EXERCISES IN MATH

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1. REAL NUMBERS

1. Which one of the following statements is FALSE ?
   (a) If a is a natural number, then a is a whole number.
   (b) Any whole number is also an integer.
   (c) Any integer is also a rational number.
   (d) The number zero (0) is both rational and irrational.
   (e) Any irrational number is also a real number.

2. The multiplicative inverse of (-0.75) is
   (a) $\frac{1}{4}$
   (b) $-\frac{4}{3}$
   (c) $\frac{4}{3}$
   (d) $\frac{3}{4}$
   (e) $-\frac{1}{4}$

3. Which one of the following statements is TRUE ?
   (a) Every irrational number is a real number.
   (b) The set of the whole numbers is closed under division.
   (c) $6 + (4 + 5) = (4 + 5) + 6$ illustrates the associative property.
   (d) The set $\{0,1\}$ is closed under addition.
   (e) Each real number is either even or odd.

4. Which one of the following statements is FALSE ?
   (a) The set of all nonzero rational numbers is closed under division.
   (b) The sum or product of two irrational numbers can be rational or irrational.
   (c) The set of irrational numbers does not contain a multiplication identity.
   (d) The set of irrational numbers is closed under subtraction.
   (e) The difference of two real numbers is also a real number.

5. Which one of the following statements is TRUE ?
   (a) The set of irrational numbers is closed with respect to addition.
   (b) The set $\{-1, 0, 1\}$ is closed with respect to multiplication.
   (c) If x is any integer and y is any irrational number, then x/y is irrational.
   (d) The distributive law states that:
   $(a + b) + c = a + (b + c)$.
   (e) Any irrational number has a terminating or repeating decimal expansion.

6. Which one of the following statements is TRUE ?
   (a) Every even integer has an additive inverse.
   (b) Every rational number has a multiplicative inverse.
   (c) $\pi = \frac{22}{7}$.
   (d) The distributive law states that $a + b = b + a$.
   (e) The set $\{0, -1\}$ is closed under addition.

7. Which one of the following statements is FALSE ?
   (a) The set of irrational numbers is closed under addition.
   (b) 1.252525........ is a rational number.
   (c) $-\frac{\sqrt{12}}{3\sqrt{3}}$ is a rational number.
   (d) The multiplication inverse of any irrational number is irrational.
   (e) $\frac{\pi}{2}$ is an irrational number.

8. Which one of the following statements is FALSE ?
   (a) The addition inverse of $(-a)$ is (a) for any real number.
   (b) $ab + c = c + ba$ is true because of the commutative property for addition and multiplication.
   (c) The set of integers contains an identity element for addition and multiplication.
   (d) Every real number has a multiplication inverse.
   (e) The set of irrational numbers is not closed under addition and multiplication.

9. To prove that $[a + (-a)] \cdot b = b.0$, we use
   (a) the inverse property for addition and the commutative property for multiplication.
   (b) the identity property for addition and the property for zero.
   (c) the commutative property for addition only.
   (d) the definition for subtraction only.
   (e) the distributive property only.

10. If $A = \left\{-\sqrt{9}, \frac{\pi}{2}, -\frac{3}{16}, 0.67, \sqrt{8}, -\sqrt{-100}\right\}$, then A has
    (a) one natural number.
    (b) four rational numbers.
    (c) six real numbers.
    (d) two integers.
    (e) two irrational numbers.

11. Let S be a set consisting of the squares of the positive integers, that is $1, 4, 9, 16,$ ......, then S is closed under
    (a) addition.
    (b) subtraction.
    (c) multiplication.

(d) division.
(e) addition and subtraction.

12. $a\,x + a\,y = (x + y)\,a$ is true because of

(a) the commutative property for multiplication only.
(b) the distributive property only.
(c) the commutative property for multiplication and the distributive property.
(d) the commutative property for addition and the distributive property.
(e) the commutative property for addition only.

13. The expression $\frac{-20 \div 4 \cdot 5 - 10}{32 \div 8 \cdot 2 - (5-2)}$ is equal to

(a) -7
(b) 50
(c) 7
(d) 3
(e) $\frac{15}{11}$

14. The expression $\frac{-17 \div (3 \cdot 5 + 2) \div 8}{-(6 \cdot 5) - 3 - 3(-11)}$ is equal to

(a) $\frac{1}{396}$
(b) $\frac{17}{396}$
(c) $\frac{1}{66}$
(d) meaningless
(e) $\frac{1}{3168}$

15. If $x = 3 \cdot 4^2 + 7 - 2 \cdot 3^2 \div 6$, $y = 35 - 20 \div 5 \cdot 2 - 6 \cdot 3$, and $z = 6 - 4 \div 2 + 49$, then the expression $x - [y \div (z - x)]$ is equal to

(a) 19
(b) -16
(c) 35
(d) 51
(e) 43

16. The number 980.665×10^{-2} written in scientific notation is

(a) 0.980665×10
(b) 0.0980665×10^2
(c) 9.80665
(d) 98066.5×10^{-4}
(e) 98.0665×10^{-1}

2. POLYNOMIALS

1. Which one of the following is a polynomial ?

(a) $x^2 + 3x + 2x^{-1}$
(b) $\frac{x^3+4}{x-7}$
(c) $3\left(\frac{1}{x}\right)^2$
(d) $5x^4 + 3x + 7$
(e) $2x + \sqrt{x}$

2. When simplified, the expression $-\left[\left(3x^3 + x - 5\right) - \left(x^2 - x - 5x^3\right)\right] + \left(3x^2 - 5x + 8x^3\right)$ is

(a) a monomial of degree 2
(b) a binomial of degree 3
(c) a trinomial of degree 2
(d) a constant
(e) not a polynomial

3. The expression $3y^3\left(y^3 - 4y + 3\right) + \left(2y^3 - 4y^2\right)\left(2y^3 + 4y^2\right)$ is equal to

(a) $7y^6 - 28y^4 + 9y^3$
(b) $7y^9 - 16y^4 - 3y^3$
(c) $7y^6 - 16y^4$
(d) $3y^6 - 28y^4 + 13y^3$
(e) $7y^9 - 8y^5 - 28y^4 + 9y^3$

4. $A = (x - 2y)^3$ and $B = (2x + y)^3$, then $A - B$ is equal to

(a) $(-x - 3y)^3$
(b) $-7x^3 - 18x^2y + 6xy^2 - 9y^3$
(c) $-7x^3 - 6x^2y + 18xy^2 - 7y^3$
(d) $-7x^3 + 12x^2y - 6xy^2 - 9y^3$
(e) $-7x^3 + 6x^2y + 6xy^2 - 9y^3$

5. The expression $a^x\,(a^x - 4)\,(a^x + 1) - (a^x - 1)^3$ is equal to

(a) $1 - 7a^x$
(b) $1 - a^x$
(c) $1 - 4a^x - 3a^{2x}$
(d) $1 - 4a^x$
(e) $2a^{3x} - 6a^{2x} - 7a^x + 1$

6. The expression $(3p - 4q)\,(4q - 3p)$ is equal to

(a) $16q^2 - 9p^2$
(b) $-(3p - 4q)^2$
(c) $-\left(9p^2 + 16q^2\right)$
(d) $-(3p + 4q)^2$
(e) $9p^2 - 16q^2$

7. The expression $(3^x - 5^y)^2$ is equal to

(a) $3^{x^2} - 2.3^x 5^y + 5^{y^2}$
(b) $3^{2x} - 2.30^{x+y} + 5^{2y}$
(c) $3^{x^2} - 2.30^{x+y} + 5^{y^2}$
(d) $3^{2x} - 2.3^x 5^y + 5^{2y}$
(e) $3^{2x} - 5^{2y}$

8. The expression $\left(3x^2-2\right)^3$ is equal to:
   (a) $27x^6-8$
   (b) $27x^6+54x^4+36x^2+8$
   (c) $27x^6-54x^4+36x^2-8$
   (d) $\left(3x^2-2\right)\left(9x^4-6x^2+4\right)$
   (e) $\left(3x^2-2\right)\left(9x^4+12x^2+4\right)$

9. The coefficient of x^3 in the product $(x-1)^2(3x+1)^3$ is
   (a) -54
   (b) -18
   (c) -27
   (d) 27
   (e) 9

10. If the coefficient of x^3 in the product $\left(x^4+x^3-kx^2+x-5\right)\left(3x^2-4x+k\right)$ is 18, then k is equal to
   (a) 2
   (b) -2
   (c) 1
   (d) -5
   (e) 3

11. The coefficient of k^2z^5 in the product $\left(5k-2z^5\right)^3$ is
   (a) 125
   (b) 60
   (c) -8
   (d) -150
   (e) -75

12. The sum of the coefficients of x^3 and x^2 in the product $\left(x^2-2x+p\right)\left(x^2+kx-2\right)$ is -3, then $p-k$ is equal to
   (a) -3
   (b) -1
   (c) -4
   (d) 1
   (e) 9

13. The coefficient of a^{2x} in the product $(a^x-2)^3(a^x+1)^2$ is
   (a) 22
   (b) 0
   (c) 10
   (d) 18
   (e) -8

14. If $\frac{1}{x}+x=3$, then by using the expansion of $\left(x+\frac{1}{x}\right)^3$, the value of $x^3+\frac{1}{x^3}$ is equal to
   (a) 27
   (b) 18
   (c) 3
   (d) 0
   (e) 36

15. Let $P(x)=3x^4-6x^2+2x^5+7x^3-x+10$. Then only one of the following is TRUE :
   (a) $P(x)+\frac{1}{x}$ is a polynomial
   (b) The degree of $P(x)$ is 6.
   (c) There are 5 terms in $P(x)$.
   (d) $P(x)$ is in simplest form.
   (e) The leading coefficient of $P(x)$ is equal to 2.

3. FACTORING POLYNOMIALS

1. A factorization of $-6m^4+41m^3+7m^2$ is equal to
   (a) $-m^2(6m+1)^2$
   (b) $m(3m+1)(2m-7)$
   (c) $-m\left(6m^2+1\right)(m-7)$
   (d) $m^2(6m-1)(m-7)$
   (e) $-m^2(6m+1)(m-7)$

2. Factoring $-5a^4b-5a^3b^2+30a^2b^3$ gives
   (a) $5a^2b(a+3b)(2b-a)$
   (b) $-5a^2b(a-3b)(a+2b)$
   (c) $-5\left(a^3-2b^2\right)(a+b)$
   (d) $-(6b-a)\left(a^2b^2+5b\right)$
   (e) $-5a^2b(a+b)^2$

3. A factorization of $x^2y^2-1-2xyz+z^2$ is equal to
   (a) $(x+y+z-1)(x+y+z+1)$
   (b) $(xyz-1)(xyz+1)$
   (c) $(xy+z-1)(xy+z+1)$
   (d) $(x+y+1-z)(x+y+1+z)$
   (e) $(xy-z-1)(xy-z+1)$

4. Factoring $3ab^2+9a-2ab^3-6ab$ gives
   (a) $(3a-2b)\left(b^2+3\right)$
   (b) $a\left(3+2b^2\right)(b-3)$
   (c) $a\left(3-2b^2\right)(b+3)$
   (d) $a(3-2b)\left(b^2+3\right)$
   (e) $a(3+2b)\left(b^2-3\right)$

5. A factorization of $10x^3y-15xy^3+25x^2y^2$ is equal to

(a) $5xy(2x+y)(x-3y)$
(b) $10xy(x-y)(x+3y)$
(c) $5xy(2x-y)(x+3y)$
(d) $5xy(x-y)(2x+3y)$
(e) $5\left(2x^2-y^3\right)(x+3y)$

6. One factor of $3x^2+xy-2y^2-x-y$ is equal to
(a) $3x-2y+1$
(b) $-3x-2y-1$
(c) $3x+2y-1$
(d) $3x+2y+1$
(e) $3x-2y-1$

7. Factoring $6x^2y^3+18xy+3x^2y^2+9x$ gives
(a) $3x(2y+1)\left(xy^2+3\right)$
(b) $3x(2x+y)\left(y^2+3\right)$
(c) $3x(2y+x)(x+3)$
(d) $3x(3y+1)\left(xy^2+3\right)$
(e) $3x(y+1)\left(2xy^2+3\right)$

8. One factor of $6\left(4x^2-12xy+9y^2\right)+7(2x-3y)-3$ is equal to
(a) $4x+6y-1$
(b) $6x-9y-1$
(c) $6x-9y+3$
(d) $4x-6y-1$
(e) $6x-9y-3$

9. When factoring $x^2y-xy^2+x^3-y^3$, we get
(a) $(x-y)^2(x+y)$
(b) $(x-y)(x+y)^2$
(c) $(x-y)\left(x^2+y^2+xy\right)$
(d) $(x-y)\left(x^2+y^2\right)$
(e) $(x-y)(x+y+3xy)$

10. When factoring $6x^2-2y^2-xy-6x+4y$, we get
(a) $(3x+2y)(2x-y+2)$
(b) $(3x+2y)(2x+y+2)$
(c) $(3x-2y)(2x-y+2)$
(d) $(3x-2y)(2x+y-2)$
(e) $(3x-2y)(3x+y+2)$

11. When factoring $a^2+2ab+b^2-x^2-2xy-y^2$, we get
(a) $(a+b-x+y)(a+b+x+y)$
(b) $(a-b-x-y)(a+b+x+y)$
(c) $(a+b-x-y)(a+b+x+y)$
(d) $(a-b+x-y)(a+b+x+y)$
(e) $(a+b-x-y)^2$

12. By completing the square, the expression $m^4+m^2n^2+25n^4$ gives
(a) $\left(m^2+5n^2\right)^2$
(b) $\left(m^2-3mn+5n^2\right)\left(m^2+3mn+5n^2\right)$
(c) $\left(m^2-3mn+5n^2\right)^2$
(d) $\left(m^2+3mn-5n^2\right)\left(m^2-3mn-5n^2\right)$
(e) $(m+5n)(m-n)(m-5n)(m+n)$

13. If the expression x^4+9x^2+81 is completely factored, the result is
(a) $\left(x^2-9+3x\right)\left(x^2+9-3x\right)$
(b) $\left(x^2+9+3x\right)\left(x^2+9-3x\right)$
(c) $\left(x^2-9-3x\right)\left(x^2+9-3x\right)$
(d) $\left(x^2+9+3x\right)\left(x^2-9-3x\right)$
(e) $\left(x^2+9\right)^2$

14. One factor of m^4+m^2+25 is equal to
(a) m^2+5
(b) m^2-m+5
(c) m^2-5
(d) m^2+m+5
(e) m^2-3m+5

15. Factoring $4y^4-5y^2+1$ gives
(a) $(2y-1)(2y+1)(y-1)(y+1)$
(b) $(1-2y)(1+y)(y-1)(y+2)$
(c) $(2y-1)^2(y-1)^2$
(d) $(4y+1)(y-1)$
(e) $\left(2y^2-1\right)^2$

16. If the expression x^4+324 is completely factored, the result is
(a) $\left(x^2-6x+18\right)\left(x^2+6x+18\right)$
(b) $\left(x^2+3x-18\right)\left(x^2+3x+18\right)$
(c) $\left(x^2+18x-18\right)\left(x^2+18x+18\right)$
(d) $\left(x^2+9x-18\right)\left(x^2+9x+18\right)$
(e) $\left(x^2+18\right)^2$

17. One factor of w^4+4v^4 is
(a) $\left(w^2-4wv+v^2\right)$
(b) $\left(w^2+3wv-1\right)$
(c) $\left(2v^2+w^2\right)$
(d) $(w+2v)$
(e) $\left(w^2+2v^2-2wv\right)$

18. When factoring x^4-82x^2+81 , we get
(a) $\left(x^2-5x+3\right)\left(x^2+5x+27\right)$
(b) $\left(x^2+5x-3\right)\left(x^2-5x-27\right)$

(c) $\left(x^2+10x-9\right)\left(x^2-10x-9\right)$
(d) $\left(x^2-5x+9\right)\left(x^2+5x+9\right)$
(e) $\left(x^2-10x+9\right)\left(x^2+10x+9\right)$

19. When factoring $3x^4+12x^2+48$, we get
(a) $3\left(x^2+4-2x\right)\left(x^2+4+2x\right)$
(b) $3\left(x^2-4+2x\right)\left(x^2+4-2x\right)$
(c) $6\left(x^2+4-2x\right)^2$
(d) $6\left(x^2-4+2x\right)^2$
(e) $6\left(x^2+4x-2\right)\left(x^2+4x+2\right)$

20. A factorization of $2x^{2n}-23x^ny^n-39y^{2n}$ is
(a) $(x^n+3y^n)(2x^n-13y^n)$
(b) $(2x^n-3y^n)(x^n+13y^n)$
(c) $(2x^n+3y^n)(x^n-13y^n)$
(d) $(x^n-y^n)^2$
(e) $2(x^n-y^n)(x^n+y^n)$

21. When factoring $6(m+n)^{2k}+(m+n)^k-15$, we get
(a) $\left[2(m+n)^k+3\right]\left[3(m+n)^k-5\right]$
(b) $\left[2(m+n)^k-3\right]^2$
(c) $\left[2(m+n)^k-3\right]\left[3(m+n)^k+5\right]$
(d) $\left[3(m+n)^k+5\right]^2$
(e) $\left[3(m+n)^k-3\right]\left[2(m+n)^k+5\right]$

22. One factor of $27x^6-(x-y)^3$ is
(a) $3x^2+x+y$
(b) $3x^2-x+y$
(c) $3x^2-x-y$
(d) x^2-3x+y
(e) x^2+3x+y

23. One factor of $\left(x^2+y^2\right)^3-8x^3y^3$ is
(a) $y-x$
(b) $x+y$
(c) x^2+y^2
(d) x^2+y
(e) $y+x^2$

24. Factoring $y^6-4y^4-25y^2+100$ gives
(a) $\left(y^2+5\right)^2(y-2)^2$
(b) $(y-5)(y+5)\left(y^2-2\right)\left(y^2+2\right)$
(c) $\left(y^2-5\right)(y-2)(y+2)^3$
(d) $\left(y^2-5\right)\left(y^2+5\right)(y-2)(y+2)$
(e) $\left(y^2-5\right)^4(y-2)$

25. Factoring $(x-y-2z)^2-(2x+y-z)^2$ gives
(a) $-3(x+z)(x+z+2y)$
(b) $3(x-z)(x-z+2y)$
(c) $(3x-z)(x+z-2y)$
(d) $(x-3z)(x+z+2y)$
(e) $-3(x-z)(x+z+2y)$

26. Factoring $x^3y^3-1+x^3-y^3$ gives
(a) $(x+1)(y-1)\left(x^2-x+1\right)\left(y^2+y+1\right)$
(b) $\left(x^3+x+1\right)\left(y^3-y^2+1\right)$
(c) $(x-1)(y+1)\left(x^2+x+1\right)\left(y^2-y+1\right)$
(d) $(x-1)(y-1)\left(x^2-x+1\right)\left(y^2-y+1\right)$
(e) $(x-1)^2(y+1)^2(x+1)(y-1)$

27. If we factor $P(x)=2x^4-5x^3+4x^2-5x+2$ completely in $\Re$, we get
(a) three linear factors
(b) one prime and two linear factors
(c) four linear factors
(d) two prime factors
(e) $P(x)$ is a prime factor

28. The expression $\left(p^{4n}-1\right)$ factors into $p^{4n}-1=(p^n-1)\,x$, then x equals
(a) $(p^n+1)\left(p^{2n}+1\right)$
(b) $p^{3n}+1$
(c) $p^{2n}+1$
(d) $(p^n-1)\left(p^{2n}+1\right)$
(e) $(p^n+1)(p^n-1)$

4. RATIONAL EXPRESSIONS

1. The expression $\left(1-\frac{4xy}{x^2+2xy+y^2}\right)\div\left(1+\frac{4xy}{x^2-2xy+y^2}\right)$ simplifies to
(a) 1
(b) $x-y$
(c) $\left(\frac{x-y}{x+y}\right)^4$
(d) $x+y$
(e) $\left(\frac{x+y}{x-y}\right)^4$

2. The expression $\frac{x^2y^{-2}-y^2x^{-2}}{yx^{-1}+xy^{-1}}$ simplifies to
(a) $\frac{x^6-y^6}{x^3y^3}$
(b) $\frac{x^4-y^4}{xy}$
(c) $\frac{x^2-y^2}{x^2+y^2}$
(d) $\frac{x+y}{xy}$

(e) $\frac{(x+y)(x-y)}{xy}$

3. The expression $\frac{2-\frac{2}{2-\frac{2}{x}}}{2+\frac{2}{2-\frac{2}{x}}}$ simplifies to
   (a) -1
   (b) $\frac{x+2}{3x-2}$
   (c) $\frac{x-2}{2-3x}$
   (d) $\frac{x-2}{3x-2}$
   (e) 1

4. The expression $\frac{x^{-1}-y^{-1}+1}{1+(y-x)^{-1}xy}$ simplifies to
   (a) $\frac{xy}{y-x}$
   (b) $\frac{y-x}{xy}$
   (c) 1
   (d) $\frac{x+y}{xy}$
   (e) $\frac{xy}{2y-x}$

