

Simplify and write the answer so all exponents are positive:

$$\begin{aligned}
 1. \text{ (5pts)} \quad (3x^4y^{-2})^2(5x^{-2}y^6)^3 &= 3^2(x^4)^2(y^{-2})^2 5^3(x^{-2})^3(y^6)^3 \\
 &= 9 \cdot 125 x^8 y^{-4} x^{-6} y^{18} \\
 &= 1125 x^2 y^{14}
 \end{aligned}$$

$$\begin{aligned}
 2. \text{ (7pts)} \quad \frac{(4a^3b^{-4})^3}{(12a^3b^5)^2} &= \frac{4^3(a^3)^3(b^{-4})^3}{12^2(a^3)^2(b^5)^2} = \frac{\overset{4}{64}a^9b^{-12}}{\underset{9}{144}a^6b^{10}} = \frac{4a^3b^{-22}}{9} = \frac{4a^3}{9b^{22}}
 \end{aligned}$$

3. (4pts) Convert to scientific notation or a decimal number:

$$\underline{32,987,041} = 3.2987041 \times 10^7 \quad \underline{1.4783 \times 10^{-3}} = 0.0014783$$

Simplify and write in standard form:

$$\begin{aligned}
 4. \text{ (4pts)} \quad (x^2 + 3)5x - (2x - 3)(x - 7) &= \lambda \\
 &= 5x^3 + 15x - (2x^2 - 14x - 3x + 21) \\
 &= 5x^3 + 15x - 2x^2 + 17x - 21 \\
 &= 5x^3 - 2x^2 + 32x - 21
 \end{aligned}$$

$$\begin{aligned}
 5. \text{ (4pts)} \quad (2x - 1)(3x^2 + 4x - 2) &= \\
 &= 6x^3 + 8x^2 - 4x - 3x^2 - 4x + 2 \\
 &= 6x^3 + 5x^2 - 8x + 2
 \end{aligned}$$

Use formulas to expand:

$$6. (4\text{pts}) (3x - 5y)(3x + 5y) = (3x)^2 - (5y)^2 = 9x^2 - 25y^2$$

$$7. (5\text{pts}) (4x^3 - 7y)^2 = (4x^3)^2 - 2 \cdot 4x^3 \cdot 7y + (7y)^2 \\ = 16x^6 - 56x^3y + 49y^2$$

$$8. (6\text{pts}) (5x + 4)^3 = (5x)^3 + 3 \cdot (5x)^2 \cdot 4 + 3 \cdot 5x \cdot 4^2 + 4^3 \\ = 125x^3 + 3 \cdot 25x^2 \cdot 4 + 15 \cdot 16x + 64 \\ = 125x^3 + 300x^2 + 240x + 64$$

Factor the following. Use either a known formula or a factoring method.

$$9. (3\text{pts}) x^2 + 3x - 18 = (x+6)(x-3)$$

$$\text{prod} = -18$$

$$\text{sum} = 3$$

$$10. (6\text{pts}) 8x^2 + 2x - 15 = 8x^2 + 12x - 10x - 15 = 4x(2x+3) - 5(2x+3) \\ \text{prod} = -120 \quad 12, -10 \\ \text{sum} = 2 \\ = (4x-5)(2x+3)$$

$$11. (6\text{pts}) 27w^3 - 125 = (3w)^3 - 5^3 \\ = (3w-5)(3w)^2 + 3w \cdot 5 + 5^2 \\ = (3w-5)(9w^2 + 15w + 25)$$

12. (6pts) The population of Hong Kong was 7,071,576 according to 2011 census data. If its land area is 1104 square kilometers, find the population density (people per square kilometer) and write it in scientific notation, rounded to six decimal points.

$$\frac{7071576}{1104} = \underbrace{6405.413043}_3 = 6.405413 \times 10^3 \text{ people per square kilometers}$$