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Problem Solving Set A

Bronze:

a) $x^2 + (y-5)^2 = 100$

$2x^2 + y = 1$

$y = 1 - 2x^2$

$x^2 + (1-2x^2-5)^2 = 100$

$x^2 + (-2x-4)^2 = 100$

$x^2 + 4x^2 + 16x + 16 = 100$

$x^2 + 4x^2 + 16x + 16 - 100 = 0$

$5x^2 + 16x - 84 = 0$

$x = 2.8, x = -6$

$y = 1 - 2(2.8) = -4.6$

$y = 1 - 2(-6) = 13$

$P = (2.8, -4.6)$

$Q = (-6, 13)$

Silver:

$(x-5)^2 + (y-1)^2 = 25$

$y = \frac{44-3x}{4}$

$(x-5)^2 + \left(\frac{44-3x}{4} - 1\right) = 25$

$(x^2 - 10x + 25) + \frac{(1600 - 240x + 9x^2)}{16} = 25$

$16(x^2 - 10x + 25) + (1600 - 240x + 9x^2) = 400$

$16x^2 - 160x + 400 + 1600 - 240x + 9x^2 = 400$

$25x^2 - 400x + 1600$

$b^2 - 4ac = 0$

$(-400)^2 + 4(25)(1600) = 0$

↳ shows it is a tangent

Gold:

$5y - 4x = k$

$4x - 5y = -k$

$y = \frac{4x+k}{5}$

$(x-3)^2 + \left(\frac{4x+k}{5} + 2\right)^2 = 41$

$41x^2 + (8k+120)x + (k^2 + 100k - 840) = 0$

$(8k+120)^2 - 4(41)(k^2 + 100k - 840) < 0$

$\frac{-164k^2 - 6560k + 145840 < 0}{-164} \quad \overline{-164}$

$k^2 + 40k - 888 < 0$

$(k+63)(k+14) < 0$

↳ $-14 < k < -63$