5. The expression $1-\frac{1-\frac{1}{x^2}}{x^2-\frac{1}{x^2}}$ simplifies to
   (a) $\frac{x^2}{x+1}$
   (b) $\frac{x^2+1}{x^2}$
   (c) $\frac{x^2}{x^2+1}$
   (d) $\frac{x+1}{x}$
   (e) $\frac{x}{x+1}$

6. The expression $\frac{1-\frac{1}{1+\frac{1}{x}}}{1-\frac{1}{x+1}}$ simplifies to
   (a) $\frac{(x+1)^2}{x}$
   (b) 1
   (c) $\frac{1}{(x+1)^2}$
   (d) $\frac{x}{(x+1)^2}$
   (e) $\frac{1}{x}$

7. The expression $\left[a^{-1}-\frac{1}{a-1}-\frac{a+1}{a}\right]^{-1}$ simplifies to
   (a) $\frac{a}{a+1}$
   (b) $\frac{1-a}{a}$
   (c) $\frac{a+1}{a}$
   (d) $\frac{a}{1-a}$
   (e) $2a$

8. The expression $\frac{r^{-1}+q^{-1}}{r^{-1}-q^{-1}}\cdot\frac{r-q}{r+q}$ simplifies to
   (a) $\left(\frac{r-q}{r+q}\right)^2$
   (b) -1
   (c) $\left(\frac{r+q}{r-q}\right)^2$
   (d) 1
   (e) $\frac{r^2-q^2}{r^2+q^2}$

9. The expression $\frac{8y^3-125}{4y^2-20y+25}\div\frac{4y^2+10y+25}{2y-5}$ simplifies to
   (a) $(2y+5)^2$
   (b) $\frac{1}{(2y+5)^2}$
   (c) $\left(4y^2+10y+25\right)^2$
   (d) $\frac{1}{(4y^2+10y+25)^2}$
   (e) 1

10. The expression $\left[\frac{1}{x}-\frac{1}{x-2}+\frac{1}{x^2-2x}\right]\div\left[\frac{x}{x-2}+\frac{3}{x}\right]$ simplifies to
    (a) $\frac{-1}{x^2+3x-6}$
    (b) $\frac{2x-3}{x^2+3x-6}$
    (c) $\frac{x+2}{x^2-2x}$
    (d) $\frac{-2}{x+1}$
    (e) $\frac{-4x+2}{x+1}$

11. The expression $\left(x^{-2}-y^{-2}\right)(x+y)^{-1}xy$ simplifies to
    (a) $\frac{x-y}{xy}$
    (b) $\frac{xy}{x-y}$
    (c) $\frac{xy}{x+y}$
    (d) $\frac{y-x}{xy}$
    (e) $\frac{x+y}{xy}$

12. The expression $\left(\frac{9y^2+2x^2}{x^3+27y^3}-\frac{x}{x^2-3xy+9y^2}\right)\div\left(x^2-9y^2\right)^{-1}$ simplifies to
    (a) $3x+y$
    (b) $y-3x$
    (c) $-x-3y$
    (d) $3y+x$
    (e) $x-3y$

13. The expression $\frac{x^3+2x^2-x-2}{x^2+3x+2}-\frac{x^2-2x+1}{x+1}$ simplifies to
    (a) $\frac{2(x-1)}{x+1}$
    (b) $\frac{2}{x+1}$
    (c) $\frac{2x+3}{(x+2)(x-1)}$
    (d) 0
    (e) $-(x-1)^2$

14. The expression $\left[\frac{-b^2+a^2}{ab^3-a^3b}\right]^{-1}\left(a^{-1}+b^{-1}\right)$ simplifies to
    (a) $ab(a+b)$
    (b) $-a+b$
    (c) $-a-b$
    (d) $\frac{1}{a}+\frac{1}{b}$
    (e) $\frac{ab}{a+b}$

15. The expression $\left(1+x^{a-b}\right)^{-1}+\left(1+x^{b-a}\right)^{-1}$ simplifies to
    (a) x^{2a}
    (b) x^{-2b}
    (c) 2
    (d) $x^{2a}+x^{-2b}$
    (e) 1

16. The expression $2+\frac{1}{2+\frac{1}{1+\frac{1}{x}}}$ simplifies to
    (a) $\frac{x+2}{x+1}$
    (b) $\frac{5x+4}{x+1}$
    (c) $\frac{7x+2}{2x}$
    (d) $\frac{2x+10}{x+4}$
    (e) $\frac{7x+5}{3x+2}$

17. The expression $\left(\frac{y^3+4y^2-5y}{y^2-2y+1} \div \frac{y^2+y-2}{y^4+8y}\right) \cdot \frac{y-1}{y^2-2y+4}$ simplifies to
    (a) $\frac{y+5}{y-1}$
    (b) $\frac{y^2}{y-1}$
    (c) $\frac{y^2(y+5)}{y-1}$
    (d) $\frac{y+5}{y+2}$
    (e) $\frac{y^2}{y+2}$

18. The expression $\frac{x^{-3}-y^{-3}}{x^{-1}-y^{-1}}$ simplifies to
    (a) $x^{-2}-y^{-2}$
    (b) $\frac{x^2+xy+y^2}{x^2y^2}$
    (c) $\left(x^{-1}-y^{-1}\right)^2$
    (d) $\frac{x^2-xy+y^2}{x^2y^2}$
    (e) x^2+xy+y^2

19. The expression $\frac{\left(-4x^3y^{-2}\right)^{-2}}{\left(4x^5y^4\right)^{-1}}$ simplifies to
    (a) $\frac{y^8}{4x}$
    (b) $\frac{4x}{y^8}$
    (c) $-x^2y^6$
    (d) $\frac{4}{x}$
    (e) $\frac{5y^8}{16x}$

20. The expression $\frac{3}{a^2+5a-6}-\frac{3}{a^2+7a+6}$ simplifies to
    (a) $\frac{6}{(a-6)(a^2+1)}$
    (b) $\frac{6}{(a+6)(a^2+1)}$
    (c) $\frac{6}{(a-6)(a^2-1)}$
    (d) $\frac{6}{(a+6)(a^2-1)}$
    (e) $\frac{-6}{(a-6)(a^2+1)}$

21. The expression $\left(x^2y\right)^{-1}\left(x^2+y^2\right)^3\left(x^{-2}+y^{-2}\right)^{-2}$ simplifies to
    (a) $x^3y\left(x^2+y^2\right)$
    (b) $\left(x^2+y^2\right)^2$
    (c) $\frac{x^3y}{x^{-2}+y^{-2}}$
    (d) $x^2y^3\left(x^2+y^2\right)$
    (e) $\left(x^2y\right)^{-1}\left(x^2+y^2\right)$

22. The expression $\frac{x^2-3x+2}{x^2+x-6} \div \frac{x^3+x^2-2x}{x^2+5x+6}$ simplifies to
    (a) $\frac{(x-1)(x+3)}{x(x+1)(x-3)}$
    (b) $\frac{x-1}{x(x+1)}$
    (c) $\frac{(x-2)^2}{x(x+2)^2}$
    (d) $\frac{(x+3)}{x(x-3)}$
    (e) $\frac{1}{x}$

23. The expression $\frac{\frac{5}{5-\frac{5}{x}}-5}{5+\frac{5}{5-\frac{5}{x}}}$ simplifies to
    (a) $\frac{4x-5}{6x-5}$
    (b) $\frac{5-4x}{6x-5}$
    (c) $\frac{5-4x}{6x+5}$
    (d) $\frac{5+4x}{6x-5}$
    (e) $\frac{5+4x}{6x+5}$

24. The expression $\frac{3}{x^2+xy-2y^2}+\frac{2}{y^2-x^2}$ simplifies to
    (a) $\frac{2x+5y}{(x-2y)(x^2-y^2)}$
    (b) $\frac{1}{(x-2y)(x+y)}$
    (c) $\frac{1}{(x+2y)(x+y)}$
    (d) $\frac{5x+7y}{(x+2y)(x^2-y^2)}$
    (e) $\frac{x+y}{(x-2y)(x-y)^2}$

25. The expression $\frac{4}{2b^2-6b+4}-\frac{2}{b^2-b-2}$ simplifies to
    (a) $\frac{4}{(b-2)(b-1)^2}$
    (b) $\frac{4}{(b-2)(b+1)^2}$
    (c) $\frac{-4b}{(b-2)(b-1)^2}$
    (d) $\frac{-4b}{(b-2)(b^2-1)}$
    (e) $\frac{4}{(b-2)(b^2-1)}$

26. The expression $\left(\frac{x^3-1}{x^2+x+1}-\frac{x^2-1}{x-1}\right) \div \frac{x-2}{-x^2+5x-6}$ simplifies to
    (a) $6-2x$
    (b) $x-3$
    (c) 0
    (d) $2x-6$
    (e) $3-x$

27. The expression $\frac{(a+b+c)^2-(b-c)^2}{a+2c}$ simplifies to

(a) $2a-b$
(b) $a-2b$
(c) $a+2b$
(d) $a+b$
(e) $a+b-c$

28. The expression $\frac{1}{x^2+x-12}-\frac{1}{x^2-7x+12}+\frac{1}{x^2-16}$ simplifies to
(a) $\frac{x-3}{(x-3)(x-4)(x+4)}$
(b) $\frac{x-11}{(x+3)(x-4)(x+4)}$
(c) $\frac{x+3}{(x-3)(x+4)^2}$
(d) $\frac{x-11}{(x-3)(x+4)(x-4)}$
(e) $\frac{11-x}{(x-3)(x+4)(x-4)}$

29. The expression $\frac{3x^2-3x-1}{2x^2-3x-2}+\frac{1}{2-x}$ simplifies to
(a) $\frac{3(x-1)}{2(x-2)}$
(b) $\frac{8-3x}{2(2-x)}$
(c) $\frac{3x-1}{2x+1}$
(d) $\frac{-3x^2+12x-13}{(2x-5)(2-x)}$
(e) $\frac{3x+1}{2x+1}$

30. The expression $\left[\frac{6}{x}-\frac{1}{x^2}-\frac{2}{x^3}\right]\div\left[3-\frac{14}{x}+\frac{8}{x^2}\right]$ simplifies to
(a) $\frac{x+4}{x(2x+1)}$
(b) $\frac{x(x-4)}{2x+1}$
(c) $\frac{1}{x}$
(d) $\frac{2x+1}{x(x-4)}$
(e) $\frac{2x+1}{x(x+4)}$

31. The expression $\left[\left(\frac{a}{b}-\frac{b}{a}\right)\div\left(\frac{1}{a}-\frac{1}{b}\right)\right](a+b)$ simplifies to
(a) $\frac{a}{b}$
(b) $\frac{b+a}{a-b}$
(c) $-(a+b)^2$
(d) a
(e) $-b$

32. The expression $\left(y^{-2}-x^{-2}\right)^{-3n}\left(x^2-y^2\right)^{2n}\left(x^2y^2\right)^{-3n}$ simplifies to
(a) $\left(x^2-y^2\right)^{-n}$
(b) $\left(x^2+y^2\right)^{n}$
(c) $\frac{x^2-y^2}{x^2+y^2}$
(d) x^ny^n
(e) $\left(x^2y\right)^{-n}\left(x^2+y^2\right)$

33. The expression $\frac{27\left(3m^{-2}\right)^{-2}\left(3m^{-2}\right)^{-5}}{(5m^2n^{-3})^0m^4}$ simplifies to
(a) $\frac{81}{m^{10}}$
(b) $\frac{m^{10}}{3}$
(c) $\frac{m}{27}$
(d) $\frac{m^{10}}{81}$
(e) mn^3

34. The expression $\left[\frac{x}{x^2+x-2}-\frac{5}{3(x^2+3x-4)}-\frac{7}{3(x^2+6x+8)}\right]\div\left(\frac{x+1}{x+4}\right)$ simplifies to
(a) $\frac{1}{x+1}$
(b) $\frac{1}{x+2}$
(c) $x-2$
(d) $x+2$
(e) $x+1$

35. The expression $\frac{a^3+b^3}{a^3-b^3}\div\frac{a^2+2ab+b^2}{a^2-b^2}$ simplifies to
(a) $\frac{a-b}{a+b}$
(b) $\frac{a+b}{a-b}$
(c) $\frac{a^2-ab+b^2}{a^2+ab+b^2}$
(d) a^2-ab+b^2
(e) $(a-b)^2$

5. RADICALS AND RATIONAL EXPONENTS

1. If x, y and z are positive variables, then the expression $\left(\frac{\sqrt[3]{x}\sqrt{y^4}z^3}{x^{\frac{7}{3}}y^4z^{-3}}\right)^{\frac{1}{2}}$ is equal to
(a) $\frac{z^3}{xy}$
(b) $\frac{xz^2}{y}$
(c) $\frac{z}{x^2y}$
(d) $\frac{z^3}{xy^2}$
(e) $\frac{y^2}{x^2z^3}$

2. If x and y are positive real numbers, then the expression $\left[\frac{\left(5x^2y\right)^{-1}\left(5x^3y^{-2}\right)^2}{5(xy)^{-3}(x^5y^{-2})^{-1}}\right]^{-\frac{1}{4}}$ is equal to
(a) $\frac{y}{x^3}$
(b) $\frac{y^{16}}{x^{48}}$
(c) $\frac{x^3}{y}$
(d) $\frac{25y}{x^3}$
(e) $\frac{x^{48}}{y^{16}}$

3. Given $A=\frac{1}{3-\sqrt{7}}$ and $B=\frac{1}{\sqrt{6}-2}$, Which one of

the following is TRUE

(a) $A = B$
(b) $A^3 = B^3$
(c) $A < B$
(d) $A > B$
(e) $A\sqrt{6} = B\sqrt{7}$

4. By rationalizing the denominator, the expression $\frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+2} + \frac{1}{2+\sqrt{5}}$ is equal to
(a) $\sqrt{5} + \sqrt{2}$
(b) $\sqrt{2} - \sqrt{5}$
(c) $2 - \sqrt{3}$
(d) $\sqrt{5} - \sqrt{2}$
(e) $\sqrt{3} - 2$

5. The expression $\left(\sqrt[3]{2} - \sqrt[3]{5}\right)^3$ is equal to
(a) -3
(b) $-3\left[1 - \sqrt[3]{20} - \sqrt[3]{50}\right]$
(c) $-3\left[1 + \sqrt[3]{20} + \sqrt[3]{50}\right]$
(d) $-3\left[1 + \sqrt[3]{20} - \sqrt[3]{50}\right]$
(e) $3\left[1 + \sqrt[3]{20} - \sqrt[3]{50}\right]$

6. The expression $\frac{\sqrt[3]{m^2} \cdot \sqrt[4]{m^5}}{\sqrt[3]{m^5} \cdot \sqrt{m^3} \cdot m^{\frac{3}{4}}}$ is equal to
(a) $\sqrt[12]{m}$
(b) 1
(c) m^{-2}
(d) m^2
(e) $\sqrt[12]{m^{-5}}$

7. The value of $\frac{2^{n+4} - 2(2^n)}{2(2^{n+3})}$ in simplest form is
(a) $\frac{1}{4}$
(b) $\frac{3}{4}$
(c) $\frac{1}{2}$
(d) $\frac{7}{8}$
(e) $\frac{5}{8}$

8. The expression $\left[\sqrt[3]{x+2} - \sqrt[3]{x-2}\right] *$ $\left[\sqrt[3]{(x+2)^2} + \sqrt[3]{x^2-4} + \sqrt[3]{(x-2)^2}\right]$ is equal to
(a) 4
(b) 0
(c) $x + 2$
(d) $x^2 - 4$
(e) $2x$

9. For $x, y, z > 0$, the expression $\left[\frac{\sqrt{x}\sqrt[3]{y^2}}{z}\right]^{12} \cdot \left[\frac{x^{\frac{1}{2}}y}{x^{-\frac{1}{2}}\sqrt[4]{z}}\right]^{-2}$ is equal to
(a) $\frac{x^4y^6}{z^{11}}$
(b) $\frac{x^4y^6}{z^{\frac{23}{2}}}$
(c) $\frac{x^4y^{10}}{z^{24}}$
(d) $\frac{x^4y^{16}}{z^{11}}$
(e) $\frac{x^6y^8}{z^{12}}$

10. For $x, y > 0$, the expression $\sqrt[4]{x^2y} \cdot \sqrt[3]{xy^2}$ is equal to
(a) x^3y^3
(b) $x^5y^{\frac{11}{2}}$
(c) $\sqrt[12]{x^3y^3}$
(d) $x^{10}y^{11}$
(e) $\sqrt[12]{x^{10}y^{11}}$

11. If $x, y > 0$ and $x \neq y$, then the expression $\frac{x-2\sqrt{xy}+y}{x+2\sqrt{xy}+y}$ is equal to
(a) $\frac{\left(\sqrt{x}-\sqrt{y}\right)^4}{x^2-y^2}$
(b) $\frac{\left(\sqrt{x}-\sqrt{y}\right)^4}{(x-y)^2}$
(c) $\frac{\left(\sqrt{x}+\sqrt{y}\right)^4}{(x-y)^2}$
(d) $\frac{\left(\sqrt{x}-\sqrt{y}\right)^4}{\left(\sqrt{x}+\sqrt{y}\right)^4}$
(e) 1

12. The expression $\left(3\sqrt{2} + \sqrt{3}\right)\left(2\sqrt{3} - \sqrt{2}\right)$ is equal to
(a) 5
(b) $5\sqrt{6}$
(c) 15
(d) 10
(e) $3\sqrt{6}$

13. The expression $\frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}+\sqrt{3}}$ is equal to
(a) $-\left(4 + \sqrt{15}\right)$
(b) $4 + \sqrt{15}$
(c) $4 - \sqrt{15}$
(d) $\sqrt{15} - 4$
(e) 4

14. The expression $\frac{x+\sqrt{x^2-1}}{x-\sqrt{x^2-1}}$ is equal to
(a) -2
(b) 2
(c) $2x^2 - 1 + 2x\sqrt{x^2-1}$
(d) 1
(e) $-\left[2x^2 - 1 - 2x\sqrt{x^2-1}\right]$

15. The value of $\frac{1}{\left|2-\sqrt{5}\right|} + \frac{1}{\left|-2-\sqrt{5}\right|}$ is equal to
(a) 4
(b) $2\sqrt{5}$
(c) $-2\sqrt{5}$

(d) $2\sqrt{5}+4$
(e) -4

16. If $m=8$ and $n=4$, then the expression $\left[\frac{3m^{\frac{5}{6}}}{n^{\frac{3}{4}}}\right]^2 \left[\frac{8n^3}{m^6}\right]^{\frac{2}{3}}$ is equal to
(a) $\frac{9}{16}$
(b) $\frac{9}{32}$
(c) $\frac{3}{32}$
(d) $\frac{9}{64}$
(e) $\frac{3}{16}$

17. If a is any real number, then which one of the following expressions is TRUE ?
(a) $\sqrt[4]{a^4}=|a|$
(b) $\sqrt[4]{a^2}=\sqrt{a}$
(c) $\sqrt[3]{a^3}=|a|$
(d) $\sqrt[7]{\sqrt[3]{a}}=a^{\frac{3}{7}}$
(e) $\sqrt[3]{a^2}=\sqrt[6]{a}$

18. If n is a positive integer, then $(4)^{\frac{2}{n}+\frac{3}{2}}$ is equal to
(a) $8\sqrt[n]{2}$
(b) $\sqrt[n]{16}+8$
(c) $\sqrt[2n]{18}+8$
(d) $8\sqrt[n]{16}$
(e) $16\sqrt[n]{16}$

19. If $m>0$, then the expression $\frac{\sqrt[3]{m^5}.\sqrt[6]{m^3}}{\sqrt[4]{\sqrt[3]{m^2}}}$ is equal to
(a) $m^{\frac{5}{6}}$
(b) $m^{\frac{7}{3}}$
(c) m
(d) m^2
(e) $m^{\frac{-12}{5}}$

20. The expression $\left[\sqrt{2}+\sqrt[3]{16}\right]^2$ is equal to
(a) $2+4\sqrt[6]{32}+4\sqrt[3]{4}$
(b) $2+\sqrt[6]{16}$
(c) $2+4\sqrt[6]{4}$
(d) $2+2\sqrt[5]{32}+\sqrt[9]{16}$
(e) $2+4\sqrt[3]{4}$

21. The expression $\frac{m}{\sqrt{m-1}}-\sqrt{m-1}$ is equal to
(a) $\sqrt{m-1}$
(b) $\frac{1}{(m-1)^{\frac{3}{2}}}$
(c) $\frac{1}{\sqrt{m-1}}$
(d) $(m-1)^{\frac{3}{2}}$
(e) $(m-1)^{\frac{1}{3}}$

22. The expression $\frac{1}{\sqrt[4]{2}-1}$ is equal to
(a) $\left(\sqrt[4]{2}+1\right)^2$
(b) $\left(\sqrt[4]{2}+1\right)\left(\sqrt{2}-1\right)$
(c) $\left(\sqrt[4]{2}+1\right)\left(\sqrt{2}+1\right)$
(d) $\left(\sqrt[4]{2}+1\right)$
(e) $\left(\sqrt[4]{2}-1\right)^2$

