

1. Algebraic Fractions with Factoring

March 2010 (No Calculators)

1. Express the following as a single fraction in simplest form.

$$\frac{1}{x + \frac{1}{2 + \frac{1}{x+2}}}$$

Ans. _____

2. Simplify: $\frac{x+2}{x-3} - \frac{3x-5}{2x+1} + \frac{3x^2+2x+23}{2x^2-5x-3}$

Ans. _____

3. Find all value(s) of x such that $\frac{x+1}{x-2} - \frac{x-2}{x+1} = \frac{5}{6}$

Ans. _____

1. Algebraic Fractions with Factoring

March 2011 (No Calculators)

1. The reciprocal of half a number increased by half the reciprocal of the number is $\frac{1}{2}$. Find the number.

Ans. _____

2. Simplify: $\frac{x^{2n} - 2x^n y^n + y^{2n}}{x^{2n} + 3x^n y^n - 4y^{2n}}$

Ans. _____

3. Find all real values of x such that $\frac{\frac{1}{x^2} - x^2}{\frac{1}{x} + x} = \frac{3}{2}$

Ans. _____

1. Algebraic Fractions with Factoring**March 2012 (No Calculators)**

1. Find the lowest common denominator for the following expressions:

$$\frac{2x + 3y}{6x^3y^7} + \frac{x - y}{4x^7y^3z} - \frac{x + y}{8x^8yz^7}$$

Ans. _____

2. Simplify: $\frac{2x^2 + 5x + 2}{2x^2 - 5x - 3} + \frac{15x^2 + 19x + 6}{3x^2 - 7x - 6} - \frac{12x^2 + 7x - 12}{4x^2 - 15x + 9}$

3. Solve for x, if: $\frac{x}{3} - \frac{x-3}{x} = \frac{x-3}{x+3} + \frac{x+3}{2x}$

Ans. _____**1. Algebraic Fractions and Fractional Equations****March 2013 (No calculators)**

1. Find, in simplest form, as a single fraction with no parentheses, for $x > 0$:

$$\frac{x^4 + 2x^3 + x^2}{4} \div \frac{2x^3 + 3x^2 + x}{6}$$

Ans. _____

2. Simplify and write as a binomial without parentheses:

$$\frac{8x^4 - 24x^3 - 32x^2 + 96x}{8x - \frac{32}{x}}$$

Ans. _____

3. Find all values of x such that $\frac{x-2}{2x-3} + \frac{2x-7}{1-x} = \frac{x^2-3x-3}{2x^2-5x+3}$

Ans. _____

1. Algebraic Fractions and Fractional Equations

March 2014 (No calculators)

1. Simplify: $\frac{3}{x+3} + \frac{2}{2x+1} - \frac{6x+8}{2x^2+7x+3}$

Ans. _____

2. Find $7B - 3A$, if $\frac{A}{2x-3} + \frac{B}{2x+3} = \frac{24x+6}{4x^2-9}$

Ans. _____

3. Find all x such that $\frac{x-4}{x+3} - \frac{x-10}{x-3} = \frac{x-8}{2x+6}$

Ans. _____

2. Trigonometric Equations and Identities

March 2010 (No Calculators)

1. Express $\sin\theta + \tan\theta - \tan\theta\cos\theta$ as a single trig function in simplest form.

Ans. _____

2. Solve the following for x , where $0^\circ \leq x < 360^\circ$: $2\csc^2 x - 3\csc x = 2$.

Ans. _____

3. Find all values of x where $0^\circ \leq x \leq 180^\circ$: $\tan^3 2x = \tan 2x$

Ans. _____

2. Trigonometric Equations and Identities

March 2011 (No Calculators)

1. Find the value in simplest form of: $\cos\frac{\pi}{4}\cos\frac{\pi}{12} + \sin\frac{\pi}{4}\sin\frac{\pi}{12}$.

Ans. _____

2. If $\tan\alpha = -\frac{8}{15}$, and $\tan\beta = \frac{3}{4}$, find the value of $\tan(\alpha + \beta)$.

Ans. _____

3. Simplify the following to an expression in terms of a single trig function of x in simplest form.

$$\frac{2\tan\frac{x}{2}}{1 + \tan^2\frac{x}{2}}$$

Ans. _____

2. Trigonometric Equations and Identities

March 2012 (No Calculators)

