

(35 minutes)

1. The nature of the roots of the equation  $3x^4 + 4x^3 + x - 1 = 0$  is
  - (a) three positive real roots and one negative real root
  - (b) three negative real roots and one positive real root
  - (c) one negative real root and three complex roots
  - (d) one positive real root, one negative real root, and two complex roots
  - (e) two positive real roots, one negative real root, and one complex root
  
2. For what value(s) of  $k$  is  $x^2 + 3x + k$  divisible by  $x + k$ ?
  - (a) only 0
  - (b) only 0 or 2
  - (c) only 0 or -4
  - (d) no value of  $k$
  - (e) any value of  $k$
  
3. What is the equation of the set of points that are 5 units from point  $(2, 3, 4)$ ?
  - (a)  $2x + 3y + 4z = 5$
  - (b)  $x^2 + y^2 + z^2 - 4x - 6y - 8z = 25$
  - (c)  $(x - 2)^2 + (y - 3)^2 + (z - 4)^2 = 25$
  - (d)  $x^2 + y^2 + z^2 = 5$
  - (e)  $x/2 + y/3 + z/5 = 5$
  
4. If  $3x^{3/2} = 4$ , then  $x =$ 
  - (a) 1.1
  - (b) 1.2
  - (c) 1.3
  - (d) 1.4
  - (e) 1.5
  
5. For what values of  $k$  are the roots of the equation  $kx^2 + 4x + k = 0$  real and unequal?
  - (a)  $0 < k < 2$
  - (b)  $|k| < 2$
  - (c)  $|k| > 2$
  - (d)  $k > 2$
  - (e)  $-2 < k < 0$  or  $0 < k < 2$

6. A point moves in a plane so that its distance from the origin is always twice its distance from the point  $(1, 1)$ . All such points form
- (a) a line
  - (b) a circle
  - (c) a parabola
  - (d) an ellipse
  - (e) a hyperbola
7. If  $f(x) = 3x^3 + 24x - 53$ , find the negative value of  $f^{-1}(0)$ .
- (a) -58.8
  - (b) -9.8
  - (c) -8.2
  - (d) -1.8
  - (e) -0.2
8. The equations of the asymptotes of the graph of  $4x^2 - 9y^2 = 36$  are
- (a)  $y = x$  and  $y = -x$
  - (b)  $y = 0$  and  $x = 0$
  - (c)  $y = 2x/3$  and  $y = -2x/3$
  - (d)  $y = 3x/2$  and  $y = -3x/2$
  - (e)  $y = 4x/9$  and  $y = -4x/9$
9. If  $g(x - 1) = x^2 + 2$ , then  $g(x) =$
- (a)  $x^2 - 2x + 3$
  - (b)  $x^2 + 2x + 3$
  - (c)  $x^2 - 3x + 2$
  - (d)  $x^2 + 2$
  - (e)  $x^2 - 2$
10. For what positive value of  $n$  are the zeros of  $p(x) = 5x^2 + nx + 12$  in ratio  $2 : 3$
- (a) 0.42
  - (b) 1.32
  - (c) 4.56
  - (d) 15.8
  - (e) 25

11. If the circle  $x^2 + y^2 - 2x - 6y = r^2 - 10$  is tangent to the line  $12y = 60$ , the value of  $r$  is
- (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
  - (e) 5
12. The length of the diameter of a circle is equal to the length of the major axis of the ellipse whose equation is  $x^2 + 4y^2 - 4x + 8y - 28 = 0$ , to the nearest whole number, what is the area of the circle?
- (a) 28
  - (b) 64
  - (c) 113
  - (d) 254
  - (e) 452
13.  $x^{2/3} + x^{4/2} =$
- (a)  $x^{2/3}$
  - (b)  $x^{8/9}$
  - (c)  $x$
  - (d)  $x^2$
  - (e)  $x^{2/3}(x^{2/3} + 1)$
14. The sum of the zeros of  $f(x) = 3x^2 - 5$  is
- (a) 3.3
  - (b) 1.8
  - (c) 1.7
  - (d) 1.3
  - (e) 0
15.  $P(x) = x^5 + x^4 - 2x^3 - x - 1$  has at most  $n$  positive zeros. Then  $n =$
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 3
  - (e) 5

16. If  $f(x)$  is a linear function and  $f(2) = 1$  and  $f(4) = 2$ , then  $f(x) =$
- (a)  $-3x/2 + 4$
  - (b)  $3x/2 - 2$
  - (c)  $-3x/2 + 2$
  - (d)  $3x/2 - 4$
  - (e)  $-2x/3 + 7/3$
17.  $P(x) = x^3 + 18x - 30$  has a zero in the interval
- (a) (0,0.5)
  - (b) (0.5,1)
  - (c) (1,1.5)
  - (d) (1.5,2)
  - (e) (2,2.5)
18. If  $f(x) = x^2 - 4$ , for what real number values of  $x$  will  $f(f(x)) = 0$ ?
- (a) 2.4
  - (b)  $\pm 2.4$
  - (c) 2 or 6
  - (d)  $\pm 1.4$  or  $\pm 2.4$
  - (e) no values
19.  $(p, q)$  is called a *lattice point* if  $p$  and  $q$  are both integers. How many lattice points lie in the area between the two curves  $x^2 + y^2 = 9$  and  $x^2 + y^2 - 6x + 5 = 0$ ?
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 3
  - (e) 4
20. For all real numbers  $x$ ,  $f(2x) = x^2 - x + 3$ . An expression for  $f(x)$  in terms of  $x$  is
- (a)  $2x^2 - 2x + 3$
  - (b)  $4x^2 - 2x + 3$
  - (c)  $x^2/4 - x/2 + 3$
  - (d)  $x^2/2 - x/2 + 3$
  - (e)  $x^2 - x + 3$

21. For what value(s) of  $k$  is  $x^2 - kx + k$  divisible by  $x - k$ ?
- (a) only 0
  - (b) only 0 or  $-1/2$
  - (c) only 1
  - (d) any value of  $k$
  - (e) no value of  $k$
22. If the graphs of  $x^2 = 4(y + 9)$  and  $x + ky = 6$  intersect on the  $x$ -axis, then  $k =$
- (a) 0
  - (b) 6
  - (c)  $-6$
  - (d) no real number
  - (e) any real number
23. The length of the latus rectum of the hyperbola whose equation is  $x^2 - 4y^2 = 16$  is
- (a) 1
  - (b) 2
  - (c)  $\sqrt{20}$
  - (d)  $2\sqrt{20}$
  - (e) 16
24. Which of the follow translations of the graph of  $y = x^2$  would result in the graph of  $y = x^2 - 6x + k$  where  $k$  is a constant greater than 10.
- (a) Left 6 units and up  $k$  units
  - (b) Left 3 units and up  $k + 9$  units
  - (c) Right 3 units and up  $k + 9$  units
  - (d) Left 3 units and up  $k - 9$  units
  - (e) Right 3 units and up  $k - 9$  units
25. When the smaller root of the equation  $3x^2 + 4x - 1 = 0$  is subtracted from the larger root, the result is
- (a)  $-1.3$
  - (b)  $0.7$
  - (c)  $1.3$
  - (d)  $1.8$
  - (e)  $2.0$