Dear Sir

I have to acknowledge the receipt of your favor of May 14. in which you mention that you have finished the 6. first books of Euclid, plane trigonometry, surveying & algebra and ask whether I think a further pursuit of that branch of science would be useful to you. there are some propositions in the latter books of Euclid, & some of Archimedes, which are useful, & I have no doubt you have been made acquainted with them. trigonometry, so far as this, is most valuable to every man, there is scarcely a day in which he will not resort to it for some of the purposes of common life. the science of calculation also is indispensible as far as the extraction of the square & cube roots; Algebra as far as the quadratic equation & the use of logarithms are often of value in ordinary cases: but all beyond these is but a luxury; a delicious luxury indeed; but not to be indulged in by one who is to have a profession to follow for his subsistence. in this light I view the conic sections, curves of the higher orders, perhaps even spherical trigonometry, Algebraical operations beyond the 2d dimension, and fluxions.

Letter from Thomas Jefferson to William G. Munford, Monticello, June 18, 1799.
fall09a2
Answer Section

1 ANS: 2
\[(3 - 7i)(3 - 7i) = 9 - 21i - 21i + 49i^2 = 9 - 42i - 49 = -40 - 42i\]

PTS: 2 REF: fall0901a2 STA: A2.N.9
TOP: Multiplication and Division of Complex Numbers

2 ANS: 3
\[f(4) = \frac{1}{2}(4) - 3 = -1. \ g(-1) = 2(-1) + 5 = 3\]

PTS: 2 REF: fall0902a2 STA: A2.A.42 TOP: Compositions of Functions
KEY: numbers

3 ANS: 1
\[\tan \theta - \sqrt{3} = 0\]
\[\tan \theta = \sqrt{3}\]
\[\theta = \tan^{-1} \sqrt{3}\]
\[\theta = 60, 240\]

PTS: 2 REF: fall0903a2 STA: A2.A.68 TOP: Trigonometric Equations
KEY: basic

4 ANS: 4
Students entering the library are more likely to spend more time studying, creating bias.

PTS: 2 REF: fall0904a2 STA: A2.S.2 TOP: Analysis of Data

5 ANS: 1
\[6x - 7 \leq 5 \quad 6x - 7 \geq -5\]
\[6x \leq 12 \quad 6x \geq 2\]
\[x \leq 2 \quad x \geq \frac{1}{3}\]

PTS: 2 REF: fall0905a2 STA: A2.A.1 TOP: Absolute Value Inequalities
KEY: graph

6 ANS: 4
(4) fails the horizontal line test. Not every element of the range corresponds to only one element of the domain.

PTS: 2 REF: fall0906a2 STA: A2.A.43 TOP: Defining Functions
7 ANS: 2
\[ K = \frac{1}{2} (10)(18) \sin 120 = 45\sqrt{3} \approx 78 \]

PTS: 2 REF: fall0907a2 STA: A2.A.74 TOP: Using Trigonometry to Find Area KEY: basic

8 ANS: 4 PTS: 2 REF: fall0908a2 STA: A2.A.38
TOP: Defining Functions KEY: graphs

9 ANS: 2
\[ 8^2 = 64 \]

PTS: 2 REF: fall0909a2 STA: A2.A.18 TOP: Evaluating Logarithmic Expressions

10 ANS: 3 PTS: 2 REF: fall0910a2 STA: A2.A.76
TOP: Angle Sum and Difference Identities KEY: simplifying

11 ANS: 3

<table>
<thead>
<tr>
<th>( n )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>( \Sigma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n^2 + 2^n )</td>
<td>0^2 + 2^0 = 1</td>
<td>1^2 + 2^2 = 3</td>
<td>2^2 + 2^2 = 8</td>
<td>12</td>
</tr>
</tbody>
</table>

\[ 2 \times 12 = 24 \]

