + \gamma\alpha = 12$ and $\alpha\beta\gamma = 3$, find the value of $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$ |
| **E** | A cubic has roots $\alpha$, $\beta$ and $\gamma$. Given that $\alpha + \beta + \gamma = -\frac{3}{2}$, $\alpha\beta + \beta\gamma + \gamma\alpha = -4$ and $\alpha\beta\gamma = \frac{5}{2}$, find the value of $\alpha^3\beta^3\gamma^3$ | **F** | $\alpha, \beta, \gamma$ and $\delta$ are roots of the equation $2z^4 - 11z^3 + 8z^2 - 16z - 5 = 0$. Find the value of $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} + \frac{1}{\delta}$ |
| **G** | $\alpha, \beta$ and $\gamma$ are roots of the equation $z^3 - 15z^2 + 10z + 11 = 0$. Find the value of $\alpha^2 + \beta^2 + \gamma^2$. | **H** | $\alpha, \beta$ and $\gamma$ are roots of the equation $2z^3 + 7z^2 - 12z - 8 = 0$. Find the value of $(\alpha\beta)^2 + (\beta\gamma)^2 + (\gamma\alpha)^2$. |
| **I** | $\alpha$ and $\beta$ are roots of the equation $2z^2 + 9z + 3 = 0$. Find the value of $\alpha^3 + \beta^3$. | **J** | A quartic has roots $\alpha$, $\beta, \gamma$ and $\delta$. Given that $\sum \alpha = 2$, $\sum \alpha\beta = -1$ and $\sum \alpha\beta\gamma = 1$ and $\sum \alpha\beta\gamma\delta$, find the value of $\alpha^2 + \beta^2 + \gamma^2 + \delta^2$. |

To get the three-digit code, add all your answers together.