23. The expression $\left(\frac{8}{27}\right)^{\frac{2}{3}}+\left(\frac{-32}{243}\right)^{\frac{2}{5}}$ is equal to
(a) 0
(b) $\frac{8}{9}$
(c) $\frac{4}{9}$
(d) $\frac{-8}{9}$
(e) $\frac{8}{18}$

24. If m,n,x are positive real numbers such that $\sqrt[4]{x}=m$ and $\sqrt[3]{x}=n$, then $\sqrt[5]{mn}$ is equal to
(a) $\sqrt[60]{x^7}$
(b) $\sqrt[5]{x^7}$
(c) $\sqrt[35]{x^{12}}$
(d) $\sqrt[7]{x^{60}}$
(e) $\sqrt[60]{x}$

25. The expression $\left(\frac{-27}{8}\right)^{\frac{-2}{3}}+\sqrt{\sqrt[3]{64}}+3\left(-2\right)^0$ is equal to
(a) $\frac{-5}{9}$
(b) $\frac{41}{9}$
(c) $\frac{31}{9}$
(d) $\frac{23}{9}$
(e) $\frac{49}{9}$

26. The expression $\sqrt{(x+y)^2-4xy}$ is equal to
(a) $x+y-2\sqrt{xy}$
(b) $x+y$
(c) $|x-y|$
(d) $x-y$
(e) $x-y+2\sqrt{xy}$

27. The expression $-(2x-5)^{-\frac{3}{2}}+3\left(2x-5\right)^{-\frac{1}{2}}$ is equal to
(a) $\frac{6x+14}{(2x-5)^{\frac{1}{2}}}$
(b) $\frac{6x-6}{(2x-5)^{\frac{3}{2}}}$
(c) $\frac{6x+14}{(2x-5)^{\frac{3}{2}}}$
(d) $\frac{2(3x-8)}{(2x-5)^{\frac{3}{2}}}$
(e) $\frac{6x-15}{(2x-5)^{\frac{3}{2}}}$

28. The expression $\left(3\sqrt{z^2-2}-2\sqrt{z^2+2}\right)*$

$\left(3\sqrt{z^2-2}+2\sqrt{z^2+2}\right)\left(z\sqrt{5}+\sqrt{26}\right)^{-1}$ is equal to

(a) 1
(b) $z\sqrt{5}-\sqrt{26}$
(c) $z\sqrt{5}+\sqrt{26}$
(d) $5z^2+26$
(e) $5z^2-26$

29. If a, b, c are positive real numbers such that $\sqrt[3]{a}=b$ and $\sqrt[4]{b}=c$, then $a \cdot c$ is equal to

(a) $\sqrt[7]{b^3}$
(b) $\sqrt[4]{b^5}$
(c) $\sqrt[7]{b}$
(d) $\sqrt[5]{b^4}$
(e) $\sqrt[4]{b^{13}}$

30. If $m>0$, then $\frac{\sqrt[2]{m^5}\,\sqrt[5]{m^2}}{\sqrt[5]{\sqrt{m^3}}}$ is equal to

(a) $m^{\frac{16}{10}}$
(b) m
(c) $m^{-\frac{3}{10}}$
(d) $m^{\frac{13}{5}}$
(e) $m^{\frac{10}{7}}$

31. The expression $\left(p^{-\frac{1}{2}}+p^{\frac{1}{3}}\right)\left(p^{\frac{1}{2}}+p^{\frac{2}{3}}\right)$ is equal to

(a) $1+p$
(b) $1+p^{\frac{1}{3}}+p^{-\frac{1}{3}}+p^{\frac{2}{9}}$
(c) $1+p^{\frac{1}{6}}+p^{\frac{5}{6}}+p$
(d) $2+p^{\frac{5}{6}}+p^{\frac{1}{6}}$
(e) $1+p^{\frac{1}{2}}$

32. If $x>1$, then the expression $\frac{\sqrt{x-1}-\sqrt{x+1}}{\sqrt{x-1}+\sqrt{x+1}}$ is equal to

(a) $\sqrt{x^2-1}-x$
(b) $\sqrt{x^2-1}+x$
(c) $x-\sqrt{x^2-1}$
(d) 1
(e) $\frac{\sqrt{x^2-1}-x}{x}$

33. Given that $k=\sqrt{x^2-2xy+y^2}$, which one of the following statements is FALSE ?

(a) k is a real number for all x and y
(b) k is either a positive real number or zero
(c) k is a real number only if $x \geq y$
(d) $k=|x-y|$
(e) $k=|y-x|$

34. Which one of the following is TRUE for all real numbers x and y ?

(a) $\sqrt[3]{54x^4y^7}+5y\sqrt[3]{16x^4y^4}=13xy^2\sqrt[3]{2xy}$
(b) $\sqrt{x^2+y^2}=x+y$
(c) $\sqrt{x^2-y^2}=|x-y|$
(d) $\sqrt{x^2y^2}=xy$
(e) $\sqrt[3]{x^5}+\sqrt[5]{x^3}=\sqrt[10]{x^{29}}$

35. Which one of the following is NOT a real number ?

(a) $\sqrt{(-11)^2}$
(b) $(-19)^{\frac{9}{4}}$
(c) $\sqrt[5]{-32}$
(d) $-\sqrt[4]{18}$
(e) $(-13)^{\frac{2}{5}}$

36. The expression $\frac{9}{\sqrt[3]{3}}-\frac{36}{\sqrt[3]{81}}+16\sqrt[3]{72}$ is equal to

(a) $22\sqrt[3]{3}$
(b) $-\sqrt[3]{3}+32\sqrt[3]{9}$
(c) $47\sqrt[3]{9}$
(d) $31\sqrt[3]{9}$
(e) $95\sqrt[3]{3}$

37. Which one of the following is FALSE ?

(a) $\sqrt[3]{\sqrt[4]{2}}=\sqrt[12]{2}$
(b) $\sqrt{\frac{\sqrt{2}-1}{\sqrt{2}+1}}=\sqrt{2}-1$
(c) $\frac{\sqrt[6]{3}\sqrt{3}}{\sqrt[4]{3}}=\sqrt[12]{3^5}$
(d) $\frac{\sqrt{7}-\sqrt{2}}{\sqrt{7}+\sqrt{2}}=\frac{9}{5}-\frac{2}{5}\sqrt{14}$
(e) $\frac{\sqrt[3]{11}\sqrt[6]{11}}{\sqrt[4]{11}}=\sqrt[3]{11}$

38. If $x \geq 0$, then $\sqrt{x\sqrt[3]{x^5}}$ is equal to

(a) $\sqrt[6]{x^{11}}$
(b) $\sqrt{x}$
(c) $\sqrt[3]{x^4}$
(d) x
(e) $\sqrt[6]{x^7}$

39. The expression $\left[\frac{\left(a^{\frac{1}{6}}b^{\frac{2}{3}}\right)\left(b^{-\frac{1}{2}}a^{\frac{1}{2}}\right)^{-1}}{a^{-2}b^{\frac{1}{2}}}\right]^3$ is equal to

(a) $\frac{b^2}{a^5}$
(b) $a^{\frac{5}{3}}b^{\frac{2}{3}}$
(c) $\frac{a^5}{b^2}$
(d) a^5b^2
(e) $a^{\frac{2}{3}}b^{\frac{5}{3}}$

40. If $(x-1)^{\frac{1}{2}}+(x-1)^{-\frac{1}{2}}-(x-1)^{-\frac{3}{2}}=(x-1)^{-\frac{3}{2}}P$, then P is equal to

(a) x^2-x-1
(b) x^2+x+3
(c) x^2+3x-1
(d) $3x^2-x-1$
(e) x^2-x-3

41. The expression $\frac{5}{\left(2-\sqrt{3}\right)\left(1+\sqrt{2}\right)}$ is equal to
   (a) $\frac{5}{21}\left(2+\sqrt{3}\right)\left(1-\sqrt{2}\right)$
   (b) $-5\left(2+\sqrt{6}\right)$
   (c) $-5\left(2+\sqrt{3}\right)\left(1-\sqrt{2}\right)$
   (d) $5\left(2-\sqrt{6}\right)$
   (e) $\sqrt{6}$

42. The expression $\sqrt[3]{\frac{16m^8n^9}{k^5p}}$ is equal to
   (a) $\frac{2m^2n^2}{k^2p}\sqrt[3]{2np^2k}$
   (b) $\frac{2m^2n^3}{k^2p}\sqrt[3]{2m^2k^2p}$
   (c) $\frac{2m^2n^3}{k^2p}\sqrt[3]{2m^2kp^2}$
   (d) $\frac{2m^2n^2}{k^3p}\sqrt[3]{2m^2k^2p}$
   (e) $\frac{2m^2n^3}{k^2p}$

43. If $y>0$, then the expression $\left[\frac{(-2y)^0y^{-2}\left(5y^2\right)^{-3}}{y^{-3}\left(5^{-1}y^5\right)^{-1}}\right]^{-\frac{1}{4}}$ is equal to
   (a) $5y^2$
   (b) $\frac{1}{5}$
   (c) $\frac{5}{y^2}$
   (d) $\frac{y^2}{5}$
   (e) 5

44. The expression $x^{-\frac{3}{4}}\left[x^{-\frac{7}{4}}+\frac{2}{\sqrt[4]{x^3}}\right]$ is equal to
   (a) $\frac{(1+2x)\sqrt{x}}{x^3}$
   (b) $\frac{(3+x)\sqrt{x}}{x^2}$
   (c) $\frac{2+\sqrt{x}}{x}$
   (d) $\frac{1-\sqrt{x}}{x}$
   (e) $\frac{3+\sqrt{x}}{x}$

45. If $\left(\sqrt[3]{3}-\sqrt[3]{2}\right)X=1$, then X is equal to
   (a) $\sqrt[3]{3}+\sqrt[3]{2}$
   (b) $\sqrt[3]{9}+\sqrt[3]{6}+\sqrt[3]{4}$
   (c) $\sqrt[3]{9}-\sqrt[3]{6}+\sqrt[3]{4}$
   (d) $\left(\sqrt[3]{3}-\sqrt[3]{2}\right)^2$
   (e) $\sqrt[3]{3}-\sqrt[3]{2}$

46. The expression $\frac{\sqrt[3]{x^2}.\sqrt[4]{x^3}}{\sqrt{x^3}.\sqrt{\sqrt[3]{x}}}$ is equal to
   (a) $\sqrt{x^3}$
   (b) $\sqrt{x}$
   (c) $\frac{\sqrt[4]{x^3}}{x}$
   (d) $\frac{\sqrt[3]{x}}{x}$
   (e) $\sqrt[4]{x}$

47. The expression $\frac{x^2}{\left(x^2-1\right)^{\frac{3}{2}}}-\frac{1}{\left(x^2-1\right)^{\frac{1}{2}}}$ is equal to
   (a) x^2
   (b) x^2-1
   (c) $\sqrt{x^2-1}$
   (d) $x^2\left(x^2-1\right)^{-\frac{3}{2}}$
   (e) $\left(x^2-1\right)^{-\frac{3}{2}}$

48. The expression $\frac{y-1}{1+y^{-\frac{1}{2}}}$ is equal to
   (a) $\sqrt{y}\,(y-1)$
   (b) $(y-1)\sqrt{1+y}$
   (c) $\sqrt{y}-1$
   (d) $\frac{\sqrt{y}(y-1)}{2}$
   (e) $y-\sqrt{y}$

49. The expression $\left(2\sqrt[3]{9}-3\right)\left(4\sqrt[3]{9^2}+6\sqrt[3]{9}+9\right)$ is equal to
   (a) 72
   (b) 18
   (c) 45
   (d) 99
   (e) 27

50. If we add and simplify without absolute value bars $\left(x^2-6x+9\right)^{\frac{1}{2}}+|3-x|$, $x<0$, we get:
   (a) 0
   (b) $6-2x$
   (c) 6
   (d) $2x+6$
   (e) $2x$

51. The value of $\frac{\sqrt[3]{3}+\sqrt[3]{2}}{\sqrt[3]{3}-\sqrt[3]{2}}$ is equal to
   (a) $2\sqrt[3]{18}+2\sqrt[3]{12}+5$
   (b) $2\sqrt[3]{6}+2\sqrt[3]{9}+5$
   (c) $2\sqrt[3]{6}+3$
   (d) $\sqrt[3]{9}-\sqrt[3]{6}+1$
   (e) $2\sqrt[3]{18}+5$

52. If $x=3-\sqrt{8}$, then the multiplicative inverse of x is:
   (a) $\frac{1}{3}-\frac{1}{\sqrt{8}}$
   (b) 17
   (c) $3+\sqrt{8}$
   (d) -1
   (e) $\frac{1}{17}$

53. Let $x=7+3\sqrt{2}$ and $y=7-3\sqrt{2}$. Then one of the following is an integer
   (a) x^2
   (b) y^2

(c) $\frac{x}{y}$
(d) $\frac{y}{x}$
(e) x^2+y^2

6. COMPLEX NUMBERS

1. If $\frac{\sqrt{-4}(2+i)}{3-i}=x+iy$, then the values of x and y are
   (a) $-1,-1$
   (b) $1,1$
   (c) $1,-1$
   (d) $-1,1$
   (e) $\frac{1}{2},-\frac{1}{2}$

2. If $z=\frac{5i^3}{4-3i}$,then the conjugate of z is
   (a) $-\frac{3}{5}-\frac{4}{5}i$
   (b) $\frac{4}{5}+\frac{3}{5}i$
   (c) $\frac{5}{3}+\frac{5}{4}i$
   (d) $-\frac{3}{5}+\frac{4}{5}i$
   (e) $\frac{3}{5}+\frac{4}{5}i$

3. If $\left[\sqrt{-25}+\sqrt[3]{-27}\right]^2=x+yi$,then the values of x and y are
   (a) $30,16$
   (b) $-34,-30$
   (c) $34,-30$
   (d) $16,30$
   (e) $-16,-30$

4. If $x=-i$,then $2x^4+2x^3-x^2+1$ is equal to
   (a) $4+2i$
   (b) $2+2i$
   (c) $2-2i$
   (d) 0
   (e) $4-2i$

5. If $z=\frac{(2+i)^2}{i^7}$, then the conjugate of z is
   (a) $-4-3i$
   (b) $-4+3i$
   (c) $3i$
   (d) $4+3i$
   (e) $-3i$

6. If $\frac{\sqrt[3]{-8}+\sqrt{-9}}{\sqrt{-1}+\sqrt[3]{-27}}=A+Bi$, then A and B are
   (a) $\frac{5}{4},0$
   (b) $\frac{9}{8},-\frac{7}{8}$
   (c) $0,\frac{5}{4}$
   (d) $\frac{3}{10},-\frac{7}{10}$
   (e) $\frac{9}{10},-\frac{7}{10}$

7. The value of $(-i)^{79}$ is
   (a) -1
   (b) i
   (c) $-i$
   (d) $-79i$
   (e) 1

8. The expression $\frac{i(3-4i)(3+4i)}{-\sqrt{-400}}$ is equal to
   (a) $\frac{5}{4}$
   (b) $\frac{4}{5}i$
   (c) $-\frac{5}{4}i$
   (d) $-\frac{5}{4}$
   (e) $\frac{5}{4}i$

9. If $z=\left(\frac{2+i}{1-i}\right)^2$, then the conjugate of z is
   (a) $2+\frac{3}{2}i$
   (b) $\frac{3}{2}-2i$
   (c) $-4-3i$
   (d) $4-3i$
   (e) $-2-\frac{3}{2}i$

10. The expression $2(3-4i)-4i^7+(-2+5i)$ is equal to
    (a) $4+i$
    (b) $7-6i$
    (c) $-1+6i$
    (d) $11+14i$
    (e) $11+6i$

11. If $x=1+i$, then x^4-ix+4 is equal to
    (a) $1-i$
    (b) 0
    (c) $9-i$
    (d) $1+i$
    (e) $7-i$

12. If $\left[\sqrt{-36}+\sqrt[3]{-125}\right]^2=A+Bi$, then A and B are equal to
    (a) $11,60$
    (b) $11,-60$
    (c) $-11,-60$
    (d) $59,-60$
    (e) $-60,-11$

13. The conjugate of $3i^{26}+\frac{5}{i^{27}}$ is
    (a) $5-3i$

(b) $-5+3i$
(c) $3-5i$
(d) $3+5i$
(e) $-3-5i$

14. Which one of the following is FALSE ?
(a) $(i)^{4n}=1$ for any positive integer
(b) $(i)^{253}=i$
(c) $\sqrt{(-3)^4}\sqrt{(-2)^6}=72$
(d) $(i)^{4n-1}=-i$ for any positive integer
(e) $\sqrt{-5}\sqrt{-2}=\sqrt{10}$

15. If $A+iB=\frac{\sqrt[3]{-125}+i^{103}-\sqrt{-4}\sqrt{-1}}{(2i-1)-(i+5)}$, then A and B are equal to
(a) $\frac{17}{37},\frac{9}{37}$
(b) $\frac{5}{37},-\frac{9}{37}$
(c) $\frac{5}{37},\frac{9}{37}$
(d) $-\frac{17}{37},-\frac{9}{37}$
(e) $\frac{17}{37},-\frac{9}{37}$

16. The reciprocal of the complex number $2-3i$ is equal to
(a) $-\frac{2}{5}-\frac{3}{5}i$
(b) $\frac{2}{5}+\frac{3}{5}i$
(c) $\frac{1}{2}+\frac{1}{3}i$
(d) $\frac{2}{13}+\frac{3}{13}i$
(e) $\frac{1}{2}-\frac{1}{3}i$

17. The conjugate of the complex number $\frac{4+5i}{1+4i}$ is
(a) $-\frac{24}{15}+\frac{11}{15}i$
(b) $\frac{24}{17}+\frac{11}{17}i$
(c) $\frac{3}{13}-\frac{9}{13}i$
(d) $\frac{9}{17}+\frac{13}{17}i$
(e) $-\frac{12}{17}-\frac{8}{17}i$

18. The expression $\frac{1+3i}{3+i}+\sqrt{-2}\sqrt{-8}$ is equal to
(a) $\frac{19}{4}+i$
(b) $\frac{23}{5}+\frac{4}{5}i$
(c) $-\frac{13}{4}+i$
(d) $4-i$
(e) $-\frac{17}{5}+\frac{4}{5}i$

19. The conjugate of $i^{81}+i^{-48}$ is
(a) $-2i$
(b) $1-i$
(c) $-1+i$
(d) $-i$
(e) $-1-i$

20. The expression $i^{1413}+(-i)^{1992}$ is equal to
(a) $1+i$
(b) 0
(c) $-1-i$
(d) $-1+i$
(e) $1-i$

21. The expression $\frac{2+3i}{3+4i}-\frac{i}{3-4i}$ is equal to
(a) $\frac{22}{25}-\frac{2}{25}i$
(b) $\frac{10}{25}+\frac{4}{25}i$
(c) $-\frac{2}{25}+\frac{4}{25}i$
(d) $-\frac{22}{7}+\frac{2}{7}i$
(e) $-\frac{2}{7}+\frac{22}{7}i$

22. The value of the real number k such that $(2-i)^2\left(k-i^{23}\right)=1+7i$ is
(a) 1
(b) -3
(c) $\frac{1}{5}$
(d) -1
(e) $\frac{1}{4}$

23. The conjugate of $\sqrt[3]{-125}+2\sqrt{-16}+\sqrt{(-23)^2}$ is
(a) $-28-8i$
(b) $8i-18$
(c) $8+18i$
(d) $-28+8i$
(e) $18-8i$

24. If $z=\frac{2+i}{1-i}$, then $\bar{z}$ is equal to
(a) $-\frac{1}{2}+\frac{3}{2}i$
(b) $\frac{3}{2}-\frac{3}{2}i$
(c) $-\frac{1}{2}+\frac{1}{2}i$
(d) $\frac{1}{2}-\frac{3}{2}i$
(e) $\frac{1}{2}-\frac{1}{2}i$

25. The number $(1+i)^2$ is
(a) real
(b) bigger than 2
(c) imaginary
(d) less than 2
(e) equal to its conjugate

26. The expression $\left|\frac{-1}{2^{-3}}\right|+\left|-3^2\right|+\sqrt{-4}\sqrt{-9}$ is equal to
(a) 23
(b) -5
(c) -7
(d) 11

(e) 7

27. If $z = a+bi, a, b \in \Re$, then only one of the following is FALSE :
(a) $a = \frac{1}{2}(z + \overline{z})$
(b) $b = \frac{1}{2}(z - \overline{z})$
(c) $\overline{\overline{z}} = z$
(d) $z \in \Re \Rightarrow z = \overline{z}$
(e) z imaginary $\Rightarrow \overline{z} = -z$

28. Let $u = \sqrt{2-\sqrt{2}} - i\sqrt{2+\sqrt{2}}$, where $i = \sqrt{-1}$. Then the imaginary part of u^2 is
(a) $-4\sqrt{2}$
(b) a rational number
(c) $-2\sqrt{2}$
(d) $\sqrt{2+\sqrt{2}}$
(e) 4