PTS: 2 REF: fall0911a2 STA: A2.N.10 TOP: Sigma Notation KEY: basic

12 ANS: 3
\[ S = \frac{-b}{a} = \frac{-( -3)}{4} = \frac{3}{4}, \quad P = \frac{c}{a} = \frac{-8}{4} = -2 \]

PTS: 2 REF: fall0912a2 STA: A2.A.21 TOP: Roots of Quadratics KEY: basic

13 ANS: 3 PTS: 2 REF: fall0913a2 STA: A2.A.65
TOP: Graphing Trigonometric Functions

14 ANS: 1 PTS: 2 REF: fall0914a2 STA: A2.A.8
TOP: Negative and Fractional Exponents

15 ANS: 1

PTS: 2 REF: fall0915a2 STA: A2.S.5 TOP: Normal Distributions KEY: interval
16 ANS: 2
\[ f^{-1}(x) = \log_e x \]

PTS: 2 REF: fall0916a2 STA: A2.A.54 TOP: Graphing Logarithmic Functions

17 ANS: 4
\[ 6x - x^3 - x^2 = -x(x^2 + x - 6) = -x(x + 3)(x - 2) \]

PTS: 2 REF: fall0917a2 STA: A2.A.7 TOP: Factoring Polynomials
KEY: single variable

18 ANS: 4
\[ 4ab\sqrt{2b} - 3a\sqrt{9b^2} - 7ab\sqrt{6b} = 4ab\sqrt{2b} - 9ab\sqrt{2b} + 7ab\sqrt{6b} = -5ab\sqrt{2b} + 7ab\sqrt{6b} \]

PTS: 2 REF: fall0918a2 STA: A2.A.14 TOP: Operations with Radicals
KEY: with variables | index = 2

19 ANS: 1
\[ 5C_3(3x)^3(-2)^3 = 10 \cdot 9x^3 \cdot -8 = -720x^3 \]

PTS: 2 REF: fall0919a2 STA: A2.A.36 TOP: Binomial Expansions

20 ANS: 2
\[ \frac{x - 1}{4} \cdot \frac{x^2 - 4}{4x} = \frac{2x + 4}{8x} \times \frac{8x}{2(x + 2)} = x - 2 \]

PTS: 2 REF: fall0920a2 STA: A2.A.17 TOP: Complex Fractions

21 ANS: 4
\[ 2 \log_4 (5x) = 3 \]
\[ \log_4 (5x) = \frac{3}{2} \]
\[ 5x = 4^{\frac{3}{2}} \]
\[ 5x = 8 \]
\[ x = \frac{8}{5} \]

PTS: 2 REF: fall0921a2 STA: A2.A.28 TOP: Logarithmic Equations
KEY: advanced

22 ANS: 4
\[ s = \theta r = 2 \cdot 4 = 8 \]

PTS: 2 REF: fall0922a2 STA: A2.A.61 TOP: Arc Length
KEY: arc length

23 ANS: 3

TOP: Domain and Range
KEY: real domain
24 ANS: 3

\begin{array}{c}
\text{I-Var Stats L₁, L₂} \\
\text{0x²} \\
\text{67.31102041}
\end{array}

PTS: 2 REF: fall0924a2 STA: A2.S.4 TOP: Dispersion
KEY: variance


26 ANS: 2 PTS: 2 REF: fall0926a2 STA: A2.A.46 TOP: Transformations with Functions and Relations

27 ANS: 4

\begin{align*}
y - 2\sin \theta &= 3 \\
y &= 2\sin \theta + 3 \\
f(\theta) &= 2\sin \theta + 3
\end{align*}

PTS: 2 REF: fall0927a2 STA: A2.A.40 TOP: Functional Notation

28 ANS:

\[
\frac{5(3 + \sqrt{2})}{7} \cdot \frac{5}{3 - \sqrt{2}} \cdot \frac{3 + \sqrt{2}}{3 + \sqrt{2}} = \frac{5(3 + \sqrt{2})}{9 - 2} = \frac{5(3 + \sqrt{2})}{7}
\]

PTS: 2 REF: fall0928a2 STA: A2.N.5 TOP: Rationalizing Denominators

29 ANS:

\[
(x + 3)^2 + (y - 4)^2 = 25
\]

PTS: 2 REF: fall0929a2 STA: A2.A.49 TOP: Writing Equations of Circles

30 ANS:

\[
\frac{4x}{x - 3} = 2 + \frac{12}{x - 3}
\]

\[
\frac{4x - 12}{x - 3} = 2
\]

\[
\frac{4(x - 3)}{x - 3} = 2
\]

no solution.

\[
4 \neq 2
\]