1. Solve for x , such that $0 \leq x \leq \frac{\pi}{2}$: $3 \sin x = 1.5$

Ans. _____

2. If $\tan x = 3/4$ and $\tan y = 7/24$, and x and y are first quadrant angles, find $\sin(x - y)$.

Ans. _____

3. Find all values of θ , where $0^\circ \leq \theta < 360^\circ$, such that

$$\sin 2\theta = \sin \theta$$

Ans. _____

2. Trigonometric Equations and Identities

March 2013 (No calculators)

1. If $0^\circ \leq \theta < 360^\circ$, find all values of θ satisfying:

$$\frac{\sin \theta}{5} - \frac{\sin \theta}{3} = \frac{\sqrt{3}}{15}$$

Ans. _____

2. Let $A = \sec x$. Find both values of A for which $\cot x = 2$.

Ans. _____

3. On the domain $0 \leq x < \pi$, find all values of x satisfying

$$4 \sin^2 x + 6 \cos x = 8 \sin^2 x \cos x + 3$$

Ans. _____

2. Trigonometric Equations and Identities

March 2014 (No calculators)

1. In right triangle ABC with $m\angle C = 90^\circ$, $\tan \angle B = 15/8$. Find $\sin \angle A$.

Ans. _____

2. Find the value of $\tan 157^\circ 30'$.

Ans. _____

3. Find all θ , where $0^\circ \leq \theta < 360^\circ$, for which

$$\sqrt{3} \sec^2 \theta - \tan \theta = \sqrt{3} \tan \theta + \sqrt{3} - 1 = 0$$

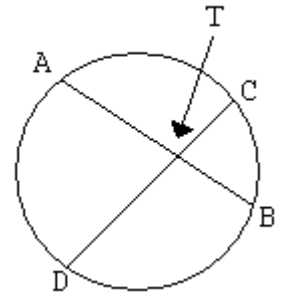
Ans. _____

3. Circles and Spheres

March 2010 (No Calculators)

1. If the measure of arc $BC = 35^\circ$ and $m\angle BT D = 152^\circ$, find the measure of arc AD .

Ans. _____



2. Point P is 10 cm from a circle in a plane. If one of the tangent segments to the circle is 20 cm long, what is the length of the radius of the circle?

Ans. _____

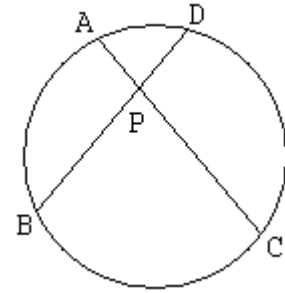
3. A point P is 17 cm from the center of a sphere. A tangent segment from P to the sphere is 15 cm long. How long is the radius of the circle of intersection made by all the point of tangency from P to the sphere?

Ans. _____

3. Circles and Spheres

March 2011 (No Calculators)

1. In the circle at right, measure of arc $AD = 40^\circ$ and measure of arc $BC = 120^\circ$. Find the measure of angle DPC .

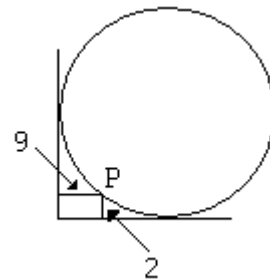


Ans. _____

2. Points A and B lie on a sphere of radius 12. The length of the chord joining A and B is $12\sqrt{3}$. What is the length of the shortest path from A to B, if every point on the path lies on the sphere?

Ans. _____

3. A circular table in the diagram at right is pushed against two perpendicular walls. the point P on the circumference of the table is a distance of 2 feet from one wall and 9 feet from the other wall. What is the radius of the table?

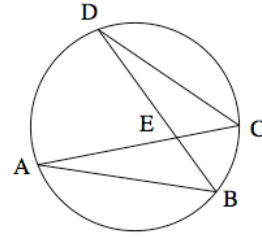


Ans. _____

3. Circles and Spheres

March 2012 (No Calculators)

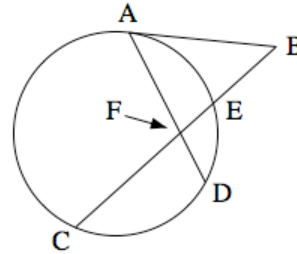
1. In the figure, $m\angle A = 20^\circ$, $m \text{ arc } AD = 100^\circ$.
Find the sum of $m\angle D$ and $m\angle AED$.



Ans. _____

2. In the figure, $AB = 2x$, $BE = x$, $FE = 2$,
 $CF = x+6$, $DF = 3$ and $AF = y$

Find y .



