Name: Key

MA131/135: College Algebra
Instructor: Justin Ryan
Midterm Exam 3—Chapter 3
Due by:

Butler Community College

Read and follow all instructions.

Part I: True or False [2 points each]
Read each statement carefully. In the space provided, write **T** *if the statement is always true, or* **F** *otherwise.*

F **1.** A polynomial function of degree 5 has exactly 5 real zeros. at most

F **2.** A polynomial function of degree 4 has at least 1 real zero. could have 0

T **3.** A polynomial function of degree 6 with negative leading coefficient and positive y-intercept must have at least 2 real zeros.

T **4.** Every polynomial of odd degree has an even number of turning points.

T **5.** The polynomial function $P(x) = 3x^6 - 3x^2 - 3$ has no positive real roots larger than 2.

Part II: Fill in the Blank [2 points each]
Choose the appropriate word or phrase from the word bank, and write its corresponding letter in the space provided.

Word Bank:

A. zero	**B.** one	**C.** two
D. three	**E.** four	**F.** five
G. remainder	**H.** root	**I.** factor
J. quotient	**K.** divisor	**L.** squirrel

B **6.** The polynomial function $P(x) = x^3 + 3x$ has _____ real zeros.

B **7.** The polynomial function $P(x) = -x^5 + 9x^4 + 13x^3 - 5x^4 + 2x^2 + 12$ has exactly _____ positive real root(s).

A **8.** The polynomial function $P(x) = 9x^9 + 7x^7 + x^3 + 5x$ has _____ negative real roots.

I **9.** If $x = k$ is a root of a polynomial function P, then $(x - k)$ is a _____ of P.

J **10.** When dividing $P(x) = 3x^4 - 4x^2 + 9x - 12$ by $D(x) = x^2 - 3x + 2$, the term $3x^2 + 9x + 17$ is called the _____ .

Part III: Multiple Choice [4 points each]
Write the letter corresponding to the appropriate answer in the space provided.

C **11.** Find the vertex of the function $P(x) = -2x^2 - 4x + 6$.

A. $(1, 8)$ **B.** $(4, 6)$

C. $(-1, 8)$ **D.** $(-4, 6)$

$P(x) = -2(x^2 + 2x + 1 - 3 - 1)$

$= -2(x+1)^2 + 8$

D **12.** Solve the equation $6x^2 - 15x + 6 = 0$.

A. $x = 1, 2$ **B.** $x = -\frac{1}{2}, 2$

C. $x = 3, 12$ **D.** $x = \frac{1}{2}, 2$

$x = \frac{15}{12} \pm \frac{\sqrt{15^2 - 4 \cdot 6^2}}{12}$

$= \frac{15}{12} \pm \frac{\sqrt{81}}{12}$

$= \frac{15}{12} \pm \frac{9}{12} = \frac{24}{12} = 2$

$\text{or } \frac{6}{12} = \frac{1}{2}$

C **13.** Solve the equation $x^2 - 4x = 2$.

A. $x = -2 \pm \sqrt{6}$ **B.** $-2 \pm i\sqrt{2}$

C. $x = 2 \pm \sqrt{6}$ **D.** $2 \pm i\sqrt{2}$

$x^2 - 4x + 4 = 2 + 4$

$(x-2)^2 = 6$

$x = 2 \pm \sqrt{6}$

A **14.** Solve the equation $3x^2 + 3x - 2 = 0$.

A. $x = -\frac{1}{2} \pm \frac{\sqrt{33}}{6}$ **B.** $\frac{1}{2} \pm \frac{\sqrt{33}}{6}$

C. $x = -\frac{1}{2} \pm \frac{i\sqrt{33}}{6}$ **D.** $\frac{1}{2} \pm \frac{i\sqrt{33}}{6}$

A **15.** The function $f(x) = x^6 - 5x^5 + 3x^4 + x^3 + 40x^2 - 24x - 72$ has 3 as a root of multiplicity 2, 2 as a root of multiplicity 1, and -1 as a root of multiplicity 1. Find all other roots.

A. $x = -1 \pm i\sqrt{3}$ **B.** $\pm\sqrt{3}$

C. $x = -1 \pm \sqrt{3}$ **D.** $\pm i\sqrt{3}$

$x^2 + 2x + 1 = -4 + 1$

$(x+1)^2 = -3$

$x = -1 \pm \sqrt{-3}$

3	1	−5	3	1	40	−24	−72
	↓	3	−6	−9	−24	48	−72
3	1	−2	−3	−8	16	24	0
	↓	3	3	0	−24	−24	
2	1	1	0	−8	−8	0	
	↓	2	6	12	8		
−1	1	3	6	4	0		
	↓	−1	−2	−4			
	1	2	4	0			

D **16.** The function $f(x) = 4x^4 - 21x^2 - 25$ has i as a root. Find all roots of f.

A. $x = i, \pm\frac{5}{2}$ **B.** $x = \pm i, \pm 5$

C. $x = i, \pm 5$ **D.** $x = \pm i, \pm\frac{5}{2}$

$$x^2+1 \;\overline{)\; 4x^4 + 0x^3 - 21x^2 + 0x - 25}$$

$4x^4 + 4x^2$

$-25x^2 - 25$

$x = \pm\frac{5}{2}$

B **17.** Divide $\dfrac{3x^3 - 5x^2 + 6}{x - 1}$.