PTS: 2 REF: fall0930a2 STA: A2.A.23 TOP: Solving Rationals
KEY: rational solutions
31 ANS:

\[ 197^\circ 40'. \quad 3.45 \times \frac{180}{\pi} \approx 197^\circ 40'. \]

PTS: 2  REF: fall0931a2  STA: A2.M.2  TOP: Radian Measure
KEY: degrees

32 ANS:

\[ 2,298.65. \]

PTS: 2  REF: fall0932a2  STA: A2.A.12  TOP: Evaluating Exponential Expressions

33 ANS:

\[ \frac{\sqrt{13}}{2} \cdot \sin \theta = \frac{y}{\sqrt{x^2 + y^2}} = \frac{2}{\sqrt{(-3)^2 + 2^2}} = \frac{2}{\sqrt{13}}. \quad \csc \theta = \frac{\sqrt{13}}{2}. \]

PTS: 2  REF: fall0933a2  STA: A2.A.62  TOP: Determining Trigonometric Functions

34 ANS:

\[-3, -5, -8, -12.\]

PTS: 2  REF: fall0934a2  STA: A2.A.33  TOP: Recursive Sequences

35 ANS:

\[ 41,040. \]

PTS: 2  REF: fall0935a2  STA: A2.S.12  TOP: Combinations
36 ANS:
3 ± \sqrt{7}. \ 2x^2 - 12x + 4 = 0
\begin{align*}
x^2 - 6x + 2 &= 0 \\
x^2 - 6x &= -2 \\
x^2 - 6x + 9 &= -2 + 9 \\
(x - 3)^2 &= 7 \\
x - 3 &= \pm\sqrt{7} \\
x &= 3 \pm \sqrt{7}
\end{align*}

PTS: 4 \hspace{1cm} REF: fall0936a2 \hspace{1cm} STA: A2.A.24 \hspace{1cm} TOP: Completing the Square

37 ANS:
\pm \frac{3}{2}, -\frac{1}{2} \hspace{1cm} 8x^3 + 4x^2 - 18x - 9 = 0
\begin{align*}
4x^2(2x + 1) - 9(2x + 1) &= 0 \\
(4x^2 - 9)(2x + 1) &= 0 \\
4x^2 - 9 &= 0 \text{ or } 2x + 1 = 0 \\
(2x + 3)(2x - 3) &= 0 \hspace{1cm} x = \frac{1}{2} \\
x &= \pm \frac{3}{2}
\end{align*}

PTS: 4 \hspace{1cm} REF: fall0937a2 \hspace{1cm} STA: A2.A.26 \hspace{1cm} TOP: Solving Polynomial Equations

38 ANS:
y = 2.001x^{2.298}, 1,009. \ y = 2.001(15)^{2.298} \approx 1009

PTS: 4 \hspace{1cm} REF: fall0938a2 \hspace{1cm} STA: A2.S.7 \hspace{1cm} TOP: Power Regression
ANS:

\[ r^2 = 25^2 + 85^2 - 2(25)(85)\cos 125. \]

\[ r^2 \approx 10287.7 \]

\[ r \approx 101.43 \]

\[
\frac{2.5}{\sin x} = \frac{101.43}{\sin 125}
\]

\[ x \approx 12 \]

