Directions:

- This is a two hour exam. Clearly print your name on the first page and the top of the third page (second piece of paper). No books, notes, cell phones, or internet connection can be used during this exam. Any scratch paper must be provided to you by the proctor and turned in with the exam. A calculator maybe used; however, the calculator cannot have a Computer Algebra System (CAS) or a QWERTY keyboard. When you have completed the exam:
  1) Turn in the entire exam (including cover page, and any scratch papers) to the proctor
  2) Show your ID to the proctor
  3) Sign the "Sign Out Sheet"
- All answers must be fully filled in on the front page, like so:

  (A) B C D E
- The exam is out of 100 total points (5 points for each of the 20 questions). Only this front page will be graded and no partial credit will be awarded. Consequently, please double check to make sure that you have marked the answer you desire. Good Luck!

#1 A B (C) D E
#2 A (B) C D E
#3 A B (C) D E
#4 A B (C) D E
#5 A (B) C D E
#6 (A) B C D E
#7 A B (C) D E
#8 A (B) C D E
#9 A B (C) D E
#10 A B C (D) E
#11 A (B) C D E
#12 (A) B C D E
#13 A B (C) D E
#14 A (B) C D E
#15 (A) B C D E
#16 A (B) C D E
#17 (A) B C D E
#18 (A) B C D E
#19 A (B) C D E
#20 A B C (D) E

Name (Print): Key

Section Number:

Section	Instructor	Class Start Time	Exam Location
001	Drew Butcher	MWF 8:00 AM	MEH
002	Konstantina Christodoulopoulou	MWF 9:00 AM	CB 106
003	Konstantina Christodoulopoulou	MWF 2:00 PM	CB 118
004	Drew Butcher	MWF 11:00 AM	MEH
005	Drew Butcher	MWF 3:00 PM	MEH (A-K) & CP 320 (L-Z)
006	Jonathan Constable	TR 8:00 AM	CB 102
007	Stephen Deterding	TR 8:00 AM	CB 110
008	Jonathan Constable	TR 9:30 AM	CB 102
009	Stephen Deterding	TR 9:30 AM	CB 110
010	Michael Gustin	TR 11:00 AM	CB 114
011	Robert Davis	TR 11:00 AM	CB 122
012	Michael Gustin	TR 12:30 PM	CB 114
013	Robert Davis	TR 12:30 PM	CB 122
014	Ray Kremer	TR 2:00 PM	CP 139
015	Clinton Hines	TR 2:00 PM	CP 139
016	Ray Kremer	TR 3:30 PM	CP 139
017	Clinton Hines	TR 3:30 PM	CP 139

UK: "Go CATS" Name:_____ Section:_____

1. (5 points) How many distinct real solutions does each equation have?

Discriminant $= b^2 - 4ac$

(I) $3x^2 - 6x + 3 = 0$ **(II)** $2x^2 + 6x + 4 = 0$

$b^2 - 4ac = 6^2 - 4(2)(4) = 36 - 32 = 4 > 0$

$b^2 - 4ac = (-6)^2 - 4(3)(3) = 36 - 36 = 0$

A. Equation **(I)** has one real solution, and equation **(II)** has no real solutions.

B. Equation **(I)** has no real solutions and equation **(II)** has one real solution.

C. Equation **(I)** has one real solution and equation **(II)** has two real solutions.

D. Equation **(I)** has two real solutions and equation **(II)** has one real solution.

E. Equation **(I)** has two real solutions and equation **(II)** has two real solutions.

2 Real Solutions

1 Real Solution

2. (5 points) Find a number k so that the equation $3x^2 + kx + 3 = 0$ has exactly one real solution.

A. $k = 7$

B. $k = 6$

C. $k = 5$

D. $k = 4$

E. All of the above

$k^2 - 4(3)(3) = 0$

$k^2 - 36 = 0$

$k^2 = 36$

$k = \pm\sqrt{36}$

$k = \pm 6$

3. (5 points) Which of the following is equal to $-(x - 3)$?

A. $x - 3$

B. $x + 3$

C. $3 - x$

D. $-x - 3$

E. None of the above

$-(x-3) = -x + 3 = 3 + (-x) = 3 - x$

4. (5 points) Find all real solutions to the equation $x^6 - 2x^3 = -1$.