7. SOLUTIONS OF EQUATIONS

1. If $|x| + 3x - 1 = 0$, then $4x$ is equal to
(a) -1
(b) 2
(c) 1
(d) -2
(e) 3

2. If $\left|\frac{x}{x+1}\right| = 1$, then x^2 is equal to
(a) $2x+1$
(b) $-\frac{1}{4}$
(c) $\frac{1}{4}$
(d) $\frac{1}{16}$
(e) $\frac{1}{9}$

3. The solution set of $||x+1| - 3| = 5$ contains
(a) only four solutions
(b) only one solution
(c) only three solutions
(d) only five solutions
(e) only two solutions

4. The solution set of $\left|\frac{3x-4}{2x+3}\right| = 1$ is
(a) $\{\frac{1}{5}, 7\}$
(b) $\{7\}$
(c) $\{1\}$
(d) $\{7, 1\}$
(e) $\{-\frac{1}{5}, 7\}$

5. For which nonzero real number x is $\frac{|x-|x||}{x}$ equal to a positive integer?
(a) For negative numbers only
(b) For positive numbers only
(c) For all real numbers
(d) For all real numbers except zero
(e) For no real numbers

6. The solution set of $|x+1| = |3x-1|$ is
(a) $\{0, 1\}$
(b) $\{0\}$
(c) $\{1\}$
(d) $\{-1, 1\}$
(e) $\{0, -1\}$

7. The solution set of $\frac{4}{5-x} = \frac{1-4x}{x-5} + 3$ is
(a) $\{10\}$
(b) $\{-10\}$
(c) $\{5\}$
(d) $\{-10, 10\}$
(e) $\{10, 5\}$

8. For any $a \neq -\frac{1}{2}$, if $(x-a)(4x+2) = (2x+1)^2$, then $x =$
(a) $\{\frac{1}{2}\}$
(b) $\{-\frac{1}{2}\}$
(c) a
(d) $2a+1$
(e) $-a$

9. The solution set of the equation $\frac{3x-1}{x} = \frac{6x+5}{2x-1}$ is
(a) $\{-\frac{1}{10}\}$
(b) $\{\frac{1}{2}, \frac{1}{10}\}$
(c) $\{0, \frac{1}{10}\}$
(d) $\{10\}$
(e) $\{\frac{1}{10}\}$

10. The value of k for which the equation $x^4 + 3kx + (k+1) = 0$ is satisfied when $x = 1$ is
(a) $\frac{1}{2}$
(b) -1
(c) 0
(d) $-\frac{1}{2}$
(e) 1

11. The solution set of $\frac{3}{x-2} - \frac{4}{2x+1} = \frac{1}{x-2}$ is
(a) $\emptyset$
(b) $\{3\}$
(c) $\{\frac{3}{2}\}$
(d) $\{-2\}$

(e) $\{\frac{1}{2}\}$

12. If the equation $\frac{2x}{x+3} = 1 + \frac{k}{x+3}$ has no solution for x , then $k =$
(a) 3
(b) -3
(c) 0
(d) 6
(e) -6

13. The solution set of $\frac{1-3x}{x-3} = \frac{8}{3-x} - 2$ is
(a) $\{-3\}$
(b) $\{3\}$
(c) $\{0,3\}$
(d) $\emptyset$
(e) $\{0,-3\}$

14. The solution set of $\sqrt{2x+4} = \sqrt[4]{9}$ is
(a) $\{\frac{5}{2}\}$
(b) $\{-\frac{7}{2}\}$
(c) $\{-\frac{1}{2}\}$
(d) $\{-\frac{1}{2}, -\frac{7}{2}\}$
(e) $\{\frac{1}{2}, \frac{7}{2}\}$

15. If a is the solution of the equation $(1+2y)(3-y) = (4-y)(2y+4)$ then
(a) $a \leq -13$
(b) $|a| \leq 12$
(c) $|a| > 31$
(d) $a^2 > 17$
(e) $a < 13$

16. If $ab < 0$ and $|a| = |b|$, then which statement must be TRUE ?
(a) $a = b$
(b) $a > b$
(c) $a < b$
(d) $a \neq b$
(e) $a^2 \neq b^2$

17. The solution set of $\sqrt{x-1} - \sqrt{x-4} = 1$ is
(a) $\{-5\}$
(b) $\{1\}$
(c) $\{1,5\}$
(d) $\{0,5\}$
(e) $\{5\}$

18. If $b^2(ax+b)^2 = a^2(bx+a)^2$, where $a \neq b$, then x is equal to
(a) $\frac{b^2-a^2}{2ab}$
(b) $-\frac{a^2+b^2}{2ab}$
(c) $\frac{a^2+b^2}{2ab}$
(d) $-\frac{2ab}{a^2+b^2}$
(e) $\frac{a^2-b^2}{2ab}$

19. When solving for $a = \frac{2bc}{b-c}$ for c , we get $c =$
(a) $\frac{ba}{a+2b}$
(b) $\frac{2ab}{a+b}$
(c) $\frac{a}{a-2b}$
(d) $\frac{a-2b}{ab}$
(e) $\frac{a+b}{2ab}$

20. If $p = k\sqrt{\frac{L}{m+n}}$, then n is equal to
(a) $\frac{p^2}{Lk^2-mp^2}$
(b) $\frac{Lk^2}{p^2-Lmk^2}$
(c) $\frac{mp^2-Lk^2}{Lmk^2}$
(d) $\frac{Lmk^2}{mp^2-Lk^2}$
(e) $\frac{Lk^2-mp^2}{p^2}$

21. If $\frac{1}{x} = \frac{1}{y} + \frac{1}{z}$, then z is equal to
(a) $x-y$
(b) $\frac{xy}{y-x}$
(c) $\frac{xy}{x-y}$
(d) $y-x$
(e) $\frac{y-x}{xy}$

22. If the equation $\sqrt[4]{4x-4k} = \sqrt{2}$ and $3x-3 = 12$ are equivalent, then k is equal to
(a) 3
(b) 0
(c) -2
(d) 1
(e) 4

23. The equation $4-x = 1$ is equivalent to
(a) $x+3 = 0$
(b) $2x-5 = 1$
(c) $\frac{x}{x-3} = \frac{3}{x-3}$
(d) $x = 9$
(e) $8-2x = 4$

24. The value of k such that the equations $3(x+2) + 2(x-1) = -(4x-2)$ and $5x+2 = -x+\frac{k}{2}$ are equivalent is
(a) $\frac{3}{4}$
(b) $\frac{4}{3}$
(c) 12
(d) $\frac{1}{12}$

(e) $-\frac{16}{3}$

25. The value of k such that the equations $(3x-4)^2+35=3(x+2)(3x+1)$ and $\frac{3x}{x-2}=\frac{k}{x-2}-4$ are equivalent is
    (a) 0
    (b) 2
    (c) 3
    (d) -1
    (e) 4

26. Which one of the following equations is equivalent to $2x+5=9$?
    (a) $3-2x=-1$
    (b) $x=-2$
    (c) $\frac{x}{x-2}=\frac{2}{x-2}$
    (d) $x=\sqrt{2}$
    (e) $x-2=-2+x$

27. The largest possible value of $\left|\frac{x^2+2}{x+3}\right|$ when x belongs to the interval $[-4,4]$
    (a) equals $\frac{18}{7}$
    (b) equals 18
    (c) equals $\frac{2}{3}$
    (d) equals $\frac{11}{6}$
    (e) does not exist

28. In solving the equation $3-7\sqrt[3]{x-1}+2(x-1)^{\frac{2}{3}}=0$, we obtain
    (a) one real solution only
    (b) two positive integer solutions
    (c) one rational and one integer solutions
    (d) two negative integer solutions
    (e) no real solution

8. LINEAR AND ABSOLUTE VALUE INEQUALITIES

1. The solution set of $\left|\frac{3-4x}{2}\right|\leq\frac{3}{4}$, is
   (a) $\left(\frac{3}{8},\frac{9}{8}\right)$
   (b) $\left[\frac{3}{8},\frac{9}{8}\right)$
   (c) $\left[\frac{3}{8},\frac{9}{8}\right]$
   (d) $\left[-\frac{3}{8},\frac{3}{8}\right]$
   (e) $\left[-\frac{9}{8},\frac{9}{8}\right]$

2. If the solution set of $|2x-1|<m$ is the set $\{x \mid -4<x<5\}$, then the value(s) of m is(are) equal to
   (a) $17,-17$
   (b) $9,-9$
   (c) 17
   (d) $9,17$
   (e) 9

3. The solution set of $\frac{9x-8}{(2x+5)^2}<0$ is
   (a) $\left(-8,\frac{8}{9}\right)$
   (b) $\left(\frac{8}{9},\infty\right)$
   (c) $\left(-\infty,\frac{9}{8}\right)$
   (d) $\left(-\infty,-\frac{5}{2}\right)\cup\left(-\frac{5}{2},\frac{8}{9}\right)$
   (e) $\left(-\frac{5}{2},\frac{8}{9}\right)$

4. The solution set of $\left|\frac{1}{x}\right|<3$ is
   (a) $\left(-\infty,-\frac{1}{3}\right)\cup\left(\frac{1}{3},\infty\right)$
   (b) $\left(-\frac{1}{3},\frac{1}{3}\right)$
   (c) $(-3,3)$
   (d) $(-\infty,\infty)$
   (e) $\left(-\frac{1}{3},\infty\right)$

5. The solution set of $0<|x-4|\leq 3$ is
   (a) $[1,7]$
   (b) $[4,7)$
   (c) $[1,4)\cup(4,7]$
   (d) $(1,4)\cup(4,7)$
   (e) $(-\infty,\infty)$

6. If $|x-2|<3$ is equivalent to $m<3x+5<n$, then the values of m and n are
   (a) $20,2$
   (b) $2,20$
   (c) $1,10$
   (d) $10,1$
   (e) $0,0$

7. The solution set of $|2x+3|+4\leq 9$ is
   (a) $[-4,1]$
   (b) $(-4,1)$
   (c) $(-\infty,-4)\cup[1,\infty)$
   (d) $(-5,5)$
   (e) $(1,4)$

8. The solution set of $|2x+1|+\frac{2}{3}\geq\frac{11}{3}$ is
   (a) $(-2,0)\cup(0,1]$
   (b) $(-\infty,-2]\cup[1,\infty)$
   (c) $[1,2]$
   (d) $\left[-\frac{1}{3},1\right]$
   (e) $\left(-\frac{1}{3},1\right)$

9. The solution set of $\left|\frac{3}{x-1}\right|+9\geq 12$ is
   (a) $[0,2]$
   (b) $(1,2]$
   (c) $[0,1)$
   (d) $[0,1)\cup(1,2]$
   (e) $\left\{\frac{1}{2}\right\}$

10. If the solution set of $\left|x+\frac{6}{k+1}\right|\leq\frac{3}{k+1}$ is $[-3,-1]$, then $k=$
    (a) $\{-2,-4\}$
    (b) $\emptyset$
    (c) $\{-\frac{1}{2},2\}$
    (d) $\{2\}$
    (e) $\{2,-3\}$

11. If x is within 6 units from -1 , then
    (a) $|x-6|\leq 1$
    (b) $|x+1|\leq 6$
    (c) $x\geq 6$
    (d) $|x-1|\leq 6$
    (e) $|x-6|\geq 1$

12. If x is at least 10 units from 12 , then
    (a) $|x-12|\leq 10$
    (b) $|x-12|=10$
    (c) $x\leq 10$
    (d) $|x-10|\leq 12$
    (e) $|x-12|\geq 10$

13. If the interval $[-2,4]$ is written in terms of absolute values, the result is
    (a) $|x-1|\geq 3$
    (b) $|x-2|=4$
    (c) $|x|\leq 4$
    (d) $|x-4|\leq 3$
    (e) $|x-1|\leq 3$

14. If the interval $(-\infty,-4)\cup(0,\infty)$ is written in terms of absolute values, the result is
    (a) $|x+4|>0$
    (b) $|x-4|=0$
    (c) $|x|\leq 4$
    (d) $|x+2|>2$
    (e) $|x-2|\leq 2$

15. Which one of the following is TRUE ?
    (a) If $x\in[-10,2]$, then $|x+4|\leq 6$
    (b) If $|x-5|<1$, then $x\in(3,5)$
    (c) If $|x-4|\leq 3$, then $x\in[0,7]$
    (d) If $x\in[8,12]$, then $|x-10|\leq 1$
    (e) If $|x-2|<10$, then $x\in[8,12]$

16. The union of the two sets $\{x\mid 2-3x>5\}\cup\{x\mid 2x-1>5\}$ in interval notation is
    (a) $[-1,3]$
    (b) $(-\infty,3]$
    (c) $(-\infty,-1]\cup[3,\infty)$
    (d) $(-\infty,-1)\cup(3,\infty)$
    (e) $(-1,3)$

17. The set of negative integers t such that $1\leq|t|\leq 5$ is
    (a) $\{-5,-4,-3,-2,-1\}$
    (b) $\{1,2,3,4,5\}$
    (c) $\{-5,-4,-3,-2,-1,0,1,2,3,4,5\}$
    (d) $[-5,-1]$
    (e) $(-5,-1)$

18. The smallest positive number M such that $\left|x^3-2x^2+3x-4\right|\leq M$ for all values of x in the interval $[-3,2]$ is
    (a) 2
    (b) 10
    (c) 125
    (d) undefined
    (e) 58

19. The solution set of the inequality $\frac{x+2}{(x-1)^2}<\frac{1}{x-2}$ is
    (a) $\left(2,\frac{5}{2}\right)$
    (b) $(-\infty,1)\cup(2,\infty)$
    (c) $(1,2)\cup\left(\frac{5}{2},\infty\right)$
    (d) $\left(1,\frac{3}{2}\right)\cup\left(\frac{3}{2},\infty\right)$
    (e) $\left(2,\frac{5}{2}\right]$

9. QUADRATIC EQUATIONS

1. The solution set of the quadratic equation $2x^2-6x+2=0$ consists of
   (a) two complex conjugate numbers
   (b) one positive and one negative irrational numbers
   (c) one rational and one irrational numbers
   (d) two positive irrational numbers
   (e) one positive and one negative rational numbers

2. The solution set of $8x^3+125=0$ is
   (a) $\left\{-\frac{5}{2},\frac{-5\pm 5i\sqrt{3}}{4}\right\}$
   (b) $\left\{-\frac{5}{2},\frac{5\pm 5i\sqrt{3}}{4}\right\}$

(c) $\left\{\frac{5\pm 5i\sqrt{3}}{4}\right\}$
(d) $\left\{\frac{5}{2}\right\}$
(e) $\left\{-\frac{5}{2}\right\}$

3. The solution set of $\left(x^2-3x\right)^2=16$ is
(a) $\left\{-4,1,\frac{3\pm i\sqrt{7}}{2}\right\}$
(b) $\left\{4,-1,\frac{3\pm i\sqrt{7}}{2}\right\}$
(c) $\{-4,-1,1,4\}$
(d) $\left\{1,-4,\frac{3\pm 5i}{2}\right\}$
(e) $\{4,-1\}$

4. The solution set of $4x^4=13x^2-9$ is
(a) $\left\{-1,1,\frac{9}{4},-\frac{9}{4}\right\}$
(b) $\left\{-1,1,3,\frac{3}{4}\right\}$
(c) $\left\{\sqrt{3},-\sqrt{3},\frac{\sqrt{3}}{2},-\frac{\sqrt{3}}{2}\right\}$
(d) $\{1,-1\}$
(e) $\left\{-1,1.\frac{3}{2},-\frac{3}{2}\right\}$

5. If $a^2x^2-2abx+b^2-16=0$, where a,b are positive real numbers, then x is equal to
(a) $\frac{b\pm 2}{a}$
(b) $\frac{4\pm b}{a}$
(c) $\frac{2\pm b}{a}$
(d) $\frac{b\pm 4}{a}$
(e) $\frac{b\pm 4}{2a}$

6. The solution set of $(2x-1)^{\frac{2}{3}}=x^{\frac{1}{3}}$ consists of
(a) one positive integer and one negative rational number
(b) one positive integer and one negative irrational number
(c) one negative integer and one positive rational number
(d) one positive integer and one positive rational number
(e) one rational and one irrational numbers

7. The solution set of $\frac{3}{x^2}+\frac{11}{x}-4=0$ is
(a) $\left\{3,-\frac{1}{4}\right\}$
(b) $\left\{-3,\frac{1}{4}\right\}$
(c) $\left\{-\frac{1}{3},4\right\}$
(d) $\left\{\frac{1}{3},-4\right\}$
(e) $\left\{3,\frac{1}{4}\right\}$

8. The solution set of $x^{-2}-x^{-1}=0$ is
(a) $\{1\}$
(b) $\{0\}$
(c) $\{0,1\}$
(d) $\{-1,0\}$
(e) $\{0,2\}$

9. The sum of the roots of $\left(x^2-5x\right)^2+\left(x^2-5x\right)=0$ is
(a) 10
(b) 5
(c) $\frac{15}{2}$
(d) $\frac{15}{2}+\sqrt{21}$
(e) $-10+\sqrt{21}$

10. If $a>\frac{1}{2}$, then the solution set of $(2a-1)^{\frac{1}{2}}-2\,(2a-1)^{\frac{1}{4}}-3=0$ is
(a) $\left\{\frac{17}{2}\right\}$
(b) $\{41\}$
(c) $\left\{1,\frac{17}{2},41\right\}$
(d) $\emptyset$
(e) $\left\{\frac{1}{2},1,\frac{17}{2},41\right\}$

11. The sum of the solutions of $(2x-3)^2=x$ is
(a) 4
(b) $\frac{21}{4}$
(c) $\frac{15}{4}$
(d) $\frac{13}{4}$
(e) 2

12. The number of solutions of the equation $\left(5x^2-6\right)^{\frac{1}{4}}=x$ is
(a) 2
(b) 0
(c) 1
(d) 3
(e) 4

13. The solution set of the equation $7p^{-2}+19p^{-1}=6$ is
(a) $\left\{\frac{7}{2},-\frac{1}{3}\right\}$
(b) $\left\{\frac{2}{7},-3\right\}$
(c) $\left\{-\frac{7}{2},-\frac{1}{3}\right\}$
(d) $\left\{\frac{7}{2},3\right\}$
(e) $\left\{-\frac{7}{2},\frac{1}{3}\right\}$

14. The number of real solutions of the equation $\frac{5}{(1-x^2)^2}+\frac{7}{1-x^2}=6$ is
(a) 4
(b) 2
(c) 0
(d) 1
(e) 3

15. If one solution of the equation $kx^2 - 17x + 33 = 0$ is 3 , then the other solution and k are
   (a) $-\frac{11}{2}, -2$
   (b) $2, \frac{11}{5}$
   (c) $\frac{11}{2}, 2$
   (d) $\frac{11}{4}, 4$
   (e) $1, 1$

16. If the product of the solutions to $kx^2 - 4x + (2k - 1) = 0$ is 3 , then k is equal to
   (a) 1
   (b) 0
   (c) -1
   (d) 2
   (e) -2

17. If one root of the equation $x^2 - kx + 18 = 0$ is twice the other, then set of all possible values of k is
   (a) $\{9\}$
   (b) $\{9, -9\}$
   (c) $\{-9\}$
   (d) $\{6\}$
   (e) $\{6, -6\}$

18. If the discriminant of the equation $-3x^2 - bx + 2 = 0$ is 29 where $b > 0$, then b is equal to
   (a) $\sqrt{5}$
   (b) 1
   (c) $\sqrt{27}$
   (d) $\sqrt{29}$
   (e) 12

19. If the negative solution of the equation $2x^2 - x - 15 = 0$ satisfies the equation $Ax + 10 = 0$, then A is equal to
   (a) 4
   (b) $-\frac{10}{3}$
   (c) $\frac{20}{3}$
   (d) 3
   (e) $\frac{4}{3}$

20. If m and n are the solutions of the equation $2x^2 - 2x + 1 = 0$, then the equation whose solutions are $3m$ and $3n$ is
   (a) $18x^2 - 6x + 1 = 0$
   (b) $6x^2 - 6x + 3 = 0$
   (c) $6x^2 - 6x + 1 = 0$
   (d) $2x^2 - 6x + 9 = 0$
   (e) $2x^2 + 6x - 9 = 0$

21. If $-\frac{1}{2}$ is a solution of $(2x - 1)(3x + 2) = k$, then the other is
   (a) $\frac{1}{2}$
   (b) -1
   (c) $-\frac{2}{3}$
   (d) $\frac{1}{3}$
   (e) 2

22. The set of all real values of k in interval notation such that the equation $x^2 - kx - 2 = 0$ has no real solutions for x is
   (a) $\emptyset$
   (b) $\left(-\infty, 2\sqrt{2}\right) \cup \left(2\sqrt{2}, \infty\right)$
   (c) $\left(-2\sqrt{2}, 2\sqrt{2}\right)$
   (d) $\left(-\infty, -2\sqrt{2}\right) \cup \left(2\sqrt{2}, \infty\right)$
   (e) $\left(-\infty, -2\sqrt{2}\right)$

