81
1. \[\frac{(a^2b^{-3})^3}{a^{-2}b} = \]
A. \(a^2b^{-7}\)
B. \(a^2b^{-5}\)
C. \(a^6b^{-2}\)
D. \(a^6b^{-6}\)
E. \(a^6b^{-7}\)

81
2. \[\frac{1}{x+1} + \frac{1}{x-1} + \frac{x+1}{x} = \]
A. \(\frac{1}{x+1}\)
B. \(\frac{1}{x-1}\)
C. \(\frac{x+1}{x-1}\)
D. \(\frac{1}{(x+1)(x-1)}\)
E. \(\frac{x^2+4x+1}{(x+1)(x-1)}\)

81
3. If \(x = \frac{-bx + ay - c}{a + by}\), then \(y = \)
A. \(ax + bx + c\)
B. \(\frac{-ax + bx + c}{a - bx}\)
C. \(\frac{ax + bx + c}{a - bx}\)
D. \(\frac{-ax + bx + c}{a + bx}\)
E. \(\frac{ax - bx - c}{a - bx}\)

81
4. \((2^x)^x = \)
D. \[ \left( \frac{M}{4\pi(H-K)} \right)^{\frac{1}{2n}} - l \]

E. \[ \left( \frac{4\pi}{M(H-K)} \right)^{\frac{1}{n}} - l^2 \]

81. If \( f(x) = x^2 + x + 1 \), then \( f(x+1) - f(x) \)

7.

A. 1
B. 3
C. \( 2x + 1 \)
D. \( 2x + 2 \)
E. \( x^2 + x + 1 \)

81. If \( \log_{10} x + \log_{10} 4 = \log_{10}(x + 4) \), what is the value of \( x \)?

8.

A. 0
B. 1
C. \( \frac{4}{3} \)
D. 4
E. \( x \) may be any positive number

81. It is given that \( x(2x + 3) = x(3x - 4) \). \( x = ? \)

9.

A. 0 only
B. 7 only
C. 0 or 7
D. \( -\frac{3}{2} \) or \( \frac{4}{3} \) only
E. \( 0, -\frac{3}{2} \) or \( \frac{4}{3} \)

81. \( 2y - 3 > 4y + 2x + 5 \) is equivalent to

10.

A. \( y > x + 4 \)
B. \( y < x + 4 \)
C. \( y > -x - 4 \)
D. \( y < -x - 4 \)
E. \( y > x + 1 \)

81. The \( n \)th term of the arithmetic progression 2, 6, 10, 14, … is

11.

A. \( 2n^2 \)
B. \( 4n \)
C. \( 4n - 2 \)
D. \( 4n + 2 \)
E. \( 6 - 4n \)

81. If \( 3x - 2y = x + 3y \), then \( x^2 : y^2 = \)

12.

A. 2 : 5
B. 5 : 2
C. 4 : 25
D. 25 : 4
E. 1 : 4

81. The marked price of a book is \( $x \). 30% of this price is profit. If the book is sold at a discount of 20%, what will the profit then be?

13.

A. \$0.04x
B. \$0.06x
C. \$0.1x
D. \$0.24x
E. \$0.56x

81. A group consists of \( n \) boys and \( n \) girls.

14. If two of the girls are exceeded by two other boys, then 51% of the group members will be boys. What is \( n \)?

A. 50
B. 51
C. 52
D. 100
E. 102

81. If the surface area of a spherical soap bubble increases by 44%, its volume increases by

15.

A. 20%
B. 33.1%
C. 60%
D. 66%
E. 72.8%
16. The total area of the six faces of the solid cube in the figure is $96 \text{ cm}^2$. What is the length of the diagonal $AB$?

A. $6\sqrt{2}$ cm
B. $4\sqrt{3}$ cm
C. $4\sqrt{2}$ cm
D. $2\sqrt{6}$ cm
E. 4 cm

17. A merchant sold 100 chairs. 80 of them were sold at a profit of 30% on each chair, while 20 of them were sold at a loss of 40% on each chair. What is his percentage gain or loss on the whole stock?