A. $x = 1$ and $x = -1$

B. $x = -1$

C. $x = 1$

D. All real numbers

E. No solution

Let $u = x^3$ then $u^2 = x^6$ so $\longrightarrow$ $u^2 - 2u = -1$

$u^2 - 2u + 1 = 0$

$(u-1)(u-1) = 0$

$u - 1 = 0$ or $u - 1 = 0$

$u = 1$ $u = 1$

Since $u = 1$

$x^3 = 1$

$x = \sqrt[3]{1} = 1$

5. (5 points) How many distinct real solutions does the equation $x^8 = 25x^3$ have?

A. 3

B. 2

C. 1

D. Infinitely many solutions

E. No solutions

$x^8 - 25x^3 = 0$

$x^3(x^5 - 25) = 0$

$x^3 = 0$ or $x^5 - 25 = 0$

$x = \sqrt[3]{0} = 0$

$x^5 = 25$

$x = \sqrt[5]{25}$

6. (5 points) What are the real solutions to the equation $x^2 - 8x = -15$?

   A. 3 and 5
   B. 3 and -5
   C. -3 and -5
   D. -3 and 5
   E. None of the above

Check $x=3$: $3^2 - 8(3) \stackrel{?}{=} -15$, $9 - 24 \stackrel{?}{=} -15$, $-15 = -15$ ✓

$x^2 - 8x + 15 = 0$
$(x-3)(x-5) = 0$
$x - 3 = 0$, $x = 3$
$x - 5 = 0$, $x = 5$

Check $x=5$: $5^2 - 8(5) \stackrel{?}{=} -15$, $25 - 40 \stackrel{?}{=} -15$, $-15 = -15$ ✓

7. (5 points) Solve $5x^2 - 7x + 1 = 0$

   A. $-\frac{7}{10} \pm \frac{69}{10}$
   B. $\frac{7 \pm \sqrt{69}}{10}$
   C. $\frac{7 \pm \sqrt{29}}{10}$
   D. $\frac{-7 \pm \sqrt{29}}{10}$
   E. None of the above or no real solutions.

$a = 5$, $b = -7$, $c = 1$

$x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(5)(1)}}{2(5)} = \frac{7 \pm \sqrt{49 - 20}}{10} = \frac{7 \pm \sqrt{29}}{10}$

8. (5 points) Find the equation of a circle with center $(2, -1)$ and radius 4.

   A. $(x-2)^2 + (y+1)^2 = 4$
   B. $(x-2)^2 + (y+1)^2 = 16$
   C. $(x+2)^2 + (y-1)^2 = 16$
   D. $(x-2)^2 - (y+1)^2 = 16$
   E. None of the above

h, k r

$(x-h)^2 + (y-k)^2 = r^2$
$(x-2)^2 + (y-(-1))^2 = 4^2$
$(x-2)^2 + (y+1)^2 = 16$

9. (5 points) Which of the following represents the equation of a line that passes through the points $(-2, 3)$ and $\left(\frac{1}{2}, -5\right)$?

   A. $y + 2 = -\frac{8}{10}(x-3)$
   B. $y + 2 = 16(x-3)$
   C. $y - 3 = -\frac{16}{5}(x+2)$
   D. $y - 3 = 16(x+2)$
   E. None of the above

(x_1, y_1) (x_2, y_2)

slope $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5-3}{\frac{1}{2} - (-2)} = \frac{-8}{\frac{1}{2} + \frac{2}{1}} = \frac{-8}{\frac{1+4}{2}} = \frac{-8/1}{\frac{5}{2}}$

$= \frac{-8}{1} \cdot \frac{2}{5} = -\frac{16}{5}$

$y - y_1 = m(x - x_1)$
$y - 3 = -\frac{16}{5}(x - (-2)) \rightarrow y - 3 = -\frac{16}{5}(x+2)$

or $y - (-5) = -\frac{16}{5}\left(x - \frac{1}{2}\right) \rightarrow y + 5 = -\frac{16}{5}\left(x - \frac{1}{2}\right)$

10. (5 points) Find the slope and y-intercept of the line $4x + 2y = 7$

A. slope $= -\frac{7}{2}$, y-intercept $= -2$
B. slope $= -\frac{7}{2}$, y-intercept $= 2$
C. slope $= -2$, y-intercept $= -\frac{7}{2}$
D. slope $= -2$, y-intercept $= \frac{7}{2}$
E. None of the above

$2y = -4x + 7$ slope $= -2$
$y = -\frac{4}{2}x + \frac{7}{2}$ y-intercept $= \frac{7}{2}$
$y = -2x + \frac{7}{2}$

11. (5 points) Which of the following equations represents the statement that the distance from -5 to a number x on the number line is 3?