23. The set of all real values of k for which the equation $x^2 + k^2 = 2(k + 1)x$ has exactly one real solution is
   (a) $\left\{\frac{1}{2}, -\frac{1}{2}\right\}$
   (b) $\left\{\frac{1}{2}\right\}$
   (c) $\left\{-\frac{1}{8}\right\}$
   (d) $\left\{\frac{1}{8}\right\}$
   (e) $\left\{-\frac{1}{2}\right\}$

24. The sum of all values of k for which the equation $\frac{4}{x^2} = \frac{k+1}{x} - 4$ has two equal solutions is
   (a) 24
   (b) -2
   (c) -5
   (d) -36
   (e) 4

25. The set of all values of M for which the equation $(M - 2)x^2 + \sqrt{3}(M + 1)x - 3 = 0$ has exactly one solution is
   (a) $\left\{-\sqrt{3}, 1\right\}$
   (b) $\{-7, 1\}$
   (c) $\{-2, 7\}$
   (d) $\left\{-\sqrt{3}, \sqrt{3}\right\}$
   (e) $\{-7, 0\}$

26. The set of all real values of k such that the equation $3x^2 - 2(k + 1)x + 3 = 0$ has only nonreal solutions is
   (a) $(-\infty, 2)$
   (b) $(-\infty, -4) \cup (2, \infty)$
   (c) $(-4, 5)$
   (d) $(-\infty, -2)$
   (e) $(-4, 2)$

27. The values of k in interval notation such that the equation $x^2 - kx + 1 = 0$ has real solutions are
    (a) $[-2, 2]$
    (b) $(-\infty, \infty)$
    (c) $(-2, 2)$
    (d) $(-\infty, -2) \cup (2, \infty)$
    (e) $(-\infty, -2] \cup [2, \infty)$

28. The values of k for which the equation $x^2 + kx + 2k = 0$ has real solutions are
    (a) $(-\infty, -8] \cup [0, \infty)$
    (b) $(-\infty, -8) \cup (8, \infty)$
    (c) $(-\infty, 8]$
    (d) $[0, 8]$
    (e) $(-\infty, 0] \cup [8, \infty)$

29. The equation $(2k+1)x^2 + (k+2)x + 1 = 0$ has two different real solutions if
    (a) $0 < k < 4$
    (b) $-4 < k < 0$
    (c) $k < -4$ or $k > 0$
    (d) $k = 0$
    (e) $k < 0$ or $k > 4$

30. The expression $x^2|y| + y\left|x^2\right|$ is equal to zero if and only if
    (a) $x = 0$ or $y > 0$
    (b) $x = 0$ or $y < 0$
    (c) $x < 0$ or $y \le 0$
    (d) $x > 0$ or $y \ge 0$
    (e) $x = 0$ or $y \le 0$

31. The solution set of the equation $|1-6x|^2 - 4|1-6x| - 45 = 0$ is
    (a) $\left\{\pm\frac{5}{3}, \pm\frac{4}{3}\right\}$
    (b) $\left\{\frac{5}{3}, \frac{5}{7}, -\frac{4}{3}, -\frac{5}{7}\right\}$
    (c) $\emptyset$
    (d) $\left\{\frac{3}{7}, -\frac{2}{7}\right\}$
    (e) $\left\{\frac{5}{3}, -\frac{4}{3}\right\}$

32. The number of solutions of the equation $|2x-1|^3 - 5|2x-1|^2 + 4|2x-1| = 0$ is
    (a) 0
    (b) 5
    (c) 3
    (d) 4
    (e) 6

33. The solution set of the equation $5|3-4x|^2 - 6|3-4x| = 8$ is
    (a) $\left\{\frac{16}{5}, \frac{24}{5}\right\}$
    (b) $\left\{-\frac{1}{4}, 2\right\}$
    (c) $\emptyset$
    (d) $\left\{\frac{1}{4}, \frac{5}{4}\right\}$
    (e) $\left\{\frac{1}{4}, -\frac{5}{4}, \frac{16}{5}, \frac{24}{5}\right\}$

34. The solution set of the equation $|2x+8|^2 - |9x+36| - 9 = 0$ is
    (a) $\{-1\}$
    (b) $\{-7\}$
    (c) $\left\{-\frac{19}{4}\right\}$
    (d) $\{-1, -7\}$
    (e) $\left\{-7, -\frac{13}{4}, -1\right\}$

35. The solution set of the equation $3(x+3) + \sqrt{x+3} = 2$ is
    (a) $\left\{-\frac{23}{9}\right\}$
    (b) $\left\{-2, \frac{23}{9}\right\}$
    (c) $\left\{2, -\frac{23}{9}\right\}$
    (d) $\{-2\}$
    (e) $\left\{-2, -\frac{23}{9}\right\}$

36. The solution set of the equation $\sqrt{2x} = \sqrt{x+7} - 1$ consists of
    (a) two even numbers
    (b) only one odd number
    (c) two odd numbers
    (d) only one even number
    (e) one odd and one even numbers

37. The solution set of the equation $\sqrt{x} - \sqrt[4]{x} - 2 = 0$ is
    (a) $\{1\}$
    (b) $\{1, 16\}$
    (c) $\{-1\}$
    (d) $\{-16\}$
    (e) $\{16\}$

38. The equation $2\sqrt{x} - 1 = \sqrt{2 - \sqrt{x}}$ has
    (a) one real solution only
    (b) no real solutions
    (c) two real solutions
    (d) one real and one complex solutions
    (e) two complex solutions

39. The sum of the solutions of the equation $\sqrt{x^3 - 6x} = -x$ is
    (a) 1
    (b) -1
    (c) 3

(d) 0
(e) -2

40. The solution set of the equation $\sqrt{x}+2=\sqrt{4+7\sqrt{x}}$ is
(a) $\{0,9\}$
(b) $\{9,7\}$
(c) $\{9\}$
(d) $\emptyset$
(e) $\{0,25\}$

41. The equation $\sqrt[3]{\sqrt{x^2+x+44}}=2$ has
(a) two rational solutions
(b) two irrational solutions
(c) no real solutions
(d) one positive real solution only
(e) one negative rational solution only

42. The set of all real solutions of the equation $\sqrt[3]{x^4}-2\sqrt[3]{x^2}-3=0$ is
(a) $\{3,-1\}$
(b) $\{3\sqrt{3},1\}$
(c) $\{\sqrt[3]{9},1\}$
(d) $\{-3\sqrt{3},3\sqrt{3},1,-1\}$
(e) $\{-3\sqrt{3},3\sqrt{3}\}$

43. The number of real solutions of the equation $3-\sqrt{x}=\sqrt{2\sqrt{x}-3}$ is
(a) 0
(b) 2
(c) 4
(d) 1
(e) 3

44. After completing the square in the equation $3x^2-2x+1=0$, we get $(x-a)^2=b$ where $a+b$ is equal to
(a) $\frac{4}{9}$
(b) $-\frac{7}{9}$
(c) $\frac{8}{9}$
(d) $-\frac{2}{9}$
(e) $\frac{1}{9}$

45. Let z be a natural number, then the solution set of the equation $z^4-15z^2-16=0$ contains
(a) only two solutions
(b) only three solutions
(c) four solutions
(d) no solution
(e) only one solution

46. The equation $\sqrt[3]{x-1}-\sqrt{x+1}=0$ has
(a) exactly one real solution
(b) two complex solutions
(c) one real and one imaginary solutions
(d) exactly two real solutions
(e) three solutions

10. NONLINEAR INEQUALITIES IN ONE REAL VARIABLE

1. The solution set of the inequality $\frac{x+1}{x-1}\le x+1$ is
(a) $[2,\infty)$
(b) $[-1,1)\cup[2,\infty)$
(c) $[-1,1)\cup(1,2]$
(d) $[-1,\infty)$
(e) $(-\infty,-1]$

2. The solution set of the inequality $\frac{1}{-x+1}\le\frac{1}{x+2}$ is
(a) $\left(-2,-\frac{1}{2}\right]\cup(1,\infty)$
(b) $\left(-\infty,-\frac{1}{2}\right]\cup(1,\infty)$
(c) $(-2,1)$
(d) $[-2,1]$
(e) $(-\infty,1)$

3. The solution set of the inequality $4m^3+7m^2-2m\le 0$ is
(a) $(-\infty,-2]\cup\left[0,\frac{1}{4}\right]$
(b) $[-2,0]\cup\left[\frac{1}{4},\infty\right)$
(c) $(-\infty,-2)\cup\left(0,\frac{1}{4}\right)$
(d) $\left[-2,\frac{1}{4}\right]$
(e) $[0,\infty)$

4. The solution set of the inequality $\frac{x^2+10x+25}{x^2-x-12}\le 0$ is
(a) $(-3,4)\cup\{-5\}$
(b) $(-3,4)$
(c) $(-\infty,-3)\cup\{5\}\cup(4,\infty)$
(d) $[-5,-3)\cup(4,\infty)$
(e) $[4,\infty)$

5. The solution set of the inequality $\frac{(2x-3)(3x+8)}{(x-6)^3}\ge 0$ is
(a) $\left[-\frac{3}{8},\frac{3}{2}\right]\cup(6,8)$
(b) $\left[-\frac{8}{3},\frac{3}{2}\right]\cup[6,\infty)$
(c) $\left[-\frac{8}{3},\frac{3}{2}\right]\cup(6,\infty)$
(d) $(6,\infty)$
(e) $\left[-\frac{8}{3},\frac{3}{2}\right]$

6. The solution set of the inequality $\frac{x-x^2}{x+1}>0$ is

(a) $(-1,0)\cup(1,\infty)$
(b) $(-1,1)$
(c) $(0,\infty)$
(d) $(-\infty,-1)\cup(1,\infty)$
(e) $(-\infty,-1)\cup(0,1)$

7. The solution set of the inequality $\frac{1}{x^2+2x-3}\le\frac{3}{x+3}$ is
(a) $(-1,3)$
(b) $(-1,3)\cup\left[\frac{4}{3},\infty\right)$
(c) $(-3,\infty)$
(d) $(-3,1)$
(e) $(-3,1)\cup\left[\frac{4}{3},\infty\right)$

8. The solution set of the inequality $(2x+1)^2<3(1-x)$ is
(a) $\left(-\frac{1}{4},2\right)$
(b) $\left(-\frac{1}{4},\infty\right)$
(c) $(-2,\infty)$
(d) $\left(-2,-\frac{1}{4}\right)$
(e) $\left(-2,\frac{1}{4}\right)$

9. The solution set of the inequality $\frac{(2x+5)^2}{(x+4)^3}>0$ is
(a) $\left(-4,-\frac{5}{2}\right)$
(b) $(-4,\infty)$
(c) $\left(-\frac{5}{2},\infty\right)$
(d) $\left(\frac{5}{2},4\right)$
(e) $\left(-4,-\frac{5}{2}\right)\cup\left(-\frac{5}{2},\infty\right)$

10. The solution set of the inequality $\frac{(x+1)^{10}(x-2)^9}{(x+7)^6}\le 0$ is
(a) $(-\infty,-7)\cup(-7,2)$
(b) $(-\infty,2)$
(c) $(-7,\infty)$
(d) $(-7,2)$
(e) $(-\infty,-7)\cup(-7,2]$

11. The solution set of the inequality $0<x^2-4\le 5$ is
(a) $(-3,-2]\cup(2,3]$
(b) $(-3,3]$
(c) $(-3,3)$
(d) $[-3,-2)\cup(2,3]$
(e) $(-3,-2]$

12. The solution set of the inequality $\left|x^2-8\right|\le 1$ is
(a) $\left[\sqrt{7},3\right]$
(b) $\left[-3,\sqrt{7}\right]$
(c) $\left[-7,\sqrt{7}\right]\cup[3,\infty)$
(d) $(-\infty,-3]\cup\left[\sqrt{7},\infty\right)$
(e) $\left[-3,-\sqrt{7}\right]\cup\left[\sqrt{7},3\right]$

13. The solution set of the inequality $\left|\frac{2x+5}{x}\right|<1$ is
(a) $[-5,-3)$
(b) $\left(-5,-\frac{5}{3}\right)$
(c) $(-\infty,-5)$
(d) $(-3,\infty)$
(e) $[-5,3)$

14. The solution set of the inequality $|x-1|\ge 3\,|x-2|$ is
(a) $\left(\frac{7}{4},\frac{5}{2}\right)$
(b) $\left[-\frac{7}{4},\infty\right)$
(c) $\left[\frac{5}{2},\infty\right)$
(d) $\left[\frac{7}{4},\frac{5}{2}\right]$
(e) $(-\infty,\infty)$

15. The solution set of the inequality $\left|\frac{3-3x}{x^2+5}\right|>0$ is
(a) $(1,\infty)$
(b) $(-\infty,1)\cup(1,\infty)$
(c) $(-\infty,1)$
(d) $[1,\infty)$
(e) $(-\infty,1]$

16. The solution set of the inequality $\left|\frac{x-5}{x^2}\right|<0$ is
(a) $(-\infty,\infty)$
(b) $(0,\infty)$
(c) $[0,\infty)$
(d) $\emptyset$
(e) $[0,1]$

17. The solution set of the inequality $|x|^2+|x|\ge 2$ is
(a) $[-1,1]$
(b) $\left(-\infty,-\sqrt{2}\right]\cup\left[1,\sqrt{2}\right]$
(c) $(-\infty,-1]$
(d) $\emptyset$
(e) $(-\infty,-1]\cup[1,\infty)$

18. The solution set of the inequality $|3-2x|^2-|2x-3|\le 6$ is
(a) $(0,3)$
(b) $(0,3]$
(c) $(0,\infty)$
(d) $[0,3]$
(e) $[3,\infty)$

19. The solution set of the inequality $|2x+8|^2-|9x+36|\ge 9$ is
(a) $(-\infty,-7]\cup[-1,\infty)$
(b) $(-\infty,\infty)$
(c) $(-\infty,-7]$
(d) $[-1,\infty)$

(e) $[-7,-1]$

20. The solution set of the inequality $x^2+x+2<0$ is
(a) $\emptyset$
(b) $(-2,-1)$
(c) $(-\infty,-2)\cup(-1,\infty)$
(d) $(-2,\infty)$
(e) $(-\infty,\infty)$

21. The solution set of the inequality $x^2+x+2>0$ is
(a) $\emptyset$
(b) $(-2,-1)$
(c) $(-\infty,-2)\cup(-1,\infty)$
(d) $(-2,\infty)$
(e) $(-\infty,\infty)$

22. The solution of the inequality $\frac{(x-2)^5(x^2+1)(x-3)^2}{(4-x)^3}\leq 0$, is
(a) $[-1,2]\cup[3,4)$
(b) $(-\infty,2]\cup\{3\}\cup(4,\infty)$
(c) $(-\infty,-1]\cup[2,3]\cup[4,\infty)$
(d) $(-\infty,2]\cup[4,\infty)$
(e) $[2,4)\cup\{3\}$

23. Let $a\geq 0$. Which one of the following statements is TRUE ?
(a) $x^2\leq a^2$ is equivalent to $|x|\leq -a$
(b) $x^2\leq a^2$ is equivalent to $x\leq a$
(c) $x^2\geq a^2$ is equivalent to $|x|\geq a$
(d) $x^2\geq a^2$ is equivalent to $x\geq a$
(e) $(x-a)^2\geq 0$ is equivalent to $|x|\geq a$

11. FUNCTIONS

1. The range of the function $y=\sqrt{9-x^2}$ is
(a) $(-\infty,-3]\cup[3,\infty)$
(b) $[0,3]$
(c) $[-3,3]$
(d) $[3,\infty)$
(e) $[0,\infty)$

2. The domain of the function $f(x)=\sqrt{x^2-3x-4}$ is
(a) $[-1,4]$
(b) $(-\infty,-1]\cup[4,\infty)$
(c) $(-\infty,-4]\cup[1,\infty)$
(d) $[4,\infty)$
(e) $(-\infty,-1)\cup(-1,4)\cup(4,\infty)$

3. The domain of the function $f(x)=-\sqrt{\frac{7}{5-|x|}}$ is
(a) $[-5,5]$
(b) $(-\infty,-5)\cup(-5,5)\cup(5,\infty)$
(c) $(-\infty,-5)\cup(5,\infty)$
(d) $[-5,0)\cup(0,5]$
(e) $(-5,5)$

4. The range of the function $y+1=-\sqrt{x+2}+4$ is
(a) $[3,\infty)$
(b) $[2,3]$
(c) $(-\infty,3]$
(d) $(-\infty,0]$
(e) $[0,\infty)$

5. The domain D and range R of the function $f(x)=-\frac{3}{4x^2+4x+1}$ are
(a) $D=(-\infty,0]\cup[1,\infty)\,,R=(-\infty,\infty)$
(b) $D=(-\infty,\infty)\,,R=(-\infty,0)$
(c) $D=\left(-\infty,-\frac{1}{2}\right)\cup\left(-\frac{1}{2},\infty\right),R=(-3,\infty)$
(d) $D=\left(-\infty,-\frac{1}{2}\right)\cup\left(-\frac{1}{2},\infty\right),R=(-\infty,0)$
(e) $D=\left(-\infty,\frac{1}{2}\right)\cup\left(\frac{1}{2},\infty\right),R=(-\infty,0)$

6. The domain of the function $f(x)=\sqrt{-x^2-25}$ is
(a) $x\geq 5$
(b) $(-\infty,\infty)$
(c) $\emptyset$
(d) $-5\leq x\leq 5$
(e) $-25\leq x\leq 25$

7. The domain of the function $f(x)=\sqrt{\frac{-3+4x-x^2}{x}}$ is
(a) $[1,3]$
(b) $(-\infty,0)\cup[1,3]$
(c) $(-\infty,1]\cup[3,\infty)$
(d) $(0,3]$
(e) $(0,1]\cup[3,\infty)$

8. The domain D and range R of the function $f(x)=\sqrt{-3x-12}$ are
(a) $D=\emptyset,R=[0,\infty)$
(b) $D=R=\emptyset$
(c) $D=(-\infty,-4]\,,R=(-\infty,0]$
(d) $D=R=(-\infty,0]$
(e) $D=(-\infty,-4]\,,R=[0,\infty)$

9. The domain of the function $f(x)=\frac{\sqrt{x+1}}{x}$ is
(a) $(-1,0)\cup(0,\infty)$
(b) $[-1,\infty)$
(c) $[-1,0)\cup(0,\infty)$
(d) $[1,\infty)$

(e) $[0,\infty)$

10. The domain D and range R of the function $f(x)=\sqrt{|x-5|}$ are
(a) $D=(-\infty,-5], R=[0,\infty)$
(b) $D=(-\infty,\infty), R=[0,\infty)$
(c) $D=[5,\infty), R=(-\infty,0)$
(d) $D=[-5,5], R=[0,\infty)$
(e) $D=(-5,\infty), R=[5,\infty)$

11. The domain D and range R of $|xy|=1$ are
(a) $D=(-\infty,\infty), R=(-\infty,\infty)$
(b) $D=(0,\infty), R=(0,\infty)$
(c) $D=(-\infty,0)\cup(0,\infty), R=(-\infty,0)\cup(0,\infty)$
(d) $D=(-\infty,0), R=(-\infty,0)$
(e) $D=(-\infty,\infty), R=[0,\infty)$

12. The domain D and range R of $|x+y|=1$ are
(a) $D=[-1,1), R=[-1,1)$
(b) $D=[1,\infty), R=[1,\infty)$
(c) $D=[-1,\infty), R=[-1,\infty)$
(d) $D=(-\infty,\infty), R=(-\infty,\infty)$
(e) $D=[-1,1], R=[-1,1]$

13. The domain D of $f(x)=\sqrt[3]{25-x^2}$ and the range R of $g(x)=-\sqrt{\frac{1}{x^2+9}}$ are
(a) $D=[-5,5], R=\left(0,\frac{1}{3}\right]$
(b) $D=(-\infty,0], R=(0,\infty)$
(c) $D=(-\infty,\infty), R=\left[-\frac{1}{3},0\right)$
(d) $D=[0,\infty), R=(-\infty,0)$
(e) $D=(-\infty,-5]\cup[5,\infty), R=\left[-\frac{1}{3},\frac{1}{3}\right]$

14. If $f(x)=\frac{1}{x+1}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
(a) $-\frac{2}{h}$
(b) $-\frac{3}{2(2+h)}$
(c) $-\frac{1}{2(2+h)}$
(d) $-\frac{2}{2+h}$
(e) $-2(2+h)$

15. If $f(x)=x^2$, then $\frac{f(x+h)-f(x)}{2xh+h^2}$ is equal to
(a) x
(b) 1
(c) $x+h$
(d) $2x+h$
(e) $\frac{2x+h}{x+h}$

16. If $f(x)=\frac{x}{x+1}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
(a) $\frac{1}{2+h}$
(b) $\frac{1}{h(2+h)}$
(c) $\frac{1}{2(2+h)}$
(d) $\frac{h+1}{2h(2+h)}$
(e) $\frac{h}{2(2+h)}$