PTS: 6

REF: fall0939a2

STA: A2.A.73

TOP: Vectors
0610a2
Answer Section

1. ANS: 3  PTS: 2  REF: 061001a2  STA: A2.A.30  TOP: Sequences

2. ANS: 2
\[
\frac{11\pi}{12} \cdot \frac{180}{\pi} = 165
\]

PT: 2  REF: 061002a2  STA: A2.M.2  TOP: Radian Measure

3. ANS: 3
\[
\frac{3^2}{(-2)^3} = \frac{9}{-8} = \frac{-9}{8}
\]

PT: 2  REF: 061003a2  STA: A2.A.8  TOP: Negative and Fractional Exponents

4. ANS: 1  PTS: 2  REF: 061004a2  STA: A2.A.52  TOP: Identifying the Equation of a Graph

5. ANS: 4  PTS: 2  REF: 061005a2  STA: A2.A.50  TOP: Solving Polynomial Equations

6. ANS: 3
\[
\sqrt{-300} = \sqrt{100} \sqrt{-1} \sqrt{3}
\]

PT: 2  REF: 061006a2  STA: A2.N.6  TOP: Square Roots of Negative Numbers

7. ANS: 3  PTS: 2  REF: 061007a2  STA: A2.S.9  TOP: Differentiating Permutations and Combinations

8. ANS: 4
\[
12x^4 + 10x^3 - 12x^2 = 2x^2(6x^2 + 5x - 6) = 2x^2(2x + 3)(3x - 2)
\]

PT: 2  REF: 061008a2  STA: A2.A.7  TOP: Factoring Polynomials

9. ANS: 4
\[
\frac{3 \pm \sqrt{(-3)^2 - 4(1)(-9)}}{2(1)} = \frac{3 \pm \sqrt{45}}{2} = \frac{3 \pm 3\sqrt{5}}{2}
\]

PT: 2  REF: 061009a2  STA: A2.A.25  TOP: Quadratic Formula

10. ANS: 1
\[
2\log x - (3\log y + \log z) = \log x^2 - \log y^3 - \log z = \log \frac{x^2}{y^3z}
\]

PT: 2  REF: 061010a2  STA: A2.A.19  TOP: Properties of Logarithms

12 ANS: 1
\[
\frac{\sqrt{3}+5}{\sqrt{3}-5} \cdot \frac{\sqrt{3}+5}{\sqrt{3}+5} = \frac{3+5\sqrt{3}+5\sqrt{3}+25}{3-25} = \frac{28+10\sqrt{3}}{-22} = \frac{14+5\sqrt{3}}{11}
\]

PTS: 2 REF: 061012a2 STA: A2.N.5 TOP: Rationalizing Denominators

13 ANS: 1 PTS: 2 REF: 061013a2 STA: A2.A.38
TOP: Defining Functions

14 ANS: 3
Cofunctions tangent and cotangent are complementary

PTS: 2 REF: 061014a2 STA: A2.A.58 TOP: Cofunction Trigonometric Relationships

15 ANS: 3

\[
\begin{align*}
4^{x^2+4x} & = 2^{-6} & 2x^2 + 8x & = -6 \\
(2^3)^{x^2+4x} & = 2^{-6} & 2x^2 + 8x + 6 & = 0 \\
2^{2x^2+8x} & = 2^{-6} & x^2 + 4x + 3 & = 0 \\
& & (x + 3)(x + 1) & = 0 \\
& & x = -3 & x = -1
\end{align*}
\]

PTS: 2 REF: 061015a2 STA: A2.A.27 TOP: Exponential Equations
KEY: common base shown

16 ANS: 2

\[
\begin{align*}
x^2 - 2x + y^2 + 6y & = -3 \\
x^2 - 2x + 1 + y^2 + 9 & = -3 + 1 + 9 \\
(x - 1)^2 + (y + 3)^2 & = 7
\end{align*}
\]

PTS: 2 REF: 061016a2 STA: A2.A.47 TOP: Equations of Circles

17 ANS: 1

\[
\begin{align*}
y & \geq x^2 - x - 6 \\
y & \geq (x - 3)(x + 2)
\end{align*}
\]

PTS: 2 REF: 061017a2 STA: A2.A.4 TOP: Quadratic Inequalities
KEY: two variables

18 ANS: 1 PTS: 2 REF: 061018a2 STA: A2.A.22
TOP: Solving Radicals KEY: extraneous solutions

19 ANS: 1 PTS: 2 REF: 061019a2 STA: A2.N.7
TOP: Imaginary Numbers
20 ANS: 3

PTS: 2 REF: 061020a2 STA: A2.A.71 TOP: Graphing Trigonometric Functions

21 ANS: 2 PTS: 2 REF: 061021a2 STA: A2.S.8 TOP: Correlation Coefficient

22 ANS: 3 PTS: 2 REF: 061022a2 STA: A2.A.63 TOP: Domain and Range

23 ANS: 1

\[ \cos K = \frac{5}{6} \]

\[ K = \cos^{-1} \frac{5}{6} \]

\[ K \approx 33^\circ 33' \]