A. $|5 - 3| = x$
B. $|x + 5| = 3$
C. $|x - 5| = 3$
D. $|x - 3| = 5$
E. $|x + 3| = 5$

$|x - (-5)| = 3$
$|x + 5| = 3$

12. (5 points) What is $\sqrt{9}$?

A. 3
B. 81
C. -81
D. -3
E. both 3 and -3

$\sqrt{9}$ = the principal square root of $9 = 3$
because $3^2 = 9$ and 3 is non-negative

13. (5 points) Solve the equation $\sqrt{-x-2} = x + 2$ for x.

A. $x = -2$ and $x = -3$
B. $x = -3$
C. $x = -2$
D. All real numbers
E. No solution

$\sqrt[n]{a} = b$ means $b^n = a$
$\sqrt{-x-2} = x+2$
$(x+2)^2 = -x-2$
$(x+2)(x+2) = -x-2$
$x^2+2x+2x+4 = -x-2$
$x^2+4x+4 = -x-2$
$x^2+5x+6 = 0$
$(x+3)(x+2) = 0$
$x+3=0$ $x+2=0$
$x=-3$ $x=-2$

Check $x=-2$
$\sqrt{-(-2)-2} \stackrel{?}{=} -2+2$
$\sqrt{2-2} \stackrel{?}{=} 0$
$\sqrt{0} \stackrel{?}{=} 0$
$0 = 0$
So $x=-2$ is a solution

Check $x=-3$
$\sqrt{-(-3)-2} \stackrel{?}{=} -3+2$
$\sqrt{3-2} \stackrel{?}{=} -1$
$\sqrt{1} \stackrel{?}{=} -1$
$1 \neq -1$
So $x=-3$ is not a solution

14. (5 points) Find all real solutions of the equation $|3x - 2| = 5x + 4$.

A. No real solutions
B. $x = -\frac{1}{4}$
C. $x = 3$ and $x = -\frac{1}{4}$
D. $x = -3$ and $x = -\frac{1}{4}$
E. $x = -\frac{1}{4}$ and $x = 2$

$3x - 2 = 5x + 4$
$3x - 2 + 2 = 5x + 4 + 2$
$3x = 5x + 6$
$3x - 5x = 5x + 6 - 5x$
$-2x = 6$
$\frac{-2x}{-2} = \frac{6}{-2}$
$x = -3$

$3x - 2 = -(5x + 4)$
$3x - 2 = -5x - 4$
$3x - 2 + 2 = -5x - 4 + 2$
$3x = -5x - 2$
$3x + 5x = -5x - 2 + 5x$
$\frac{8x}{8} = \frac{-2}{8}$ $x = -\frac{1}{4}$

Check $x=-3$
$|3(-3)-2| \stackrel{?}{=} 5(-3)+4$
$|-9-2| \stackrel{?}{=} -15+4$
$|-11| \stackrel{?}{=} -11$
$11 \neq -11$
So $x=-3$ is not a solution

Check $x=-\frac{1}{4}$
$|3(-\frac{1}{4})-2| \stackrel{?}{=} 5(-\frac{1}{4})+4$
$|-\frac{3}{4}-\frac{2}{1}\cdot\frac{4}{4}| \stackrel{?}{=} -\frac{5}{4}+\frac{4}{1}\cdot\frac{4}{4}$
$|\frac{-11}{4}| \stackrel{?}{=} \frac{11}{4}$
$\frac{11}{4} = \frac{11}{4}$
So $x=-\frac{1}{4}$ is a solution

15. (5 points) Find the midpoint of the line segment between the points $(-2,-3)$ and $(1,0)$.