A. $3x^3 - 2x^2 - 2x + 4$ **B.** $3x^2 - 2x - 2 + \frac{4}{x-1}$

C. $\dfrac{3x^2 - 2x - 2}{4}$ **D.** $3x^2 - 2x - 2$

1	3	−5	0	6
	↓	3	−2	−2
	3	−2	−2	4

D **18.** Divide $\dfrac{x^4 - 2x + 6}{x^2 + 2}$.

A. $x^2 - 2 - 2x + 10$ **B.** $x^2 - 2 + \frac{-2x+2}{x^2+2}$

C. $\dfrac{x^2 - 2}{-2x + 10}$ **D.** $x^2 - 2 + \frac{-2x+10}{x^2+2}$

$$x^2+2 \;\overline{)\; x^4 + 0x^3 + 0x^2 - 2x + 6}$$

$x^4 + 2x^2$

$-2x^2 - 2x + 6$

$-2x^2 \quad -4$

$-2x + 10$

A **19.** Does the function $P(x) = 3x^4 + 5x^3 - 35x^2 - 55x + 22$ have a real root between $x = 3$ and $x = 4$?

A. Yes **B.** No

C. Indeterminate **D.**

3	3	5	-35	-55	22
	↓	9	42	21	-102
	3	14	7	-34	-80

4	3	5	-35	-55	22
	↓	12	68	132	308
	3	17	33	77	330

A **20.** Find a cubic polynomial with zeros at 4 and $2i$, and such that $f(1) = -15$.

A. $f(x) = x^3 - 4x^2 + 4x - 16$ **B.** $f(x) = x^3 + 4x^2 + 4x + 16$

C. $f(x) = x^2$ [illegible] -16 **D.** $f(x) = -15x^3 - 4x^2 + 4x$

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

$= x^3 - 4x^2 + 4x - 16$

D **21.** Find all roots of the function $P(t) = 7t^2 + 3t + 4$.

A. $t = 7, 3$ **B.** $t = -\frac{3}{14} \pm \frac{\sqrt{103}}{14}$

C. $t = \frac{3}{14} \pm i\frac{\sqrt{103}}{14}$ **D.** $t = -\frac{3}{14} \pm \frac{i\sqrt{103}}{14}$

D **22.** Describe the end behavior of the graph of the function

$$P(x) = -\sqrt{2}x^3 + 4x^2 + 2x - 4.$$

A. ↙ ... ↗ **B.** ↖ ... ↘

C. ↖ ... ↗ **D.** ↙ ... ↘

A **23.** Divide the polynomial function $P(x) = 2x^3 + 3x^2 + 4x - 10$ by $D(x) = x + 1$.

A. $2x^2 + x + 3 - \frac{13}{x+1}$ **B.** $2x^2 + x + 3$ -13

C. $2x^2 + x + 3 \quad -13$ **D.** $2x^2 + x + 3 \quad -13(x+1)$

B **24.** Solve the equation $x^3 + 5x^2 - 14x = 0$.

A. $-5, 7, 0$ **B.** $x = -7, 0, 2$

C. $x = -\frac{5}{2} \pm \frac{9}{2}i$ **D.** $x = -7, 2$

D **25.** Find a polynomial function with real coefficients of lowest possible degree having 2 and $6i$ as zeros.

A. $P(x) = x^3 + 2x^2 + 36x - 72$ **B.** $P(x) = x^2 - (2+6i)x + 12i$

C. $P(x) = x^2 - 8x + 12$ **D.** $P(x) = x^3 - 2x^2 + 36x - 72$

C **26.** Let $P(x) = 2x^3 - 3x^2 - 4x + 19$. Use synthetic division to find $P(-3)$.

A. 50 **B.** -3

C. -50 **D.** 19

P **27.** Find all (real *and* complex) solutions of equation

$$5x^4 + 7x^3 + 119x^2 + 175x - 150 = 0.$$

A. $x = 1, 2, 30, 5$ **B.** $x = -2, 1, 5i, -5i$

C. $x = 1, 1, i, -i$ **D.** $x = -2, \frac{3}{5}, 5i, -5i$

A **28.** Find a polynomial function P of lowest degree with $-3+4i$ as a root and $P(1) = 48$.

A. $P(x) = \frac{3}{2}x^2 + 9x + \frac{75}{2}$ **B.** $P(x) = 48x^2 + 6x^3 + 25$

C. $P(x) = x^2 + 6x + 25$ **D.** $P(x) = 48(x^2 + 25)$

C **29.** Let P be a quadratic function with a root at $5 - 12i$ and leading coefficient of -3. What is the vertex of P?

A. $(5, 12)$ **B.** $(-3, -432)$

C. $(5, -432)$ **D.** $(5, 432)$

D **30.** What is the maximum number of positive roots of the function?

$$P(x) = 17x + 3x^3 + 7x^5 - 2x^2 - x^6 - 13x^4 - 5$$

A. 1 **B.** 4

C. 0 **D.** 6