A. A loss of 8%
B. A loss of 10%
C. A gain of 8%
D. A gain of 16%
E. A gain of 24%

18. If $0^\circ < \theta < 90^\circ$ and $\sin \theta = \frac{k}{2}$, then $\cos \theta =$

A. $1 - \frac{k}{2}$
B. $\frac{2}{\sqrt{4+k^2}}$
C. $\frac{\sqrt{4+k^2}}{2}$

19. $\tan \theta \sin \theta - \frac{1}{\cos \theta} =$

A. 0
B. $\cos \theta$
C. $-\cos \theta$
D. $-\frac{1}{\cos \theta}$
E. $-\tan \theta \sin \theta$

20. If $0^\circ \leq \theta \leq 360^\circ$, the number of roots of the equation $2 \sin \theta \cos \theta - \cos \theta = 0$ is

A. 0
B. 1
C. 2
D. 3
E. 4

21. An angle measures $x$ radians. What is its measure in degrees?

A. $\left( \frac{x \pi}{180} \right)^\circ$
B. $\left( \frac{180x}{\pi} \right)^\circ$
C. $\left( \frac{x}{180} \right)^\circ$
D. $\left( \frac{x \pi}{360} \right)^\circ$
E. $\left( \frac{360x}{\pi} \right)^\circ$
22. In the figure, \( \cos \theta = \) 
A. \( \frac{1}{2} \) 
B. \( \frac{2}{3} \) 
C. \( \frac{3}{4} \) 
D. \( \frac{\sqrt{3}}{2} \) 
E. \( \frac{\sqrt{3}}{4} \) 

23. In the figure, \( AD = p, \ DC = q, \ \angle B = 90^\circ. \ \ AB = \) 
A. \( p \sin \theta + q \sin \phi \) 
B. \( p \cos \theta + q \cos \phi \) 
C. \( p \sin \theta + q \cos \phi \) 
D. \( p \cos \theta + q \sin \phi \) 
E. \( (p + q)(\cos \theta + \cos \phi) \) 

24. In the figure, \( BE \) is a diameter of the circle. \( ABC \) and \( EDC \) are straight lines. \( \alpha^\circ = \) 
A. \( 21^\circ \) 
B. \( 31^\circ \) 
C. \( 38^\circ \) 
D. \( 52^\circ \) 
E. \( 59^\circ \) 

25. In the figure, \( AT \) touches the circle at \( A \). In \( \triangle ABC, \ \angle A : \angle B : \angle C = 2 : 3 : 4. \ \theta = \) 
A. \( 40^\circ \) 
B. \( 50^\circ \) 
C. \( 60^\circ \) 
D. \( 70^\circ \) 
E. \( 80^\circ \)
In the figure, \( AB \) is a diameter of the circle with centre at \( O \). The length of the minor arc \( AC \) is twice the length of the minor arc \( CD \). \( \angle BOD = \) 

A. \( 72^\circ \)  
B. \( 90^\circ \)  
C. \( 108^\circ \)  
D. \( 132^\circ \)  
E. \( 144^\circ \)  

In the figure, two circles both with radius 2 cm touch each other externally. \( AP \) and \( AQ \) are equal tangents to the two circles. \( AP = ? \) 

A. \( \sqrt{3} \) cm  
B. \( 2\sqrt{3} \) cm  
C. 4 cm  
D. \( 4\sqrt{3} \) cm  
E. \( \frac{4\sqrt{3}}{3} \) cm

In the figure, \( ABCD \) is a quadrilateral. The shaded portions are four sectors with centres at \( A, B, C \) and \( D \). Their radii are all equal to \( a \). What is the total area of the four sectors? 

