Polynomial and Rational Functions Solutions
2003 National Mu Alpha Theta Convention

1. **A.** $m = -\frac{2}{9}, \perp m = \frac{9}{2};\ \frac{9}{2} = \frac{3}{4k}; k = \frac{1}{6}$

2.**B.** $\frac{-5}{2k-4} = \frac{9}{5+k}; k = \frac{11}{23}; m = \frac{9}{\frac{126}{23}} = \frac{23}{14}$

3. **B.** $2x^2 + 4(45x) = 4400; x^2 + 90x - 2200 = 0; x =$ -110 or 20; - 110 extraneous;
$V = 45(20)(20) = 18000\text{cm}^3$

4. **D**.

5. **D**. $A = 1; B = -\left(\frac{5}{8} + 2i\sqrt{5} + \frac{5}{8} - 2i\sqrt{5}\right) = -\frac{5}{4}; C = \left(\frac{5}{8} + 2i\sqrt{5}\right)\left(\frac{5}{8} - 2i\sqrt{5}\right) = \frac{1305}{64}$
$\frac{A+C}{B} = -\frac{1369}{80}$

6. **C**. $A = 0; B = \frac{9}{16}; A + B = \frac{9}{16}$

7. **C**.

8. **D.** Let $x$= number of \$0.05 increases
$(0.50 + 0.05x)(360 - 20x) = 196; (x-4)^2 = 0; x = 4;$ price = \$0.50 + \$0.20 = \$0.70

9. **B.** $\frac{4}{3}\pi(r+4.5)^3 - \frac{4}{3}\pi r^3 = 425\pi; (r+4.5)^3 - r^3 = 318.75;$
$13.5r^3 + 20.25r - 227.625 = 0; r = 3.4\text{cm}; 3.4 + 4.5 = 7.9\text{cm}$

10.**D**. $x - 7 \geq 0$ and $x - 5 \geq 0$ or $x - 7 \leq 0$ and $x - 5 \leq 0; x \geq 0$ or $x \leq 5;$
$\{x : x \geq 7 x \leq 5\}$

11. **B**.
$(x^{2n} + 4)(x^n + 1)(x^n - 1) < 0; x^{2n} + 4 > 0$ for all $x$;
$x^n + 1 > 0$ and $x^n - 1 < 0$ for -1 < $x$ < 1; $x^n + 1 < 0$ and $x^n - 1 > 0$ does not exist ; $\{x : -1 < x < 1\}$

12. **B**.

13. **C**. $(g+f)(x) = 2x^2 + 3x - 1, (g+f)(-3) = 2 \bullet 9 + 3 \bullet -3 - 1 = 8$

14. **C**. $\left(\frac{\left(\frac{(u-v)(u+v)+2v^2}{u+v}\right)\left(\frac{v^2-u^2}{u^2v^2}\right)}{\frac{u^3(u+v)-(u^3v+v^4)}{u+v}}\right) = \left(\frac{u^2+v^2}{u+v}\right)\left(\frac{v^2-u^2}{u^2v^2}\right)\left(\frac{u+v}{u^4-v^4}\right) = -\frac{1}{u^2v^2}$

15. **C.** Let $x$ = number of hours to increase 1; $\frac{5}{2}x - 2x - \frac{2}{3}x + \frac{2}{9}x = 1; t = 18$

16.**B**. $0.285(451.2) + x = 0.464(451.2 + x); x = 150.68$

17. **C**.

18. **A.** slope = $-\frac{A}{B} = \frac{-4}{k}; \frac{-4}{k} = 2; k = -2$

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| 19.**B**. $\frac{p_1^2}{d_1^3}=\frac{p_2^2}{d_2^3}; p_2^2=(32485)^3\left(\frac{7.25^2}{25000^3}\right); p_2=10.7$ |
| 20.**C**. |
| 21. **D**. Solve the cubic equation, $x$= - 1, 2, 3. Test the zones on the number line. $(-\infty,-(-\infty,-1]\cup[2,3]$ |
| 22. **D.** For the vertex to be on the $x$-axis, the quadratic must be a perfect square. Thus C=16. |
| 23. **B**. $3x+(x-y)+3y=30; y=15-2x; A=x^2+y^2; f(x)=5x^2-60x+225;$ $x=-\frac{b}{2a}=\frac{60}{10}=6$ |
| 24. **C**. Descartes Rule of Signs |
| 25. **A** |
| 26. **B**. |
| 27. **D** $\frac{x}{2(x-4)}=\frac{2}{x-4}+1; x\neq 4; \frac{x}{x-4}=\frac{4}{x-4}+2; x=4+2x-8; x=4; \{\ \}$ |
| 28. **C.** |
| 29. **C**. $m=\frac{3}{7}; \perp m=-\frac{7}{3}; 7(-3)+3(2)=-15; A=7; B=3; C=15; A-B+C=19$ |
| 30.**D**. |