PTS: 2 REF: 061023a2 STA: A2.A.55 TOP: Trigonometric Ratios

24 ANS: 1

\[ \cos^2 \theta - \cos 2\theta = \cos^2 \theta - (\cos^2 \theta - \sin^2 \theta) = \sin^2 \theta \]

PTS: 2 REF: 061024a2 STA: A2.A.77 TOP: Double Angle Identities KEY: simplifying

25 ANS: 1 PTS: 2 REF: 061025a2 STA: A2.A.34 TOP: Sigma Notation

26 ANS: 4 PTS: 2 REF: 061026a2 STA: A2.A.29 TOP: Sequences

27 ANS: 4

\[ \frac{2\pi}{b} = \frac{2\pi}{1} = 6\pi \]

28 ANS:

\[ b^2 - 4ac = 0 \]
\[ k^2 - 4(1)(4) = 0 \]
\[ k^2 - 16 = 0 \]
\[ (k + 4)(k - 4) = 0 \]
\[ k = \pm 4 \]

PTS: 2  
REF: 061028a2  
STA: A2.A.2  
TOP: Using the Discriminant  
KEY: determine equation given nature of roots

29 ANS:
7.4

PTS: 2  
REF: 061029a2  
STA: A2.S.4  
TOP: Dispersion  
KEY: basic, group frequency distributions

30 ANS:

\[
\text{Sum } \frac{-b}{a} = -\frac{11}{5}, \quad \text{Product } \frac{c}{a} = -\frac{3}{5} 
\]

PTS: 2  
REF: 061030a2  
STA: A2.A.20  
TOP: Roots of Quadratics

31 ANS:

\[
\begin{align*}
y &= 0 
\end{align*}
\]

PTS: 2  
REF: 061031a2  
STA: A2.A.53  
TOP: Graphing Exponential Functions

32 ANS:

\[
5\sqrt{3x^3} - 2\sqrt{27x^3} = 5\sqrt{x^2 \cdot 3x} - 2\sqrt{9x^2 \cdot 3x} = 5x\sqrt{3x} - 6x\sqrt{3x} = -x\sqrt{3x} 
\]

PTS: 2  
REF: 061032a2  
STA: A2.N.2  
TOP: Operations with Radicals
33 ANS:

![Unit Circle Diagram](image)

\[
\frac{\sqrt{3}}{2}
\]

PTS: 2   REF: 061033a2   STA: A2.A.60   TOP: Unit Circle

34 ANS:

\[K = \frac{absinC}{2} = 24 \cdot 30 \sin 57 \approx 604\]

PTS: 2   REF: 061034a2   STA: A2.A.74   TOP: Using Trigonometry to Find Area

KEY: parallelograms

35 ANS:

\[
\frac{1}{d} \cdot \frac{4}{2d} = \frac{d - 8}{2d} = \frac{d - 8}{2d} \times \frac{2d^2}{5d} = \frac{d - 8}{5}
\]

PTS: 2   REF: 061035a2   STA: A2.A.17   TOP: Complex Fractions

36 ANS:

\[0.167 \cdot C_8 \cdot 0.6^8 \cdot 0.4^2 + C_9 \cdot 0.6^9 \cdot 0.4^1 + C_{10} \cdot 0.6^{10} \cdot 0.4^0 \approx 0.167\]

PTS: 2   REF: 061036a2   STA: A2.S.15   TOP: Binomial Probability

KEY: at least or at most
37  ANS:  
0, 60, 180, 300.  
\[
\begin{align*}
\sin 2\theta &= \sin \theta \\
2 \sin \theta \cos \theta - \sin \theta &= 0 \\
\sin \theta (2 \cos \theta - 1) &= 0 \\
\sin \theta &= 0 \quad 2 \cos \theta - 1 = 0 \\
\theta &= 0, 180 \quad \cos \theta = \frac{1}{2} \\
\theta &= 60, 300
\end{align*}
\]

PTS: 2  
REF: 061037a2  
STA: A2.A.68  
TOP: Trigonometric Equations  
KEY: double angle identities

38  ANS:  
No. TENNESSEE: \( \frac{9P_9}{4! \cdot 2! \cdot 2!} = \frac{362,880}{96} = 3,780 \).  
VERMONT: \( 7P_7 = 5,040 \).  