Ans. _____

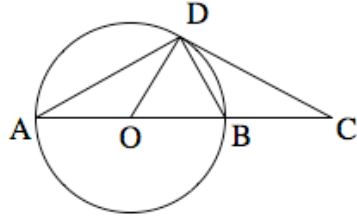
3. Three spheres are placed on the floor. Each tangent to the other two and all have a radius of 8. A fourth sphere, with the same radius is placed in the center atop the other three. How high is it from the top of the highest sphere to the floor?

Ans. _____

3. Circles and Spheres

March 2013 (No calculators)

1. Points A, B, and D lie on the circle O. O is the center. Line segment AC passes through points O and B. Line segment CD is tangent to O at point D. Line segment BD is a chord of circle O. If angle DCB measures 34° , find the measure of angle OBD.

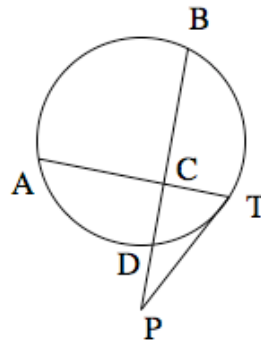


Ans. _____

2. Two balls are rolled the length of a 10 foot table. The larger ball makes 10 revolutions and the smaller ball makes 12 revolutions. How many inches greater is the radius of the larger ball than the radius of the smaller ball?

Ans. _____

3. In the drawing, \overline{PT} is a tangent with length 6. \overline{PB} is a secant passing through point D on the circle. \overline{AT} is a chord intersecting with \overline{PB} at C. If $PD = 3$, $DC = 4$, and $CT = \sqrt{13}$, find the distance from \overline{BD} to the center of the circle.

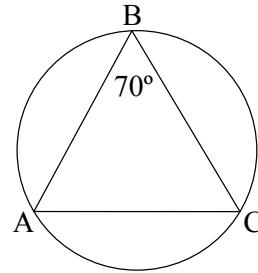


Ans. _____

3. Circles and Spheres

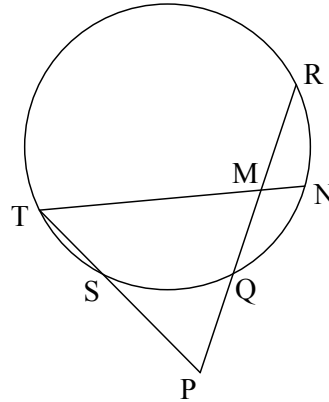
March 2014 (No calculators)

1. Find the measure of arc ABC in the figure.



Ans. _____

2. In the figure at right, $PQ = 8$, $QR = 7$,
 $SP = MT$, $ST = 2$, and $MN = 1$.
Find RM.



Ans. _____

3. Point P is 9 cm from a sphere whose diameter is 16 cm. Find the exact distance from P to the center of the circle made by the locus of points of tangency from P to the sphere.

Ans. _____

4. Conics

March 2010 (No Calculators)

1. Find the coordinates of the endpoints of the major axis of the ellipse
 $16x^2 + 25y^2 = 10,000$

Ans. _____

2. The vertices of a hyperbola are $(-3, 9)$ and $(-3, 1)$. Its eccentricity is $\frac{\sqrt{5}}{2}$. Find its equation.

Ans. _____

3. A circle is tangent to the lines $5x + 12y = -21$ and $5x + 12y = 83$. Its center is on the line $2x + 3y = 7$. Find the equation of the circle.

Ans. _____

4. Conics

March 2011 (No Calculators)

1. Find an equation for the ellipse with foci at $(8, 0)$ and $(-8, 0)$ and y-intercepts at 6 and -6.

Ans. _____

2. Find an equation of the parabola with vertex $(1/2, -1/4)$ and directrix on the line having equation $y = -1/2$.

Ans. _____

3. Find an equation for the hyperbola with foci at $(0, 4)$ and $(0, -4)$ and passing through the point $(\sqrt{5}, 3)$.

Ans. _____

4. Conics

March 2012 (No Calculators)

1. Find the endpoints of the latus rectum of the parabola $y^2 + 12x = 0$.

Ans. _____

2. The eccentricity of an ellipse is .6 and the minor axis is 2 units shorter than the major axis. The minor axis is horizontal. The center is at the intersection of the lines $5x - y = 2$ and $x + 2y = 7$. Find the equation of the ellipse.

Ans. _____

3. One axis of symmetry of a hyperbola is $y + 8 = 0$, which the hyperbola does not intersect. One of the asymptotes of the hyperbola has the equation $2x + y = 0$. The distance between the foci is $6\sqrt{5}$. Find the equation of the hyperbola.