A. $\left(-\frac{1}{2},-\frac{3}{2}\right)$

B. $\left(-\frac{3}{2},-\frac{3}{2}\right)$

C. $\left(-\frac{3}{2},-\frac{1}{2}\right)$

D. $\left(\frac{3}{2},0\right)$

E. None of the above

(x_1,y_1) (x_2,y_2)

$\text{midpoint} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) = \left(\frac{-2+1}{2}, \frac{-3+0}{2}\right) = \left(\frac{-1}{2}, \frac{-3}{2}\right)$

16. (5 points) Solve the following equation for z, $5x+2y-\frac{z}{\pi}=1$.

A. $z=\frac{1}{\pi}(5x+2y+1)$

B. $z=\pi(5x+2y-1)$

C. $z=\frac{1}{\pi}(5x+2y-1)$

D. $z=\pi(5x+2y+1)$

E. $z=5x+2y-\pi$

$\pi\left(5x+2y-\frac{z}{\pi}\right)=(1)\pi$

$5\pi x+2\pi y-\frac{z}{\pi}=\pi$

$5\pi x+2\pi y-z=\pi$

$5\pi x+2\pi y-z+z=\pi+z$

$5\pi x+2\pi y=\pi+z$

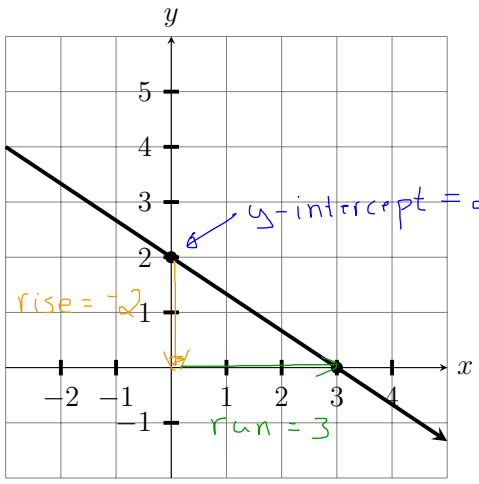
$5\pi x+2\pi y-\pi=\pi+z-\pi$

$5\pi x+2\pi y-\pi=z$

$z=5\pi x+2\pi y-\pi$

$z=\pi(5x+2y-1)$

17. (5 points) Which of the following represents an equation of the line whose graph is shown below?



$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{-2}{3}$

A. $y=-\frac{2}{3}x+2$

B. $y=-\frac{3}{2}x+2$

C. $y=\frac{2}{3}x+2$

D. $y=\frac{3}{2}x+2$

E. None of the above

18. (5 points) Solve the equation $\sqrt{x+a} = 2\sqrt{a}$ for x where a is a positive constant.

A. $x = 3a$
B. $x = 2a^2$
C. $x = a$ and $x = -a$
D. $x = 5a$
E. No solution

Recall $\sqrt[n]{a} = b$ means $b^n = a$

$\sqrt[2]{x+a} = 2\sqrt{a}$

$(2\sqrt{a})^2 = x+a$

$4a = x+a$

$4a - a = x + a - a$

$3a = x$

$x = 3a$

19. (5 points) When listing the order in which operations are being applied to c in the expression

$$a(bc+d)^2 - e$$

what is the **third** operation?

A. add d
B. square
C. subtract e
D. multiply by b
E. multiply by a

1st Multiply by b $\quad c \rightsquigarrow bc$
2nd Add d $\quad bc \rightsquigarrow bc+d$
3rd Square $\quad bc+d \rightsquigarrow (bc+d)^2$
4th Multiply by a $\quad (bc+d)^2 \rightsquigarrow a(bc+d)^2$
5th Subtract e $\quad a(bc+d)^2 \rightsquigarrow a(bc+d)^2 - e$

20. (5 points) Write the given expression without absolute values

Counted Correct for all students

$$|a-6| \text{ if } a < 6$$

A. $-6 - a$
B. $a - 6$ some
C. $-6 + a$
D. $6 - a$
E. None of the above.

If $a < 6$ then

$a - 6 < 6 - 6$

so $a - 6 < 0$

which means $|a-6| = -(a-6) = -a+6 = 6-a$