17. If $f(x)=\sqrt{x}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
(a) $-\frac{1}{1+\sqrt{1+h}}$
(b) $\frac{1}{h}$
(c) $\frac{1}{\sqrt{1+h}-1}$
(d) $\frac{1}{1+\sqrt{1+h}}$
(e) $-\frac{1}{h}$

18. If $f(x)=\frac{2x+1}{x-2}$, then $\frac{f(x)-f(4)}{x-4}$ is equal to
(a) $\frac{-5x-16}{2(x-2)(x-4)}$
(b) $-\frac{5}{2x-4}$
(c) $-\frac{5}{x-2}$
(d) 1
(e) $\frac{-5x+16}{2(x-2)(x-4)}$

19. If $f(x)=\frac{1}{\sqrt{x-1}+2}$, then $f(x+1)$ is equal to
(a) $\frac{\sqrt{x}+2}{x+4}$
(b) $\frac{\sqrt{x-1}-3}{x-8}$
(c) $\frac{\sqrt{x-1}+3}{x+8}$
(d) $\frac{\sqrt{x}-2}{x-4}$
(e) $\frac{\sqrt{x-1}+3}{\sqrt{x-1}+2}$

20. If $f(x)=3-x^2$, then $[f(x)]^2+f\left(x^2-1\right)$ is equal to
(a) $13-8x^2$
(b) $11-4x^2$
(c) $10-7x^2+x^4$
(d) $11-7x^2+x^4$
(e) $7-x^2-x^4$

21. If $f(x)=\sqrt{x^2+2x+1}$ with $-2<x<-1$, then $\frac{f(x-2)}{x-1}$ is equal to
(a) 1
(b) ±1
(c) $\frac{|x+2|-2}{x-1}$
(d) $\frac{x}{x-1}$
(e) -1

22. Which one of the following relations represents a function of x ?
(a) $x^2+y^2=9$
(b) $x^2-y^2=1$

(c) $x^3 - y = 1$
(d) $x = |y|$
(e) $x^2 + y^4 = 4$

23. The graph of the function $f(x) = -x^4 + 2x^3 + 3x^2$ intercepts the x-axis at
(a) $(1,0), (-1,0), (0,0), (3,0)$
(b) $(3,0), (0,-3), (0,0)$
(c) $(1,0), (0,0), (0,3), (0,-3)$
(d) $(0,0), (3,0), (-1,0)$
(e) $(-3,0), (0,0), (1,0)$

24. The value of k in interval notation for which the function $y = kx^2 - 8x + 4$ has no x-intercepts is
(a) $(-\infty, 4)$
(b) $(4, \infty)$
(c) $(0, 4)$
(d) $(-4, 4)$
(e) $(-4, 0)$

25. The graph of $x|y| = 1$ is completely in
(a) the first and second quadrants
(b) the first and third quadrants
(c) the third and fourth quadrants
(d) the first and fourth quadrants
(e) the fourth quadrant

26. The graph of the set of points (x, y) for which $|x+4| \leq 1$ and $0 \leq y+2 \leq 1$ lies completely in
(a) all quadrants
(b) the first quadrants
(c) the third quadrant
(d) the second quadrant
(e) the fourth quadrant

27. In the graph of $f(x) = \begin{cases} |x| - 1 & if \quad x > -1 \\ x - 1 & if \quad x \leq -1 \end{cases}$ we have
(a) one x-intercept and one y-intercept
(b) one x-intercept and two y-intercepts
(c) two x-intercepts and one y-intercept
(d) two x-intercepts and two y-intercepts
(e) two x-intercepts only

28. If the point (a, b) is in the fourth quadrant, then $(b, -a)$ lies in the
(a) first quadrant
(b) third quadrant
(c) fourth quadrant
(d) second quadrant
(e) first and second quadrants

29. The x- and y-intercepts of $y = \begin{cases} 2x - 3 & if \quad x \leq 2 \\ 12 - 3x & if \quad x > 2 \end{cases}$ are
(a) x-intercept $= -4$ and y-intercept $= -3$
(b) x-intercept $= \frac{3}{2}, 4$ and y-intercept $= -3$
(c) x-intercept $= 0$ and y-intercept $= 0$
(d) x-intercept $= \frac{3}{2}$ and y-intercept $= 12$
(e) x-intercept $= \frac{3}{2}$ and y-intercept $= 12, -3$

30. The graph of $y = \begin{cases} 3 - 2x & if \quad x \leq 1 \\ x - 2 & if \quad x > 1 \end{cases}$ has
(a) x-intercept $= 2$ and y-intercept $= 3$
(b) x-intercept $= \frac{3}{2}, 2$ and y-intercept $= -2, 3$
(c) x-intercept $= -2$ and y-intercept $= -3$
(d) x-intercept $= \frac{3}{2}$ and y-intercept $= -2$
(e) no x- or y-intercepts

31. If $f(x) = \begin{cases} 4x^2 & if \quad x \leq 0 \\ 2x + 1 & if \quad 0 < x < 2 \\ |x - 2| & if \quad x \geq 2 \end{cases}$, then $f(-1) + f(1) + f(5)$
(a) 10
(b) 4
(c) 6
(d) 18
(e) 14

32. The slope of the line passing through $(2, 3)$ and $(-4, r)$ is equal to $\frac{1}{2}$, then r is equal to
(a) 3
(b) 0
(c) 1
(d) 2
(e) 4

33. Which one of the following statements is TRUE ?
(a) If a line goes down from left to right, then its slope is negative
(b) A horizontal line has no slope
(c) A vertical line has zero slope
(d) The slope of $x = my + b$ is m
(e) The slope of the line joining (x_1, y_1) and (x_2, y_2) is $\frac{y_2 - y_1}{x_2 - x_1}$ for all values of x_1, x_2, y_1, y_2

34. If $(-2, 20)$ is the midpoint of the line segment joining (a, b) and $\left(-\frac{a}{2}, \frac{2b}{3}\right)$, then a, and b are
(a) $-4, 12$
(b) $-8, 24$
(c) $-\frac{8}{3}, 12$
(d) $-8, 12$
(e) $-\frac{8}{3}, 24$

35. If $(4,6)$ is the midpoint of the line segment joining $\left(\frac{x}{2}, y\right)$ and $\left(\frac{3x}{2}, \frac{y}{2}\right)$, then x and y are
   (a) $8, 4$
   (b) $4, 8$
   (c) $8, -24$
   (d) $4, -24$
   (e) $8, -4$

36. If $(-2, 8)$ is the midpoint of the line segment joining (a, b) and $\left(-\frac{a}{2}, \frac{b}{3}\right)$, then $a + b$ is
   (a) 16
   (b) $\frac{10}{3}$
   (c) 12
   (d) 4
   (e) 8

37. If (x, y) is equidistant from $(1, 1)$ and $(3, 3)$, then $x + y$ is
   (a) 3
   (b) 1
   (c) 4
   (d) 0
   (e) 2

38. If $f(x) = [2x - 1]$, where $[]$ is the greatest integer function, then $f(x) = 0$ when
   (a) $0 \leq x < \frac{1}{2}$
   (b) $0 < x \leq \frac{1}{2}$
   (c) $0 \leq x < 1$
   (d) $\frac{1}{2} \leq x < 1$
   (e) $\frac{1}{2} < x \leq 1$

39. If $f(x) = [1 - 2x]$, where $[]$ is the greatest integer function, then $f(x) = 1$ when
   (a) $0 \leq x < \frac{1}{2}$
   (b) $-\frac{1}{2} < x \leq 0$
   (c) $-\frac{1}{2} \leq x < 0$
   (d) $-1 < x \leq 1$
   (e) $\frac{1}{2} < x \leq 1$

40. If $f(x) = [3x - 2]$, where $[]$ is the greatest integer function, then the x- and y-intercepts are
   (a) $\frac{3}{2} \leq x < 2,\ y = 2$
   (b) $\frac{1}{3} \leq x \leq \frac{2}{3},\ y = 2$
   (c) $-\frac{2}{3} < x \leq 1,\ y = -2$
   (d) $\frac{2}{3} \leq x < 1,\ y = -2$
   (e) $\frac{1}{3} < x \leq \frac{2}{3},\ y = 2$

41. If $f(x) = [x] + 1$, then the part of the graph which lies on the x-axis is
   (a) $[-1, 0)$
   (b) $(-1, 0)$
   (c) $[-1, 1)$
   (d) $(-1, 1)$
   (e) $[0, 1)$

42. Given $f(x) = \begin{cases} 2x + 1 & if \quad x < 2 \\ [2x + 1] & if \quad x \geq 2 \end{cases}$, where $[]$ is the greatest integer function, then $f(-4) + f\left(\frac{7}{3}\right)$ is equal to
   (a) -2
   (b) $\frac{29}{3}$
   (c) -3
   (d) -9
   (e) $-\frac{4}{3}$

43. Given $f(x) = \begin{cases} \sqrt{(1 - 5x)^2} & if \quad x < 2 \\ [2x + 1] & if \quad x \geq 2 \end{cases}$, where $[]$ is the greatest integer function, then $f(\pi) + f(1)$ is equal to
   (a) 11
   (b) $5\pi + 2$
   (c) -4
   (d) 7
   (e) $2\pi + 5$

44. Let $f(x) = [x]$ be the greatest integer function. Then the value of $\frac{f(x+h) - f(x)}{h}$ when $x = 1.5$ and $h = 0.5$ is equal to
   (a) 0
   (b) 2
   (c) 4
   (d) -6
   (e) 1

45. Let $f(x) = [x]$ be the greatest integer function. Then only one of the following statements is TRUE ?
   (a) $y = [x]$ is not a function by the vertical line test
   (b) $[\pi - 1] = 3$
   (c) $[x] = -3$ if $-4 \leq x < -3$
   (d) the range of $y = [x - 1]$ is the set of all integers
   (e) the domain of $y = [x - 1]$ is the set of all integers

12. THE ALGEBRA OF FUNCTIONS

1. If $f(x) = \sqrt{2 - x}$ and $g(x) = \sqrt{x + 3}$, then the domain of $\left(\frac{f}{g}\right)(x)$ is

(a) $[-2,3)$
(b) $(-3,\infty)$
(c) $(-3,2]$
(d) $(-\infty,-3]\cup[2,\infty)$
(e) $(-\infty,-2]\cup(3,\infty)$

2. If $f(x)=\sqrt{16+\sqrt{x}}$, then $(f\circ f)(0)$ is equal to
(a) 9
(b) $2\sqrt{3}$
(c) $3\sqrt{2}$
(d) 8
(e) 4

3. If $f(x)=\begin{cases} 2x-1 & if \quad x\le -1 \\ 2x+3 & if \quad x>-1 \end{cases}$, and $g(x)=[x]$, where $[]$ is the greatest integer function, then $(f\circ g)(-0.3)+\sqrt{(f\cdot g)(0.5)}$ is equal to
(a) -2
(b) -4
(c) -1
(d) -3
(e) 1

4. Let $f(x)=x^2-12x+36$ and $g(x)=\sqrt{-x}$, then $(g\circ f)(x)$ is
(a) equal to zero
(b) undefined
(c) equal to $|x-6|$ for all x in the domain of f
(d) equal to $(x-6)$ for all x in the domain of f
(e) equal to $-(x-6)$ for all x in the domain of f

5. If $f(x)=2x-1$ and $(f\circ g)(x)=2x+1$, then $g(x)$ is equal to
(a) -2
(b) $2x+2$
(c) 2
(d) $x+2$
(e) $x+1$

6. If $f(x)=3x^2-2$ and $g(x)=x^2-3x+4$, then $\sqrt{\left(\frac{f}{g}\right)(3)}$ is equal to
(a) 25
(b) $\frac{25}{4}$
(c) undefined
(d) $\frac{5}{2}$
(e) 4

7. If $g(x)=1-x^3$ and $(g\circ f)(x)=1-2x-x^2$, then $f(2)$ is equal to
(a) 3
(b) -2
(c) 2
(d) 1
(e) -5

8. Let $f(x)=|x|$, and $g(x)=[x]$, where $[]$ is the greatest integer function, then which one of the following is FALSE ?
(a) $(f\circ g)\left(-\frac{1}{2}\right)=0$
(b) $(g\circ f)(-3.2)=3$
(c) $(g\circ f)(x)\ge 0$
(d) $g(x)=-2$ if $-2\le x<-1$
(e) $(f\circ g)\left(n^2\right)=n^2$ for any positive integer n

9. If $f(x)=\frac{x-1}{3-x}$ and $g(x)=\sqrt{x+2}$, then the domain of $(f\circ g)(x)$ is
(a) $[-2,7)\cup(7,\infty)$
(b) $(3,\infty)$
(c) $[-2,\infty)$
(d) $[-2,3)$
(e) $[-2,3)\cup(3,\infty)$

10. Let $f(x)=x^2-2x$ and $g(x)=\frac{1}{x+3}$. If $(f\circ g)(k)=0$, then k is equal to
(a) $-\frac{2}{5}$
(b) 2
(c) $-\frac{1}{2}$
(d) -2
(e) $-\frac{5}{2}$

11. If $f(x)=x^3$ and $g(x)=|x-1|$, then $\left(\frac{f}{g}\right)(\sqrt{2})$ is equal to
(a) $2+2\sqrt{2}$
(b) $4+2\sqrt{2}$
(c) $2+\sqrt{2}$
(d) $4-2\sqrt{2}$
(e) $2\sqrt{2}-2$

12. If $(f\circ g)(x)=10-x$, and $f(x)=2x+4$ and $g(x)=ax+b$, where a,b are real numbers, then a,b are equal to
(a) $-\frac{1}{2},3$
(b) $-\frac{1}{2},7$
(c) $-2,3$
(d) $\frac{1}{2},-3$
(e) $-1,10$

13. If $f(x)=\sqrt{x+3}$ and $g(x)=\frac{\sqrt{25-x^2}}{x+1}$, then the domain of $\left(\frac{f}{g}\right)(x)$ is
(a) $(-5,5)$

(b) $(-3, 5)$
(c) $[-3, -1) \cup (-1, 5)$
(d) $(-1, 5)$
(e) $(-5, -3] \cup (-1, 5)$

14. The domain of $(g \circ f)(x)$, where $f(x) = \frac{2}{x}$ and $g(x) = \sqrt{x-3}$ is
(a) $\left(0, \frac{2}{3}\right]$
(b) $(-\infty, 0) \cup \left[\frac{2}{3}, \infty\right)$
(c) $(-\infty, \infty)$
(d) $(-\infty, 0) \cup (0, \infty)$
(e) $\left[0, \frac{2}{3}\right]$

15. If $f(x) = \sqrt{x}$ and $g(x) = x^2 - 1$, then the domain of $(f \circ g)(x)$ is
(a) $[0, \infty)$
(b) $[-1, 0) \cup (0, 1]$
(c) $(-\infty, -1] \cup [1, \infty)$
(d) $(-\infty, \infty)$
(e) $[-1, \infty)$

16. Given that $(g \circ f)(k) = 1$, where $f(x) = x + 1$ and $g(x) = 2 - x^2$, then the set of all possible values of k is equal to
(a) $\{-2, 0\}$
(b) $\{-2, -1, 0, 1, 2\}$
(c) $\{0\}$
(d) $\{-2, 0, 2\}$
(e) $\{0, 2\}$

17. If $f(x) = 2x - 1$ and $g(x) = x^3 - 3x$, then $(g \circ f)(x)$ is
(a) $8x^3 - 12x^2 + 2$
(b) $2x^3 - 6x - 1$
(c) $8x^3 - 16x^2 - 6x + 3$
(d) $2x^3 - 12x^2 + 2$
(e) $8x^3 - 12x^2 + 6x + 1$

18. Let $[x]$ denote the greatest integer function and let $f(x) = \begin{cases} \frac{1}{5}([x] - 1) & if \quad x \le -1 \\ 1 - [x] & if \quad x > -1 \end{cases}$, then the value of $(f \circ f)\left(-\frac{3}{2}\right)$ is equal to
(a) 0.2
(b) 0.36
(c) 2
(d) -0.2
(e) 0

13. LINEAR FUNCTIONS

1. The equation of the line passing through the points (k, k) and $(k+1, k)$ is
(a) $y = x + k$
(b) $x = k + 1$
(c) $y = k + 1$
(d) $y = k$
(e) $x = k$

2. The equation of the line whose x-intercept is -1 and which is perpendicular to the line $2x - 3y = 5$ is
(a) $2x + 3y + 2 = 0$
(b) $3x + 2y + 2 = 0$
(c) $3x + 2y + 3 = 0$
(d) $2x - 3y + 2 = 0$
(e) $3x + 2y - 3 = 0$

3. Let f be a linear function such that $f(9) = 0$ and the graph of f is parallel to the line $x - 3y - 4 = 0$, then $f(3)$ is equal to
(a) -18
(b) 18
(c) -2
(d) 10
(e) $-\frac{1}{3}$

4. The equation of the perpendicular bisector to the line segment containing $(3, -1)$ and $(-1, 5)$ is
(a) $3x - 2y + 4 = 0$
(b) $3x + 2y - 7 = 0$
(c) $2x - 3y + 4 = 0$
(d) $2x + 3y - 4 = 0$
(e) $3x + 2y + 9 = 0$

5. If the lines $ky + 2 = -5x$ and $2x + 4y = 5$ are perpendicular, then k is equal to
(a) $-\frac{2}{5}$
(b) $-\frac{5}{2}$
(c) -2
(d) $\frac{2}{5}$
(e) $-\frac{1}{5}$

6. The line with x-intercept equal to -2 and y-intercept equal to 3 is parallel to the line
(a) $6x - 4y = 3$
(b) $3y - 2x = 1$
(c) $y = \frac{2}{3}x + 1$
(d) $6x + 4y = 1$
(e) $3x + 2y = 4$

7. The value of k so that the line through the points $(4,-1)$ and $(k,2)$ is perpendicular to the line $2y-5x=1$ is equal to
   (a) -7
   (b) $-\frac{7}{2}$
   (c) $\frac{14}{5}$
   (d) $\frac{26}{5}$
   (e) $\frac{7}{2}$

8. The equation of the line passing through $(1,6)$ and perpendicular to the line $3x+5y=1$ is
   (a) $2x-3y=-16$
   (b) $x+6y=37$
   (c) $x-\frac{3}{5}y=\frac{1}{5}$
   (d) $5x-3y=-13$
   (e) $\frac{3}{5}x+\frac{3}{5}y=\frac{1}{5}$

9. The x-intercept and the y-intercept of the line passing through $(-2,-1)$ and $(1,3)$ are
   (a) $-\frac{7}{2},-\frac{7}{3}$
   (b) $-\frac{5}{4},\frac{5}{3}$
   (c) $0,0$
   (d) $-3,\frac{9}{4}$
   (e) $-2,\frac{4}{3}$

10. If the line $\frac{1}{2}kx+3y-7=0$ is perpendicular to the line passing through $\left(1,-\frac{1}{2}\right)$ and $(-2,-5)$, then k is equal to
    (a) 4
    (b) -1
    (c) $-\frac{3}{2}$
    (d) $\frac{3}{4}$
    (e) $\frac{1}{2}$

11. If $a,b,c,$ and d are nonzero real numbers such that the line $ax+y=b$ is perpendicular to the line $cx+y=d$, then
    (a) $ac=1$
    (b) $0<ac<1$
    (c) $ac>1$
    (d) $ac>-1$
    (e) $ac=-1$

12. The y-intercept of the line passing through $(2,-5)$ and perpendicular to the line $3x+2y=5$ is
    (a) $\frac{11}{3}$
    (b) -2
    (c) $\frac{19}{3}$
    (d) $-\frac{19}{3}$
    (e) $-\frac{11}{3}$

13. If the line $3x-y=5$ is perpendicular to the line $ax-by=2b$, then
    (a) $ab=-\frac{1}{3}$
    (b) $3a=-b$
    (c) $3a=b$
    (d) $a=3b$
    (e) $a=-3b$

14. If $f(5)=-2$, $f(1)=0$, and f is a linear function, then $f(-4)$ is equal to
    (a) 3
    (b) $\frac{3}{2}$
    (c) $-\frac{5}{2}$
    (d) $\frac{5}{2}$
    (e) $-\frac{3}{2}$

15. The x-intercept of the line passing through $(-1,1)$ and perpendicular to $8x+3y=4$ is equal to
    (a) $-\frac{11}{3}$
    (b) $-\frac{5}{8}$
    (c) $-\frac{11}{8}$
    (d) $\frac{11}{8}$
    (e) $\frac{11}{3}$

16. The equation of the line whose x-intercept is $\frac{4}{5}$ and parallel to $y=-2x+3$ is
    (a) $5y+10x-8=0$
    (b) $y+2x+10=0$
    (c) $5y-10x-4=0$
    (d) $5y-10x-8=0$
    (e) $y-2x+10=0$

17. The equation of the vertical line through $(-2,3)$ is
    (a) $y=-2$
    (b) $x=3$
    (c) $y=3$
    (d) $-2x+3y=0$
    (e) $x+2=0$

18. The equation of the horizontal line through $\left(\sqrt{2},-\sqrt{3}\right)$ is
    (a) $x=-\sqrt{3}$
    (b) $x=\sqrt{2}$
    (c) $y=\sqrt{2}$
    (d) $\sqrt{2}x-\sqrt{3}y=0$
    (e) $y=-\sqrt{3}$