Ans. _____

4. Conics

March 2013 (No calculators)

1. Find the distance from the origin, $(0, 0)$, to the center of the circle whose equation is

$$x^2 + 8x + y^2 - 6y + 21 = 0.$$

Ans. _____

2. An ellipse with major axis parallel to the x-axis is inscribed in a rectangle with vertices $(0, 15)$, $(0, 17)$, $(8, 17)$, and $(8, 15)$. Find d if the equation of the ellipse is written in the form $x^2 + ay^2 + bx + cy = d$.

Ans. _____

3. The vertices of a hyperbola are $(-7, 5)$ and $(1, 5)$. The slopes of the asymptotes are $\pm \frac{1}{2}$. Find the equation of the hyperbola.

Ans. _____

4. Conics

March 2014 (No calculators)

1. Each of three different circles, centered at the origin, contains one of the following points: (4, 7), (-3, 8), and (5, -6). What is the equation of the smallest circle?

Ans. _____

2. Find the eccentricity of the ellipse whose equation is

$$x^2 + 16y^2 + 14x - 288y + 1329 = 0.$$

Ans. _____

3. Find the coordinates of the foci of the hyperbola

$$16y^2 - 9x^2 + 72x + 160y + 832 = 0.$$

Ans. _____

5. Arithmetic with Statistics

March 2010 (You may use a calculator)

1. The mean for a set 20 basketball games is 42.3. Two of the extreme scores are 96 and 11. If these two scores are removed, by how much is the mean changed? State answer to the nearest 10^{th} and whether it is higher or lower than the original mean.

Ans. _____

2. Find the base four number which is the product of 321_4 and 123_4 .

Ans. _____

3. There are three integral values of x such that the mean is equal to the median of the data set $\{x, 2, 9, -7, 1, -6\}$. Find the three values.

Ans. _____

5. Arithmetic with Statistics

March 2011 (You may use a calculator)

1. Find a group of five positive integers such that the mean, median, range and only one mode are all 12.

Ans. _____

2. At Deering High the mean score of 50 students on the MEA science test was 75. At Portland High the mean score of 40 students on the same test was 80. What is the mean score of all 90 students? Round your answer to the nearest 10^{th} .

Ans. _____

3. If the mean of the data, $x + 5$, x , $x - 1$, $x/2$, $2x$, x^2 , and $x^2 + 1$ is $1 \frac{5}{28}$, where x is a positive real number, find the numerical value of the median.

Ans. _____

5. Arithmetic with Statistics

March 2012 (You may use a calculator)

1. The mean of the set of numbers 21, 42, 25, 55, and x is 37. Find the sum of the mean, median, mode, and range of this set of numbers.

Ans. _____

2. Five positive integers have an average of 89. The median is 103. The mode is 105. The range is 70. What is the second-smallest of these five integers?

Ans. _____

3. If the following was multiplied out, what would the unit's digit of the product be?

$$242^{81}(363)^{72}(454^{97})$$

Ans. _____

5. Arithmetic with Statistics

March 2013 (You may use a calculator)

1. A data set of three samples of positive integers has a sum of 93. One of the samples is the mean of the data set and the range is 8. Find the largest sample of the set.

Ans. _____

2. The following chart shows a student's quiz grades on all math quizzes so far through his high school career. He has two quizzes left to take.

Grade	70	75	80	85	90	95	100
Number	2	5	8	11	19	16	18

What must he average of the last two quizzes in order to finish high school with exactly a 90 math quiz average?

Ans. _____

3. For a data set, define the *MS Index* ("Makes Sense") as $\frac{|Median - Mean|}{Range}$. Find the value of the smallest *MS Index* among the following data sets:

$$\{1, 2, 9\} \quad \{1, 2, 3, 12\} \quad \{1, 17, 24\} \quad \{1, 19, 19, 21\} \quad \{1, 2, 14, 15, 23\}$$

Ans. _____

5. Arithmetic with Statistics

March 2014 (You may use a calculator)

1. N is the least common multiple of 5, 6, and 7. Find the exact mean of the numbers one gets when dividing N by 5, then 6, then 7.

Ans. _____

2. Convert $344_5 + 233_4 + 122_3$ to base 6.

Ans. _____

3. The mean, median, and mode of a group of 8 positive integers are 8, 9, and 10, respectively. M is the largest of these integers. Find the sum of the largest and smallest possible values for M for all such groups.

Ans. _____