PTS: 2  
REF: 061038a2  
STA: A2.S.10  
TOP: Permutations

39  ANS:  
33.  
\[
\begin{align*}
a &= \sqrt{10^2 + 6^2 - 2(10)(6) \cos 80} \approx 10.7. \\
\angle C \text{ is opposite the shortest side.} \\
\frac{6}{\sin C} &= \frac{10.7}{\sin 80} \\
C &\approx 33
\end{align*}
\]

PTS: 2  
REF: 061039a2  
STA: A2.A.73  
TOP: Law of Cosines  
KEY: advanced
0810a2
Answer Section

1 ANS: 4
\[(3 + \sqrt{5})(3 - \sqrt{5}) = 9 - \sqrt{25} = 4\]

PTS: 2 REF: 081001a2 STA: A2.N.2 TOP: Operations with Radicals

2 ANS: 1
\[-420 \left( \frac{\pi}{180} \right) = \frac{7\pi}{3} \]

PTS: 2 REF: 081002a2 STA: A2.M.2 TOP: Radian Measure
KEY: radians

3 ANS: 2 PTS: 2 REF: 081003a2 STA: A2.A.51 TOP: Domain and Range

4 ANS: 1
\[2i^2 + 3i^3 = 2(-1) + 3(-i) = -2 - 3i\]

PTS: 2 REF: 081004a2 STA: A2.N.7 TOP: Imaginary Numbers

5 ANS: 4 PTS: 2 REF: 081005a2 STA: A2.A.60 TOP: Unit Circle

6 ANS: 3
\[\frac{59.2}{\sin 74^\circ} = \frac{60.3}{\sin C} \quad 180 - 78.3 = 101.7 \]
\[C \approx 78.3^\circ\]

PTS: 2 REF: 081006a2 STA: A2.A.75 TOP: Law of Sines - The Ambiguous Case

7 ANS: 3 PTS: 2 REF: 081007a2 STA: A2.A.64 TOP: Using Inverse Trigonometric Functions
KEY: basic

8 ANS: 4
\[9^{3x+1} = 27^{x+2} \]
\[(3^2)^{3x+1} = (3^3)^{x+2} \]
\[3^{6x+2} = 3^{3x+6} \]
\[6x + 2 = 3x + 6 \]
\[3x = 4 \]
\[x = \frac{4}{3} \]

PTS: 2 REF: 081008a2 STA: A2.A.27 TOP: Exponential Equations
KEY: common base not shown
9 \[ ANS: \frac{3}{2} \]
\[ \frac{-7 \pm \sqrt{7^2 - 4(2)(-3)}}{2(2)} = \frac{-7 \pm \sqrt{73}}{4} \]

PTS: 2 \hspace{1em} REF: 081009a2 \hspace{1em} STA: A2.A.25 \hspace{1em} TOP: Quadratic Formula

10 \[ ANS: 2 \]
TOP: Trigonometric Ratios

11 \[ ANS: 2 \]
\[ \left( \frac{w^{-5}}{w^{-9}} \right)^{\frac{1}{2}} = (w^4)^{\frac{1}{2}} = w^2 \]

PTS: 2 \hspace{1em} REF: 081011a2 \hspace{1em} STA: A2.A.8 \hspace{1em} TOP: Negative and Fractional Exponents

12 \[ ANS: 2 \]
\[ _{15}C_8 = 6,435 \]

PTS: 2 \hspace{1em} REF: 081012a2 \hspace{1em} STA: A2.S.11 \hspace{1em} TOP: Combinations

13 \[ ANS: 3 \]
\[ 68\% \times 50 = 34 \]

PTS: 2 \hspace{1em} REF: 081013a2 \hspace{1em} STA: A2.S.5 \hspace{1em} TOP: Normal Distributions

14 \[ ANS: 1 \]
common difference is 2. \( b_n = x + 2n \)
\[ 10 = x + 2(1) \]
\[ 8 = x \]

PTS: 2 \hspace{1em} REF: 081014a2 \hspace{1em} STA: A2.A.29 \hspace{1em} TOP: Sequences

15 \[ ANS: 2 \]
\[ x^2 - x - 6 = 3x - 6 \]
\[ x^2 - 4x = 0 \]
\[ x(x - 4) = 0 \]
\[ x = 0, 4 \]