14. QUADRATIC FUNCTIONS

1. The largest possible value of $\sqrt{-3x^2 - 2x + 1}$ is equal to
   (a) $\frac{4}{\sqrt{3}}$
   (b) $\frac{3}{2}$
   (c) $\frac{4}{3}$
   (d) $\frac{\sqrt{3}}{4}$
   (e) $\frac{2}{\sqrt{3}}$

2. If the line $2x + 3y = 2$ passes through the vertex of the parabola $y = -2x^2 + 4x + c$, then c is equal to
   (a) $-\frac{1}{2}$
   (b) -3
   (c) $-\frac{1}{3}$
   (d) -1
   (e) -2

3. The midpoint between the point $(1, 2)$ and the vertex of the parabola $y = -4x^2 + 8x - 6$ is
   (a) $(0, 1)$
   (b) $(1, 2)$
   (c) $(1, 0)$
   (d) $(2, 1)$
   (e) $(0, 0)$

4. If $f(x) = -x^2 - 16$, then f is decreasing on the interval
   (a) $(-\infty, 0]$
   (b) $[-4, \infty)$
   (c) $[-16, 0)$
   (d) $[0, \infty)$
   (e) $[-16, \infty)$

5. If one of the x-intercepts of an open downward parabola with vertex at $(-1, 8)$ is equal to -3, then the other x-intercept is equal to
   (a) 3
   (b) 2
   (c) 0
   (d) 1
   (e) $-\frac{1}{2}$

6. The maximum value of $(3 - 2x)(x + 2)$ is equal to
   (a) 15
   (b) $\frac{5}{8}$
   (c) $\frac{49}{8}$
   (d) -16
   (e) $\frac{63}{8}$

7. The interval where $f(x) = -2x^2 - 5x + 3$ increases is
   (a) $\left[-\frac{5}{4}, \infty\right)$
   (b) $\left[-\frac{49}{16}, \infty\right)$
   (c) $\left[-\frac{5}{4}, 0\right)$
   (d) $\left(-\infty, -\frac{49}{16}\right)$
   (e) $\left(-\infty, -\frac{5}{4}\right]$

8. The parabola $y = -2x^2 + 2x - 1$
   (a) opens to the left and has a vertex at $\left(\frac{1}{2}, -\frac{1}{2}\right)$
   (b) opens to the left and has a vertex at $\left(-\frac{1}{2}, \frac{1}{2}\right)$
   (c) opens downward and has a vertex at $\left(-\frac{1}{2}, \frac{1}{2}\right)$
   (d) opens downward and has a vertex at $\left(\frac{1}{2}, -\frac{1}{2}\right)$
   (e) opens downward and has a vertex at $(1, -1)$

9. If the slope of the line passing through $(2, -3)$ and the vertex of the parabola $y = (x + m)^2 - 5$ is $\frac{3}{m}$, then m is
   (a) -5
   (b) -4
   (c) -3
   (d) undefined
   (e) -6

10. Given the function $f(x) = x^2 + 4x + 2$ with domain $[-3, 0]$, then the minimum and maximum values of $f(x)$ are respectively
    (a) -2 and no maximum value
    (b) $-6, 12$
    (c) $-1, 1$
    (d) no minimum value , 2
    (e) $-2, 2$

11. If the equation of a parabola is $y - 2 = -2(x + 3)^2$, then which one of the following is TRUE ?
    (a) The vertex is $(3, -2)$ and the parabola opens downward
    (b) The vertex is $(-3, 2)$ and the parabola is symmetric about $x = 2$
    (c) The vertex is $(3, -2)$ and the parabola is symmetric about $x = -3$
    (d) The parabola opens upward and is symmetric about $x = -3$
    (e) The vertex is $(-3, 2)$ and the parabola opens downward

12. If $x = 3$ is the axis of symmetry of the parabola $f(x) = -x^2 + 2cx + c^2 + 4$ for some constant c, then the maximum value of $f(x)$ is equal to
    (a) 13
    (b) 22

(c) 3
(d) 6
(e) 18

13. If the sum of two numbers is 106 and their product is maximum, then the difference of these numbers is
   (a) 2
   (b) 0
   (c) 10
   (d) 14
   (e) 53

15. THE PARABOLA AND THE CIRCLE

1. The center C and the radius R of the circle $2x^2+2y^2-12x+8y+18=0$ are given by
   (a) $C=(-6,4)\,, R=4$
   (b) $C=(-3,2)\,, R=2$
   (c) $C=(2,-3)\,, R=2$
   (d) $C=(-3,-2)\,, R=2$
   (e) $C=(3,-2)\,, R=2$

2. The center C and the radius R of the circle $2x^2-12x+2y^2+16y-22=0$ are given by
   (a) $C=(-3,4)\,, R=6$
   (b) $C=(-3,4)\,, R=\sqrt{14}$
   (c) $C=(6,-8)\,, R=\sqrt{21}$
   (d) $C=\left(-\frac{3}{2},2\right), R=6$
   (e) $C=(3,-4)\,, R=6$

3. The center C and the radius R of the circle $\frac{1}{2}x^2+3x+\frac{1}{2}y^2+4y+\frac{9}{2}=0$ are given by
   (a) $C=(3,4)\,, R=4$
   (b) $C=(-3,-4)\,, R=16$
   (c) $C=(-3,-4)\,, R=4$
   (d) $C=\left(-\frac{3}{2},-2\right), R=4$
   (e) $C=\left(-\frac{3}{2},-2\right), R=16$

4. If the points $(0,-5)$ and (a,b) are the endpoints of a diameter of the circle $(x-1)^2+(y+2)^2=10$, then the expression $4a-5b$ is equal to
   (a) 4
   (b) 5
   (c) 0
   (d) 3
   (e) -5

5. The equation of the circle that has the points $(2,4)$ and $(-4,6)$ as the endpoints of a diameter is
   (a) $(x-1)^2+(y+5)^2=10$
   (b) $(x+1)^2+(y-5)^2=10$
   (c) $(x-3)^2+(y-1)^2=10$
   (d) $(x+1)^2+(y-5)^2=90$
   (e) $(x+3)^2+(y+1)^2=10$

6. The equation of the circle that has the points $(-2,0)$ and $(-4,-2)$ as the endpoints of a diameter is
   (a) $(x-3)^2+(y+1)^2=\sqrt{10}$
   (b) $(x+3)^2+(y+1)^2=4$
   (c) $(x+3)^2+(y-1)^2=2\sqrt{10}$
   (d) $(x+3)^2+(y+1)^2=2$
   (e) $(x-3)^2+(y-1)^2=2$

7. The equation of the circle which is tangent to the x-axis at the point $(-4,0)$ and of radius 3 and whose center lies in the second quadrant, is given by
   (a) $(x-4)^2+(y-3)^2=9$
   (b) $(x+1)^2+(y+3)^2=9$
   (c) $(x-4)^2+(y+3)^2=9$
   (d) $(x+4)^2+(y-3)^2=9$
   (e) $(x+1)^2+(y-3)^2=9$

8. The equation of the circle whose center is $(-1,1)$ and which passes through the point $\left(\sqrt{3},\sqrt{3}\right)$ is
   (a) $x^2-x+y^2+y=6$
   (b) $x^2-2x+y^2+2y=6$
   (c) $x^2+2x+y^2-2y=6$
   (d) $x^2+x+y^2-y=6$
   (e) $x^2+2x+y^2-2y=8$

9. Let $a\neq 0$. Which of the following statements is TRUE about the circle $x^2+y^2+2a(x+y)+a^2=0$
   (a) The circle touches both the x- and the y-axes
   (b) The circle touches the y-axis only
   (c) The circle touches the x-axis only
   (d) The circle passes through the point $(a,-a)$
   (e) The circle passes through the origin

10. The equation $2x^2-8x+2y^2+26=0$ represents
   (a) a circle
   (b) a point
   (c) no graph
   (d) a straight line
   (e) a parabola

11. The equation $x^2-8x+y^2+10y=-41$ represents

(a) a circle with center $(4,-5)$ and radius $\sqrt{41}$
(b) a parabola with vertex $(4,-5)$
(c) a circle with center $(4,-5)$ and radius 41
(d) the point $(4,-5)$
(e) a circle with center $(-5,4)$ and radius $\sqrt{41}$

12. If the point $(3,B)$ lies on the circle $x^2-2x+y^2+6y+5=0$, then B is equal to
(a) $\{4,2\}$
(b) $\{-4\}$
(c) $\{-4,-2\}$
(d) $\{-2\}$
(e) $\emptyset$

13. If the point $(1,a)$ lies on the circle $x^2+2x+y^2-6y+6=0$, then a is equal to
(a) 6
(b) 9
(c) ± 9
(d) ± 6
(e) 3

14. Given the points $P\,(7,-4)$, $Q\,(0,9)$ and the circle with center $(1,-4)$ and radius 6 . Which one of the following statements is TRUE ?
(a) P is outside the circle
(b) Q is outside the circle
(c) Q is on the circle
(d) P is inside the circle
(e) Q is inside the circle

15. Which one of the following is outside the circle $x^2-2x+y^2+8y-19=0$?
(a) $(-1,-2)$
(b) $(2,-4)$
(c) $(0,1)$
(d) $(9,1)$
(e) $(3,-2)$

16. Which one of the following is inside the circle $x^2+2x+y^2-6y+6=0$?
(a) $(0,5)$
(b) $(-1,1)$
(c) $\left(-\frac{1}{2},1\right)$
(d) $\left(-\frac{3}{2},2\right)$
(e) $(-3,3)$

17. The graph of $y=-\sqrt{4-x^2}$ is
(a) the left half of the circle with radius 2 and center $(0,0)$
(b) the lower half of the circle with radius 4 and center $(0,0)$
(c) the right half of the parabola with vertex $(0,0)$
(d) the lower half of the circle with radius 2 and center $(0,0)$
(e) the left half of parabola with vertex $(0,0)$

18. Let M be the midpoint of the line whose endpoints are at $(1,-2)$ and $(-3,6)$, and let C be the center of the circle $x^2+4x+y^2-8y+2=0$. Then, the distance between M and C is equal to
(a) $\sqrt{37}$
(b) $\sqrt{13}$
(c) $\sqrt{5}$
(d) $3\sqrt{5}$
(e) 9

19. If the distance between the point (x,y) and the midpoint of the line segment with endpoints $(-1,5)$ and $(-3,1)$ is equal to 2 , then the coordinates (x,y) satisfy the equation
(a) $x^2-6x+y^2+4y+9=0$
(b) $x^2+4x+y^2+6y+4=0$
(c) $x^2+4x+y^2-6y+9=0$
(d) $x^2-4x+y^2+6y+9=0$
(e) $x^2+6x+y^2-4y+9=0$

20. The points (x,y) with $y=-x$ that are 4 units from the point $(1,3)$ are
(a) $(3,-3),(-1,1)$
(b) $(3,-3),(-2,2)$
(c) $(-3,3),(1,-1)$
(d) $(-3,3),(2,-2)$
(e) $(2,-2),(1,-1)$

21. If the distance between the points $A\,(1,3)$ and $B\,(x,2x)$ is $\sqrt{2}$, then x is equal to
(a) $\frac{8}{5}$ or 1
(b) $-\frac{4}{5}$ or 2
(c) $\frac{2}{5}$ or 4
(d) $\frac{4}{5}$ or 2
(e) $\frac{4}{5}$ or -2

22. The shortest distance between the line $y=1$ and the vertex of the parabola $y=x^2-4x+7$ is
(a) 3
(b) 4
(c) 7
(d) 1
(e) 2

23. The sum of the x-coordinates of all points (x,y) sat-

isfying $x + y = 0$ and are at a distance 8 units from the point $(-2, 3)$ is

(a) -5
(b) -1
(c) 2
(d) 5
(e) $-\frac{5}{2}$

24. The points $A\,(3, -5)$, $B\,(0, 7)$, and $C\,(-2, 15)$
(a) lie on a circle
(b) are vertices of a right triangle
(c) lie on a straight line
(d) lie on a line segment with endpoints A and B and midpoint C
(e) are vertices of an isosceles triangle

25. The distance from the center of the circle $x^2+2x+y^2-2y-3 = 0$ to the vertex of the parabola $y = -3x^2 - 6x + 1$ is equal to
(a) $\sqrt{13}$
(b) $\sqrt{29}$
(c) $\sqrt{5}$
(d) 3
(e) $\sqrt{3}$

26. The distance between the point $(1, 2)$ and the vertex of the parabola $y = -4x^2 + 8x - 6$ is
(a) 3
(b) 0
(c) 2
(d) 16
(e) 4

27. The distance from the origin to the vertex of the parabola $y = -3x^2 - 6x + 1$ is
(a) $\sqrt{5}$
(b) $\sqrt{3}$
(c) 17
(d) $\sqrt{15}$
(e) $\sqrt{17}$

28. If the point $(1, 4)$ is 5 units from the midpoint of the line segment joining $(3, -2)$ and $(x, 4)$, then x is equal to
(a) either 7 or -9
(b) -15
(c) either $4 + 3\sqrt{11}$ or $4 - 3\sqrt{11}$
(d) either -7 or 9
(e) 15

29. The shortest distance between the point $(1, 1)$ and the line $y = x + 1$ is
(a) $\frac{1}{2}$
(b) 2
(c) 1
(d) $\sqrt{2}$
(e) $\frac{\sqrt{2}}{2}$

16. SYMMETRY AND TRANSLATIONS

1. The graph of the equation $|xy| + |x|\,y = 1$ is symmetric with respect to
(a) both the x- and y-axes
(b) the x-axis only
(c) the y-axis only
(d) the origin only
(e) both the x-axis and the origin

2. The graph of the function $|y| = \frac{|x+2|}{x^2}$ is symmetric with respect to
(a) the x-axis only
(b) the y-axis and the origin
(c) the y-axis only
(d) the origin only
(e) both the x- and y-axes

3. The graph of the function $|x| = |x - y|$ is symmetric with respect to
(a) the x-axis only
(b) the y-axis only
(c) the origin only
(d) the x- and y-axes
(e) the x-axis and the origin

4. The graph of the function $y = (x + 2)^3 + 4$ is symmetric with respect to
(a) the point $(-2, -4)$
(b) the line $x = -2$
(c) the x-axis
(d) the point $(-2, 4)$
(e) the point $(0, 0)$

5. Which one of the following statements is TRUE ?
(a) $f\,(x) = x\,|x|$ is an odd function
(b) $f\,(x) = 5$ is an odd function
(c) $f\,(x) = x\,|x|$ is an even function
(d) $f\,(x) = 5$ is neither odd nor even
(e) $y = x^3$ is an even function

6. Which one of the following graphs of the equations is symmetric with respect to the origin but not with respect to the x- and y-axes ?
   (a) $y = x^2$
   (b) $4x^2 + 9y^2 = 36$
   (c) $y = |x|$
   (d) $y = x^3 + x^2$
   (e) $xy = 3$

7. The graph of the equation $x^2 = |x - y|$ is symmetric with respect to
   (a) the x-axis only
   (b) the y-axis only
   (c) the y-axis and the origin
   (d) the origin only
   (e) the x-axis, the y-axis, and the origin

8. The graph of the equation $y^2 = |x + 1| - 3x^2$ is symmetric with respect to
   (a) the y-axis only
   (b) the origin only
   (c) the x-axis and the origin
   (d) the origin and the y-axis
   (e) the x-axis only

9. Which one of the following statements is TRUE ?
   (a) $y^2 = |y - x|$ is symmetric with respect to the y-axis
   (b) $|xy| + x|y| = 1$ is symmetric with respect to the y-axis
   (c) $(xy)^2 - 2xy = 3$ is symmetric with respect to the origin
   (d) $f(x) = \frac{x^4}{x^5 - x}$ is an even function
   (e) $|y + 2| = x^4 - x^2 + 2$ is symmetric with respect to the x-axis

10. Let $f(x)$ be any nonzero function, then $g(x) = \frac{1}{2}[f(x) + f(-x)]$ is
   (a) odd
   (b) neither odd nor even
   (c) both even and odd
   (d) constant
   (e) even

11. The graph of the equation $y = |x + 3| - 2$ may be obtained from the graph of $y = |x - 1| + 3$ by the following translations:
   (a) Three units to the left and two units down
   (b) Two units to the left and one unit down
   (c) Three units to the right and five units down
   (d) Four units to the right and two units down
   (e) Four units to the left and five units down

12. The graph of the equation $y^2 - 2y - 4x - 7 = 0$ may be obtained from the graph of $y^2 = 4x$ by means of the following translations:
   (a) One unit to the left and two units up
   (b) Two units to the right and one unit up
   (c) Two units to the left and one unit up
   (d) One unit to the left and one unit up
   (e) One unit to the right and two units down

13. The graph of the equation $(x + 1)^2 + (y - 2)^3 = 4$ may be obtained from the graph of $x^2 + y^3 = 4$ by means of the following translations:
   (a) Two units to the left and one unit up
   (b) Two units to the right and one unit down
   (c) One unit to the right and two units up
   (d) One unit to the right and two units down
   (e) One unit to the left and two units up

14. If the graph of the equation $x = y^2 + y$ is shifted one unit to the left and two units upward, then the equation of the new graph is
   (a) $x = y^2 - 3y + 3$
   (b) $x = y^2 - 3y + 1$
   (c) $x = y^2 + 5y + 5$
   (d) $x = y^2 + 2y + 7$
   (e) $x = y^2 + y$

15. If the graph of $y = \frac{x+2}{x-1}$ is translated one unit to the right and three units downward, then the equation of the new graph is
   (a) $y = \frac{3-2x}{x}$
   (b) $y = \frac{2x-1}{x+2}$
   (c) $y = \frac{4x+3}{x-2}$
   (d) $y = \frac{2x-3}{x-2}$
   (e) $y = \frac{7-2x}{x-2}$

16. By translating the graph of the equation $(x + 1)^2 + (y - 2)^3 = 1$ two units to the right and two units downward, the equation of the new graph is
   (a) $(x + 3)^2 + (y - 4)^3 = 1$
   (b) $x^2 - 2x + y^3 = 0$
   (c) $(x - 1)^2 + (y - 4)^3 = 1$
   (d) $x^2 + y^3 = 2$
   (e) $(x + 1)^2 + (y - 2)^3 = 5$

17. If the graph of $y = x^2 + x$ is shifted two units to the right and one unit upward, then the equation of the new graph is

(a) $y = x^2 - 3x + 1$
(b) $y = x^2 + 5x + 5$
(c) $y = x^2 + 2x + 7$
(d) $y = x^2 - 3x + 3$
(e) $y = x^2 + x$

18. The graph of the equation $5x = y^2 + 4y + 14$ can be obtained by translating the graph of the equation $5x = y^2$

(a) One unit to the left and two units up
(b) Two units to the left and one unit up
(c) One unit to the left and two units up
(d) Two units to the left and one unit up
(e) Two units to the right and two units down

19. The graph of the function $f(x) = 2x^2 + 12x - 7$ may be obtained from the graph of $g(x) = 2x^2$ by means of the following translations:

(a) Three units to the right and twenty five units down
(b) Three units to the left and twenty five units up
(c) Twenty five units to the left and three units up
(d) Twenty five units to the right and three units up
(e) Three units to the left and twenty five units down

20. The graph of the equation $|x| = -y + 2$ may be obtained from the graph of $y = |x|$ by

(a) reflecting about the y-axis and translating vertically 2 units downward
(b) reflecting about the y-axis and translating vertically 2 units upward
(c) translating vertically 2 units upward only
(d) translating horizontally 2 units to the right
(e) reflecting about the x-axis and translating vertically 2 units upward

21. If the graph of the equation $Ax^2 + By^2 + Cx + Dy + E = 0$ is obtained from $2x^2 - 3y^2 = 6$ by means of a horizontal translation of three units to the left and vertically three units upward, then $A + B + C + D + E$ is equal to

(a) 14
(b) 41
(c) -41
(d) 0
(e) -14

22. The graph of the function $g(x) = |3x + 6| + 2$ can be obtained from $f(x) = 3|x|$ by means of the following translations:

(a) One unit to the left and one unit up
(b) Six units to the left and two units up
(c) Two units to the left and two units up
(d) Three units to the right and two units down
(e) Three units to the left and two units up

23. Which one of the following is FALSE ?

(a) The product of an even function and an odd function is even
(b) If $f(x)$ is an even function and $g(x)$ is odd, then $(g \circ f)(x)$ is not odd
(c) If $f(x)$ is an odd function and $g(x)$ is odd, then $(f \circ g)(x)$ is odd
(d) $f(x) = |x|$ is even
(e) $f(x) = x^3$ is odd

17. THE ELLIPSE AND THE HYPERBOLA

1. The equation $9x^2 + 18x + 4y^2 - 16y + 25 = 0$ represents

(a) a parabola
(b) a point
(c) a circle
(d) an ellipse
(e) a straight line

2. The equation of the ellipse with center $(3, 1)$, minor axis of length 6 units, and a horizontal major axis of length 9 units is