A. \( \pi a^2 \)  
B. \( 2\pi a^2 \)  
C. \( 4\pi a^2 \)  
D. \( \sqrt{2} \pi a^2 \)  
E. It cannot be determined

\( 2x^2 - 2 \leq 0 \) is equivalent to 

A. \( x \leq 1 \)  
B. \( x \geq -1 \)  
C. \( -1 \leq x \leq 1 \)  
D. \( x \geq 1 \) or \( x \leq -1 \)  
E. \( x \leq 1 \) or \( x \geq -1 \)
81  \[ 6x^2 + kx + 6 = 0 \] is a quadratic equation in which \( k \) is a constant. Its roots \( \alpha \) and \( \beta \) are positive. \[ \log_{10}\alpha + \log_{10}\beta = \]

A. 0  
B. 1  
C. \( \log_{10}6 \)  
D. \( \log_{10}(-k) \)  
E. \( \log_{10}\left(-\frac{k}{6}\right) \)

31. \(-3x^2 - 3x = -3(x + a)^2 + b \) is an identity in \( x \). What are the values of the constants \( a \) and \( b \)?

A. \( a = 1 \) and \( b = 0 \)  
B. \( a = \frac{1}{2} \) and \( b = \frac{3}{4} \)  
C. \( a = \frac{1}{2} \) and \( b = \frac{3}{4} \)  
D. \( a = -\frac{1}{2} \) and \( b = \frac{3}{4} \)  
E. \( a = -\frac{1}{2} \) and \( b = -\frac{3}{4} \)

33. The H.C.F. and L.C.M. of three expressions are \( a^2b^2c \) and \( a^4b^6c^4 \) respectively. Two of the expressions are \( a^2b^3c^4 \) and \( a^3b^2c^2 \). The third expression is

A. \( a^3b^3c \)  
B. \( a^3b^6c^4 \)  
C. \( a^4b^2c \)  
D. \( a^4b^6c \)  
E. \( a^6b^6c^2 \)

34. The sum of the first five terms of an arithmetic progression is 15. If the fourth term is 7, the first term is

81  Which of the following can be summed to infinity?

A. II only  
B. I and II only  
C. I and III only  
D. II and III only  
E. I, II and III

37. If \( n \) is a positive integer, which of the following numbers is/are odd?

I. \( 2^{2n+1} \)  
II. \( 3(2^n) \)  
III. \( (2n+1)^2 \)

A. II only  
B. III only  
C. I and III only  
D. II and III only  
E. I, II and III
81. A factory employs $x$ workers each working $n$ hours a day. The whole factory produces $k$ watches per day. If $y$ workers go on leave, then how many hours a day should the remaining workers work in order to produce the same number of watches per day?

A. $\frac{nx}{y}$
B. $\frac{ny}{x}$
C. $\frac{nx}{4y}$
D. $\frac{nx}{x-y}$
E. $\frac{n(x-y)}{x}$

81. The daily wages of a man and a boy are in the ratio 2 : 1. In a day a man has to work 8 hours but a boy only 6 hours. The hourly wages of a man and a boy are in the ratio

A. 8 : 3
B. 2 : 1
C. 3 : 2
D. 4 : 3
E. 1 : 1

81. In the figure, $\angle BAC = 90^\circ$, $AB = 8$, $AC = 5$ and $AX \perp BC$. $BCDE$ is a rectangle with $CD = AX$. What is the area of the rectangle $BCDE$?

A. 20
B. 40
C. 80
D. 89

E. $4 \sqrt{89}$

The height of the cone in the figure is $h$. It contains water to a depth of $\frac{1}{2}h$. The volume of water is equal to the capacity of the cone.

A. $\frac{1}{8}$
B. $\frac{1}{4}$
C. $\frac{1}{2}$
D. $\frac{3}{4}$
E. $\frac{7}{8}$

81. The figure above represents a $50m \times 20$ m swimming pool. The pool is in the shape of a prism with a rectangular surface and four vertical walls. The dimensions of the sidewall $ABCDEF$ are as shown in the figure. What is the capacity of the pool in $m^3$?

A. 1200
B. 1500
81 Given that \( \sin \theta - \cos \theta = \frac{1}{2} \), what is the value of \( \sin \theta \cos \theta \)?

