

INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **justify all answers**. A correct answer with incorrect work or no justification may receive no credit. Books, notes, electronic devices, other unauthorized devices, and help from (or giving help to) another person are not permitted while taking the exam. The exam is worth 100 points.

Potentially useful formulas:

(i) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

(ii) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

1. The following are unrelated: (18 pts)

(a) Consider the comma-separated list of numbers $\left\{\frac{1}{6}, \sqrt{4}, -\frac{3}{2}, 0, \pi, \sqrt{2}, \frac{8}{40}\right\}$ and answer the following:

i. Write down all rational numbers given in the list. **Include all expressions that simplify to a rational number.**

ii. Write down the numbers given in the comma-separated list (include all numbers, not just rational numbers) from smallest to largest.

(b) Given $x > 0$, $y < 0$, and $z < 0$, determine whether each expression is positive, negative, or zero.

i. $2x^3y^4z$

ii. $-y^4z^5$

iii. $y^2 + 1$

(c) Express the quantity without using absolute value:

i. $|5 - x|$ if $x < 5$

ii. $|2 - \pi|$

(d) Subtract/add as indicated: $\frac{2}{15} - \frac{1}{9} + 3^{-1}$

2. The following are unrelated: (18 pts)

(a) Simplify: $(2x + 1)^2 - 2\left(\frac{3}{2}x^2 - 5x\right)$

(b) Simplify: $\frac{8x^3y}{4x^{-3}y^{-9}} + (3x^3y^5)^2$

(c) Find the missing power (that value of the exponent in the box that would make the equality true) in the calculation: $x^{2/7} \cdot x^{\square} = x$

(d) Simplify each expression:

i. $\sqrt{72} - \sqrt{32}$

ii. $\sqrt{4x^2 + 16}$

(e) Multiply: $x^{1/3} \left(x^{2/3} + \frac{1}{\sqrt[3]{x}} \right)$

3. The following are unrelated: (20 pts)

(a) Factor completely (If not factorable write NF): $27x^3 - 1$

(b) Simplify the compound fraction: $\frac{\frac{1}{2x^2} - \frac{4}{x}}{\frac{1}{3x^2} - 3}$

(c) Factor completely (If not factorable write NF): $x^3 - 4x^2 + 2x - 8$

(d) Let d be a constant real number. Find the value of d that makes the factoring of the polynomial true:
 $3x^2 + dx - 8 = (3x + 1)(x - 8)$

4. Simplify: $\frac{(x-2)(-3)4x^2 + (2x)^2 2x}{x}$ (5 pts)

5. The following are unrelated: (10 pts)

(a) Perform the subtraction: $\frac{1}{x^2 + 5x} - \frac{2}{x + 5}$

(b) Perform the multiplication: $\frac{2x^4 + 8x^2}{4(x^2 - 6x + 9)} \cdot \frac{x - 3}{x^2 + 4}$

6. Is $x = 9$ a solution of the equation: $\frac{\sqrt{x}}{x - 10} + 2x = 14$? As usual, be sure to show work to justify your answer for credit. (4 pts)

7. Solve each of the following equations: (15 pts)

(a) $12 + 8x = -x^2$

(b) $\frac{1}{4}x - 2 = \frac{5}{6} - 2x$

(c) $(y^2 + 9)(2y^2 - 4) = 0$

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8. Solve each of the following Physics equations for the specified variable: (10 pts)

(a) Solve for t : $2s - vt = 2at$

(b) Solve for v : $T = \frac{1}{2}mv^2$