(a) $\frac{4(x-3)^2}{8} - \frac{(y-1)^2}{9} = 1$
(b) $\frac{(x-3)^2}{9} + \frac{4(y-1)^2}{81} = 1$
(c) $\frac{4(x-3)^2}{81} + \frac{(y-1)^2}{9} = 1$
(d) $\frac{(x+3)^2}{8} + \frac{(y+1)^2}{36} = 1$
(e) $\frac{(x-3)^2}{81} + \frac{(y-1)^2}{36} = 1$

3. The lengths of the major and minor axes of the ellipse $4x^2 + 9y^2 - 36 = 0$ are

(a) $3, 2$
(b) $6, 2\sqrt{5}$
(c) $6, 4$
(d) $9, 4$
(e) $3, \sqrt{5}$

4. The lengths of the major and minor axes and the eccentricity of the ellipse $4(x-1)^2 + 9(y+1)^2 = 36$ are

(a) $6, 4, \frac{3}{2}$
(b) $6, 4, \frac{2}{3}$

(c) $9, 4, \frac{3\sqrt{5}}{5}$
(d) $6, 4, \frac{\sqrt{5}}{3}$
(e) $6, 2\sqrt{5}, \frac{3}{2}$

5. The graphs of the equations $x^2 + y^2 = 9$ and $x^2 - y^2 = 1$ intersect at
   (a) four points
   (b) no points
   (c) three points
   (d) two points
   (e) one point

6. The graphs of the equations $(x-1)^2 + y^2 = 4$ and $x^2 - y^2 = 1$ intersect at
   (a) three points
   (b) two points
   (c) four points
   (d) one point
   (e) no points

7. The equation $x^2 - 4x + 3y^2 + 6y + 7 = 0$ represents
   (a) a hyperbola
   (b) no graph
   (c) a point
   (d) a parabola
   (e) an ellipse

8. The graph of $(x+2)^2 = (x+y)^2$ is
   (a) an ellipse
   (b) two straight lines, one of which is vertical
   (c) a parabola
   (d) a hyperbola
   (e) two straight lines, one of which is horizontal

9. The equation of $x^2 - 6x + 4y^2 - 40y + 45 = 0$ is
   (a) an ellipse with center at $(-3, 5)$
   (b) an ellipse with major axis of length 64
   (c) a circle with center $(3, -5)$
   (d) a hyperbola with center $(3, -5)$
   (e) an ellipse with minor axis of length 8

10. A point moves so that its distance from the origin is always twice its distance from the point $(3, 0)$, then the graph described is
   (a) an ellipse
   (b) a hyperbola
   (c) a parabola
   (d) a circle
   (e) a straight line

11. The center and the vertices of the hyperbola $25(y+2)^2 - 9(x+3)^2 = 225$ are respectively
   (a) $(-3,-2), (-3,-4), (-3,4)$
   (b) $(-2,-3), (0,-3), (0,3)$
   (c) $(3,2), (2,2), (-8,2)$
   (d) $(-3,-2), (-5,0), (5,0)$
   (e) $(-3,-2), (-3,-5), (-3,1)$

12. The asymptotes of the hyperbola $4x^2 - 8x - 9y^2 + 36y - 68 = 0$ are
   (a) $3y - 2x + 8 = 0$ and $3y + 2x + 4 = 0$
   (b) $3y - 2x - 4 = 0$ and $3y + 2x - 8 = 0$
   (c) $2y - 3x - 1 = 0$ and $2y + 3x - 7 = 0$
   (d) $2y + 3x + 4 = 0$ and $2y - 3x + 7 = 0$
   (e) $3x - 2y - 4 = 0$ and $3x + 2y + 8 = 0$

13. The slopes of the asymptotes of the hyperbola with center $(1, -2)$, one focus at $(6, -2)$ and eccentricity $\frac{5}{3}$ are
   (a) $\pm\frac{16}{9}$
   (b) $\pm\frac{5}{3}$
   (c) $\pm\frac{3}{5}$
   (d) $\pm\frac{4}{5}$
   (e) $\pm\frac{4}{3}$

14. The foci of the hyperbola $\frac{9(x-1)^2}{64} - \frac{9(y-2)^2}{80} = 1$ are
   (a) $(-3,2), (5,2)$
   (b) $(-4,0), (4,0)$
   (c) $(1,-2), (1,6)$
   (d) $(-11,2), (13,2)$
   (e) $(-3,-6), (5,6)$

15. The graph of $x = -\frac{\sqrt{16-9y^2}}{2}$ is
   (a) half a hyperbola
   (b) a parabola
   (c) half an ellipse
   (d) two intersecting lines
   (e) a circle

18. INVERSE FUNCTIONS

1. If $f(x) = x^2$ with domain $(-\infty, 0]$, then $f^{-1}(x)$ is equal to
   (a) $-\sqrt{x}$
   (b) $\sqrt{x}$
   (c) x^2
   (d) $\frac{1}{x}$
   (e) $\frac{1}{x^2}$

2. If $f(x) = \sqrt{4 + \sqrt{x}}$ with domain $[0, \infty)$, then $f^{-1}(x)$ and its domain are equal to
   (a) $\left(x^2 - 4\right)^2$, $[2, \infty)$
   (b) $\sqrt{4 - \sqrt{x}}$, $[0, 16]$
   (c) $(x - 4)^2$, $[2, \infty)$
   (d) $(\sqrt{x} + 4)^2$, $[0, \infty)$
   (e) $\left(x^2 + 4\right)^2$, $[0, \infty)$

3. Which one of the following is a one-to-one function?
   (a) $f(x) = x^2 - 4$ on $[-1, \infty)$
   (b) $f(x) = |x - 3|$
   (c) $f(x) = (\sqrt{x} + 4)^2$
   (d) $f(x) = 7$
   (e) $f(x) = (\sqrt{x} - 4)^2$

4. Which one of the following is NOT one-to-one ?
   (a) $f(x) = -4x + 12$
   (b) $f(x) = x^2 - 4$ for $0 \le x < \infty$
   (c) $f(x) = \sqrt{4 - x^2}$ for $-2 \le x \le 0$
   (d) $f(x) = 5$
   (e) $f(x) = |x + 1|$ for $-\frac{1}{2} \le x \le \frac{1}{2}$

5. If $f^{-1}(x) = \frac{ax+b}{cx+d}$ is the inverse function of $f(x) = \frac{3x+1}{x-2}$, then $a + b + c + d$ is equal to
   (a) 1
   (b) 4
   (c) 3
   (d) $\frac{4}{3}$
   (e) $\frac{1}{3}$

6. If $f(x) = x^2 + 1$ with domain $(-\infty, 0]$, then
   (a) $f^{-1}(x)$ does not exist
   (b) $f^{-1}(x) = \sqrt{x - 1}$, where $x \ge 1$
   (c) $f^{-1}(x) = -\sqrt{x - 1}$, where $x \ge 1$
   (d) $f^{-1}(x) = \sqrt{1 - x}$, where $x \le 1$
   (e) $f^{-1}(x) = \pm\sqrt{x - 1}$, where $x \ge 1$

7. $f^{-1}(x)$ of the function $f(x) = \frac{2x}{x-2}$ is
   (a) $\frac{x-2}{2x}$
   (b) $-\frac{2x}{x+2}$
   (c) $\frac{x}{x+2}$
   (d) $\frac{2x}{x-4}$
   (e) $\frac{2x}{x-2}$

8. Let $f(x) = -x^2 - 3x + k$ and $f^{-1}(x)$ exists. If $f^{-1}(2) = 3$, then k is equal to
   (a) -20
   (b) 10
   (c) 20
   (d) 5
   (e) -10

9. If $f(x) = \sqrt[3]{2x - 3}$, then $f^{-1}(x)$ is
   (a) $2x^3 - 3$
   (b) $\frac{x^3+2}{3}$
   (c) $\frac{x^3+3}{2}$
   (d) $\frac{1}{\sqrt[3]{2x-3}}$
   (e) $-\sqrt[3]{2x - 3}$

10. Which one of the following is TRUE ?
   (a) If $f(x)$ is an even function, then $f^{-1}(x)$ exists
   (b) If $f(x)$ is an odd function, then $f^{-1}(x)$ exists
   (c) If $f^{-1}(x)$ exists, then $f(x)$ must be odd
   (d) It is possible to find a one-to-one function with $f(x) = f^{-1}(x)$
   (e) $f^{-1}(x) \cdot f(x) = 1$

11. If $f(x) = x^3 - 5$, then $f^{-1}(x)$ is
   (a) $\sqrt[3]{x - 5}$, where $x^3 - 5 \ge 0$
   (b) $\frac{1}{x^3-5}$ where $x^3 \ne 5$
   (c) $\sqrt[3]{x + 5}$ where x is any real number
   (d) $\sqrt[3]{x + 5}$ where $x \ge -5$
   (e) $\sqrt{x^3 + 5}$ where $x^3 + 5 \ge 0$

12. If $f(x) = mx + 4$, and $f^{-1}(1) = 6$, then m is equal to
   (a) $\frac{5}{6}$
   (b) 2
   (c) -2
   (d) $\frac{1}{2}$
   (e) $-\frac{1}{2}$

13. Given $f(x) = \frac{5x+1}{x-2}$, then $f^{-1}(\frac{3}{2})$ is equal to
   (a) 17
   (b) $\frac{1}{17}$
   (c) $-\frac{8}{7}$
   (d) $\frac{4}{17}$
   (e) $-\frac{17}{4}$

14. Given the function $f(x) = -\sqrt{18 - 2x^2}$, where $-3 \le x \le 0$, then the domain D and range R of $f^{-1}(x)$ are
   (a) $D = R = [-3, 0]$
   (b) $D = (-\infty, 0]$, $R = [-3, 0]$
   (c) $D = \left[-3\sqrt{2}, 0\right]$, $R = [-3, 0]$
   (d) $D = \left(-\infty, -3\sqrt{2}\right] \cup \left[3\sqrt{2}, 0\right)$, $R = (-\infty, 0]$
   (e) $D = \left(-\infty, -3\sqrt{2}\right]$, $R = [-3, 0]$

15. If $f(x) = |x-1|$ with domain $[1,\infty)$, then $f^{-1}(x)$ is
    (a) $1-x$
    (b) $x+1$
    (c) $1-|x|$
    (d) $|x+1|-1$
    (e) $-x-1$

16. If $f(x) = (3\sqrt{x}+4)^2$, then
    (a) $f^{-1}(x)$ does not exist
    (b) $f^{-1}(x) = \left(\frac{\sqrt{x}+4}{3}\right)^2$
    (c) $f^{-1}(x) = \left(\frac{3}{\sqrt{x}-4}\right)^2$
    (d) $f^{-1}(x) = f(x)$
    (e) $f^{-1}(x) = \left(\frac{\sqrt{x}-4}{3}\right)^2$

17. If $f(x) = \frac{1}{x}, x \neq 0$, then which one of the following is TRUE ?
    (a) $f^{-1}(x)$ does not exist
    (b) $f^{-1}(x) = f(x)$
    (c) $f^{-1}(x) = x$
    (d) $f^{-1}(x) \neq f(x)$
    (e) $f^{-1}(x) = \frac{1}{x^2}$
    (f) $f(x)$ is not one-to-one

18. If $f(x) = -4x+3$ and $g(x) = 2x^3-4$, then $\left(g^{-1} \circ f^{-1}\right)(-8)$ is equal to
    (a) $\frac{3}{2}$
    (b) $\frac{3\sqrt{3}}{2}$
    (c) $-\frac{3\sqrt{2}}{2}$
    (d) $\frac{3\sqrt{2}}{2}$
    (e) $-\frac{3}{2}$

19. If $f(x) = \frac{2x+1}{x-3}$, then $\left(f \circ f^{-1}\right)(5) + f^{-1}(1)$ is equal to
    (a) $\frac{19}{4}$
    (b) 1
    (c) -4
    (d) $\frac{1}{4}$
    (e) 9

20. If $f(x) = \frac{1-x}{x-2}$, then $3f^{-1}(2) + 2f^{-1}(-1)$ is
    (a) undefined
    (b) equal to 8
    (c) equal to $\frac{19}{6}$
    (d) equal to $\frac{11}{3}$
    (e) equal to 3

21. If $f(x) = 2x-1$, then $\left(f^{-1} \circ f^{-1} \circ f\right)(3)$ is
    (a) 2
    (b) 3
    (c) 1
    (d) -3
    (e) -2

22. If $f(x) = 5x-4$ and $g(x) = \frac{x}{6}+2$, then the inverse function of $(f \circ g)(x)$ is
    (a) $\frac{6x-36}{5}$
    (b) $\frac{5x-25}{6}$
    (c) $\frac{x-6}{6}$
    (d) $\frac{x-6}{5}$
    (e) $\frac{6x+36}{5}$

23. If $f(x) = x^2+1$ with domain $(-\infty, 0]$, then $\left(f \circ f^{-1} \circ f\right)(4)$ is
    (a) 17
    (b) -17
    (c) 4
    (d) -4
    (e) is not defined

24. Let $f(x) = 2\sqrt{9-x^2}$ with domain $= [-3,0]$ and range $= [0,6]$. The graph of $f^{-1}(x)$ lies in
    (a) quadrant IV only
    (b) quadrant II only
    (c) quadrant III only
    (d) quadrant II and IV
    (e) quadrant I and II

25. If the function $f(x) = ax+1$ and $g(x) = 3x+b$ are inverse functions of each other, then the product ab is equal to
    (a) -2
    (b) -1
    (c) -3
    (d) $-\frac{1}{3}$
    (e) $\frac{1}{3}$

26. Which one of the following functions is not one-to-one ?
    (a) $f(x) = x^3-3, \quad -2 \leq x \leq 2$
    (b) $f(x) = \sqrt{4-x^2}, \quad 0 \leq x \leq 2$
    (c) $f(x) = |x-1|+2, \quad -2 \leq x \leq 2$
    (d) $f(x) = \sqrt{4+x^2}, \quad 0 \leq x \leq 2$
    (e) $f(x) = x^2+1, \quad -2 \leq x \leq 0$

27. Which one of the following is FALSE ?
    (a) In order for a function to have an inverse, it must be one-to-one

(b) The domain of f equals the range of f^{-1}
(c) If the point (a,b) lies on the graph of f, and f has an inverse, then the point (b,a) lies on the graph of f^{-1}
(d) If a function f has an inverse and $f(-3)=6$, then $f^{-1}(6)=-\frac{1}{3}$
(e) If a function f has an inverse, then the graph of f^{-1} may be obtained by reflecting the graph of f across the line with equation $y=x$

19. SYNTHETIC DIVISION, THE REMAINDER AND THE FACTOR THEOREMS

1. The expression $\frac{-x^3+2x-1}{x+1}$ is equal to
   (a) $-x^2-x-1-\frac{2}{x+1}$
   (b) $-x^2-x+1+\frac{2}{x+1}$
   (c) $-x^2-x-1+\frac{2}{x+1}$
   (d) $-x^2+x+1-\frac{2}{x+1}$
   (e) $x^2+x+1-\frac{2}{x+1}$

2. If $x^{55}-8x+1$ is divided by $x+1$, then the remainder is
   (a) 6
   (b) 10
   (c) -6
   (d) 8
   (e) -8

3. If $x^{101}-x^{96}+1$ is divided by $x-i$, then the remainder is
   (a) 1
   (b) $1-2i$
   (c) $1+2i$
   (d) $2+i$
   (e) i

4. Upon dividing $x^4+3x^3+x^2-3x+15$ by $x+3$, we get
   (a) quotient $=x^3+x-6$; remainder $=177$
   (b) quotient $=x^3-6x-6$; remainder $=33$
   (c) quotient $=x^3+x-6$; remainder $=33$
   (d) quotient $=x^3-x-6$; remainder $=\frac{33}{x+3}$
   (e) quotient $=x^3+x^2-6$; remainder $=33$

5. The values of k so that when x^2-3x-8 is divided by $x+k$, the remainder $=-4$ is
   (a) $1,-4$
   (b) $-1,4$
   (c) $12,-4$
   (d) $4,1$
   (e) $-8,-4$

6. The value of k for which -3 is a zero of the function $f(x)=-x^4+3x^2-4x+k$ is
   (a) 0
   (b) -15
   (c) 42
   (d) 39
   (e) -35

7. If 3 is a zero of $f(x)=x^3-x^2-4x-6$, then the other zeros are
   (a) $1\pm i$
   (b) $1\pm 2i$
   (c) $-1\pm 2i$
   (d) $2\pm i$
   (e) $-1\pm i$

8. If $x-2$ is a factor of the polynomial x^3-5x^2+7x+k, then k is equal to
   (a) 14
   (b) -2
   (c) 2
   (d) -42
   (e) 42

9. The remainder when dividing $3x^3-2x^2-150$ by x^2-4 is
   (a) $12x+142$
   (b) $12x-150$
   (c) $14x+142$
   (d) $12x-158$
   (e) $-12x+158$

10. Given that $x-i$ and $x+i$ are factors of $f(x)=x^4+x^3+2x^2+x+1$, then one of the following expressions must also be a factor of $f(x)$
    (a) x^2-x-1
    (b) x^2+x+1
    (c) ix^2-x-1
    (d) x^2+x+i
    (e) x^2+ix-1

11. If $x^4+2x^3-2x-2=(x-1)(x+1)g(x)-1$, then $g(x)$ is
    (a) x^2-2x-1
    (b) x^2-2x+1
    (c) $-x^2+2x+1$

(d) $x^2 + 2x - 1$
(e) $x^2 + 2x + 1$

12. The function $f(x) = -x^3 + x - 3$ has a real zero on

(a) $[0, 1]$
(b) $[-2, -1]$
(c) $[-1, 0]$
(d) $[1, 2]$
(e) $[-1, 2]$

13. If $\begin{array}{ccccc} i & 1 & i & m & 2 \\ & & i & n & w \\ & k & l & t & 2+i \end{array}$ where $i = \sqrt{-1}$
is the synthetic division of some polynomial $p(x)$ by $x - i$, then the quotient is equal to

(a) $ix^2 + 1$
(b) $x^2 + 2ix$
(c) $x^2 - 1$
(d) $x^2 + 2ix + 1$
(e) $ix^2 + 2ix - 1$

14. The value of k so that $p(x) = x^4 + kx^3 - 3kx + 9$ is divisible by $x - 3$ is

(a) 4
(b) -5
(c) 5
(d) -4
(e) 0

ANSWERS

Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Question																			
1	d	d	e	c	a	d	c	c	d	b	b	c	d	e	e	c	b	a	d
2	b	c	a	e	a	e	c	e	b	a	b	c	c	e	e	a	c	a	d
3	a	a	e	d	d	e	e	d	b	a	e	d	c	c	c	c	c	c	e
4	d	b	d	b	d	a	a	a	e	a	c	b	c	d	d	d	d	d	c
5	b	a	c	c	d	a	e	c	d	c	d	e	b	d	b	a	a	a	a
6	a	b	e	e	c	e	a	b	d	e	c	d	a	c	d	e	a	c	c
7	a	d	a	b	d	b	b	a	a	e	b	c	b	e	d	d	c	e	e
8	d	c	b	b	a	d	b	b	a	e	e	a	d	d	c	e	e	c	b
9	a	b	b	e	b	e	e	d	a	e	c	a	b	e	a	c	e	c	d
10	e	e	d	a	e	a	d	d	b	e	b	e	a	e	c	e	d	d	b
11	c	d	c	d	b	a	a	b	d	d	c	b	e	e	d	e	e	c	e
12	c	d	b	e	b	c	e	e	a	e	d	a	d	b	c	c	b	e	b
13	a	c	b	a	c	e	d	e	a	b	c	c	b	b	e	e	e	c	d
14	d	b	e	c	c	e	c	d	b	d	c	a	d		b	b	a	c	b
15	e	e	a	e	b	a	d	a	c	b	b	c	a		d	e	c	b	
16	c		a	e	a	d	d	d	c	d	c	a	a		d	b		e	
17			e	c	a	b	e	a	b	e	d	a	e		d	d		b	
18			e	b	d	e	b	e	a	d	b	c	e		c	e		a	
19			a	a	d	b	a	a	a	a	d				c	e		b	
20			c	d	a	a	e		d	a	b				c	e		a	
21			c	d	c	a	b		d	e	e				d	a		a	
22			b	e	c	d	e		a	b	c				e	c		a	
23			a	b	b	e	b		e	c	d				a	a		e	
24			d	c	a	d	b		b		b				c			a	
25			e	e	e	c	d		b		d				d			b	
26			c	d	c	d	a		e		c				e			c	
27			b	c	d	b	e		e		a				e			d	
28			a	d	b	c	c		e		b				a				
29				e	e				e		b				e				
30				d	d				e		a								
31				c	c				e		a								
32				a	a				b		b								
33				d	c				d		a								
34				b	a				d		b								
35				c	b				a		b								
36					d				d		d								
37					e				e		c								
38					c				a		d								
39					d				e		b								
40					a				a		d								
41					c				a		a								
42					c				e		a								
43					e				d		a								
44					a				e		b								
45					b				e		d								
46					c				b										
47					e														
48					e														
49					c														
50					b														
51					a														
52					c														
53					e														