A. \( \frac{1}{2} \)  
B. \( \frac{1}{4} \)  
C. \( \frac{3}{8} \)  
D. \( \frac{3}{4} \)  
E. It cannot be determined

81 If \( 0^\circ \leq \theta \leq 360^\circ \), the minimum value of \( 1 + 2\cos \frac{\theta}{2} \) is

A. \( -2 \)  
B. \( -1 \)  
C. \( 0 \)  
D. \( 1 \)  
E. \( 2 \)

81 The radius of a sector is 3 cm and the perimeter is 10 cm. What is the area of the sector?

A. \( 6 \ \text{cm}^2 \)  
B. \( 12 \ \text{cm}^2 \)  
C. \( 15 \ \text{cm}^2 \)  
D. \( 18 \ \text{cm}^2 \)  
E. \( 45 \ \text{cm}^2 \)

81 The cone in Figure (b) is formed by bending the sector in Figure (a). The angle of the sector is \( 60^\circ \) and the radius is 12 cm. The radius of the base of the cone is

A. \( 2 \ \text{cm} \)  
B. \( 4 \ \text{cm} \)  
C. \( 6 \ \text{cm} \)  
D. \( 2\pi \ \text{cm} \)  
E. \( \frac{360}{\pi} \ \text{cm} \)

81 In the figure, \( \sin \theta = \)

A. 0.5  
B. 0.6  
C. 0.625  
D. 0.75  
E. 0.8

81 The figure above shows the graph of

A. \( y = \sin(x^\circ + 30^\circ) \)  
B. \( y = \sin(x^\circ - 30^\circ) \)  
C. \( y = \sin(x^\circ + 150^\circ) \)  
D. \( y = \sin(x^\circ - 150^\circ) \)  
E. \( y = \sin(x^\circ + 60^\circ) \)
49. In the figure, \( AD \perp BC \). \( CD = \)

A. \( h \sin \alpha \tan \beta \)
B. \( h \cos \alpha \tan \beta \)
C. \( h \tan \alpha \sin \beta \)
D. \( \frac{h \cos \alpha}{\tan \beta} \)
E. \( \frac{h \sin \alpha}{\tan \beta} \)

50. In the figure, \( ABC \) is an equilateral triangle of side \( 2a \). \( P \) and \( Q \) are the mid-points of \( AB \) and \( AC \) respectively. \( PQRS \) is a rectangle. What is the area of \( PQRS \)?

A. \( a^2 \)
B. \( \frac{1}{2} a^2 \)
C. \( \frac{2}{3} a^2 \)
D. \( \frac{1}{\sqrt{3}} a^2 \)
E. \( \frac{\sqrt{3}}{2} a^2 \)

51. In the figure, \( AB \) and \( AC \) touch the circle at \( B \) and \( C \). If \( P \) is any point on the minor arc \( BC \), what is \( \theta \)?

A. \( 112^\circ \)
B. \( 118^\circ \)
C. \( 124^\circ \)
D. \( 146^\circ \)
E. It cannot be determined

52. \( \angle BAC = 90^\circ \) \( AD \perp BC \).

\( AC \) and \( BC \) intersect at \( E \).
III

BC produced meets the tangent AT at T.

Which of the above figures contains one or more pairs of similar triangles?

A. I only
B. I and II only
C. I and III only
D. II and III only
E. I, II and III

In the figure, AB // CD // EF. ACF, BCE and BDF are straight lines. AB = 12, EF = 6. CD =?

A. 4.5
B. 4
C. 3.6
D. 3
E. 2

In the figure, P is the mid-point of AB. E is a point on AC such that

\[ AE : EC = 2 : 1. \]

\[ \frac{\text{Area of } \triangle BFE}{\text{Area of } \triangle BCE} = \]

A. \( \frac{1}{2} \)
B. \( \frac{2}{3} \)
C. 1
D. \( \frac{3}{2} \)
E. 2