PTS: 2 \hspace{1em} REF: 081015a2 \hspace{1em} STA: A2.A.3 \hspace{1em} TOP: Quadratic-Linear Systems

16 \[ ANS: 4 \]
\[ b^2 - 4ac = 3^2 - 4(9)(-4) = 9 + 144 = 153 \]

PTS: 2 \hspace{1em} REF: 081016a2 \hspace{1em} STA: A2.A.2 \hspace{1em} TOP: Using the Discriminant

KEY: determine nature of roots given equation
17 ANS: 4
\[ 7^2 = 3^2 + 5^2 - 2(3)(5) \cos A \]
\[ 49 = 34 - 30 \cos A \]
\[ 15 = -30 \cos A \]
\[ \frac{1}{2} = \cos A \]
\[ 120 = \cos A \]

PTS: 2  REF: 081017a2  STA: A2.A.73  TOP: Law of Sines

KEY: angle, without calculator

18 ANS: 2
\[
\frac{x^{-1} - 1}{x - 1} = \frac{\frac{1}{x} - 1}{x - 1} = \frac{\frac{1-x}{x}}{x-1} = \frac{-(x-1)}{x} = \frac{1}{x}
\]

PTS: 2  REF: 081018a2  STA: A2.A.9  TOP: Negative Exponents

19 ANS: 3
\[
\frac{3}{\sqrt{3a^2b}} = \frac{3}{a\sqrt{3b}} = \frac{\sqrt{3b}}{\sqrt{3b}} = \frac{3\sqrt{3b}}{3ab} = \frac{\sqrt{3b}}{ab}
\]

PTS: 2  REF: 081019a2  STA: A2.A.15  TOP: Rationalizing Denominators

KEY: index = 2

20 ANS: 3
(1) and (4) fail the horizontal line test and are not one-to-one. Not every element of the range corresponds to only one element of the domain. (2) fails the vertical line test and is not a function. Not every element of the domain corresponds to only one element of the range.

PTS: 2  REF: 081020a2  STA: A2.A.43  TOP: Defining Functions

21 ANS: 3
\[ K = (10)(18) \sin 46 \approx 129 \]

PTS: 2  REF: 081021a2  STA: A2.A.74  TOP: Using Trigonometry to Find Area

KEY: parallelograms

22 ANS: 1  PTS: 2  REF: 081022a2  STA: A2.A.46  TOP: Transformations with Functions and Relations

23 ANS: 2
The roots are \(-1, 2, 3\).

PTS: 2  REF: 081023a2  STA: A2.A.50  TOP: Solving Polynomial Equations

24 ANS: 2  PTS: 2  REF: 081024a2  STA: A2.N.8  TOP: Conjugates of Complex Numbers
25 ANS: 3
\[ 27r^{4-1} = 64 \]
\[ r^3 = \frac{64}{27} \]
\[ r = \frac{4}{3} \]

PTS: 2 REF: 081025a2 STA: A2.A.31 TOP: Conjugates of Complex Numbers

26 ANS: 3
\[ \text{period} = \frac{2\pi}{b} = \frac{2\pi}{3\pi} = \frac{2}{3} \]

PTS: 2 REF: 081026a2 STA: A2.A.70 TOP: Graphing Trigonometric Functions KEY: recognize

27 ANS: 3 PTS: 2 REF: 081027a2 STA: A2.A.44 TOP: Inverse of Functions KEY: equations

28 ANS:
\[ 10ax^2 - 23ax - 5a = a(10x^2 - 23x - 5) = a(5x + 1)(2x - 5) \]

PTS: 2 REF: 081028a2 STA: A2.A.7 TOP: Factoring Polynomials KEY: multiple variables

29 ANS:
\[ \sum_{n=1}^{15} 7n \]

PTS: 2 REF: 081029a2 STA: A2.A.34 TOP: Sigma Notation

30 ANS:
Controlled experiment because Howard is comparing the results obtained from an experimental sample against a control sample.

PTS: 2 REF: 081030a2 STA: A2.S.1 TOP: Analysis of Data

31 ANS:
\[ y = 10.596(1.586)^x \]

PTS: 2 REF: 081031a2 STA: A2.S.7 TOP: Exponential Regression

32 ANS:
\[ 45, 225 \]
\[ 2\tan C - 3 = 3\tan C - 4 \]
\[ 1 = \tan C \]
\[ \tan^{-1} 1 = C \]
\[ C = 45, 225 \]

PTS: 2 REF: 081032a2 STA: A2.A.68 TOP: Trigonometric Equations KEY: basic
33 ANS:
\[(x + 5)^2 + (y - 3)^2 = 32\]

PTS: 2 REF: 081033a2 STA: A2.A.49 TOP: Writing Equations of Circles

34 ANS:
\[
\frac{4}{9} x^2 - \frac{4}{3} x + 1 \cdot \left(\frac{2}{3} x - 1\right)^2 = \left(\frac{2}{3} x - 1\right) \left(\frac{2}{3} x - 1\right) = \frac{4}{9} x^2 - \frac{2}{3} x - \frac{2}{3} x + 1 = \frac{4}{9} x^2 - \frac{4}{3} x + 1
\]

PTS: 2 REF: 081034a2 STA: A2.N.3 TOP: Operations with Polynomials

35 ANS:
\[
39,916,800. \quad \frac{12! P_{12}}{3! \cdot 2!} = \frac{479,001,600}{12} = 39,916,800
\]

PTS: 2 REF: 081035a2 STA: A2.S.10 TOP: Permutations

36 ANS:
\[
\frac{1}{3} \frac{1}{x + 3} - \frac{2}{3 - x} = \frac{4}{x^2 - 9}
\]
\[
\frac{1}{x + 3} + \frac{2}{x - 3} = \frac{4}{x^2 - 9}
\]
\[
\frac{x - 3 + 2(x + 3)}{(x + 3)(x - 3)} = \frac{4}{(x + 3)(x - 3)}
\]
\[
x - 3 + 2x + 6 = 4
\]
\[
3x = 1
\]
\[
x = \frac{1}{3}
\]

PTS: 4 REF: 081036a2 STA: A2.A.23 TOP: Solving Rationals

KEY: rational solutions
\[ \frac{23}{2} \cos^2 B + \sin^2 B = 1 \]
\[ \tan B = \frac{\sin B}{\cos B} = \frac{\frac{5}{\sqrt{41}}}{\frac{3}{4}} = \frac{5}{4} \]
\[ \tan(A + B) = \frac{\frac{5}{3} + \frac{5}{4}}{1 - \left( \frac{3}{4} \right) \left( \frac{5}{4} \right)} = \frac{12}{12} = \frac{23}{12} = \frac{23}{2} \]

\[ \cos^2 B + \left( \frac{5}{\sqrt{41}} \right)^2 = 1 \]
\[ \cos^2 B + \frac{25}{41} = \frac{41}{41} \]
\[ \cos^2 B = \frac{16}{41} \]
\[ \cos B = \frac{4}{\sqrt{41}} \]

PTS: 4  
REF: 081037a2  
STA: A2.A.76  
TOP: Angle Sum and Difference Identities

KEY: evaluating

38 ANS:
\[ 26.2\% = \binom{10}{8} \cdot 0.65^8 \cdot 0.35^2 + \binom{10}{9} \cdot 0.65^9 \cdot 0.35^1 + \binom{10}{10} \cdot 0.65^{10} \cdot 0.35^0 = 0.262 \]

PTS: 4  
REF: 081038a2  
STA: A2.S.15  
TOP: Binomial Probability

KEY: at least or at most

39 ANS:
\[ x = -\frac{1}{3}, -1 \]
\[ \log_{x+3} \left( \frac{x^3 + x - 2}{x} \right) = 2 \]
\[ \frac{x^3 + x - 2}{x} = (x + 3)^2 \]
\[ x^3 + x - 2 = x^2 + 6x + 9 \]
\[ x^3 + x - 2 = x^3 + 6x^2 + 9x \]
\[ 0 = 6x^2 + 8x + 2 \]
\[ 0 = 3x^2 + 4x + 1 \]
\[ 0 = (3x + 1)(x + 1) \]
\[ x = -\frac{1}{3}, -1 \]

PTS: 6  
REF: 081039a2  
STA: A2.A.28  
TOP: Logarithmic Equations

KEY: basic