Kansas City Area Teachers of Mathematics
2016 KCATM Contest

Mathletics

Grade 6

Instructions:

- Do **NOT** turn this page until instructed to do so.
- WRITE YOUR **TEAM NUMBER** AND **SCHOOL NAME** ON THE LINE PROVIDED ON THE FRONT OF EACH SHEET EACH TIME YOU BEGIN A NEW PROBLEM.
- **You will want to use a calculator on this test, but NO cell phones calculators can be used!**
- Blank scratch paper can be used. Please do **NOT** write on the team number card, as they are reused each year.
- You may **not** use rulers, protractors or other measurement devices on this test.

Problem # 1

2 minutes, 2 points

Team Number: _____ **School:** _____

Students: _____

_____

_____

Problem 1 (2 minutes, 2 points)
Palette of Problems, NCTM Mathematics Teaching in the Middle School, March 2016

In Missoula, Montana, a public awareness campaign warns pet owners of the dangers of leaving pets in vehicles. A billboard contains the following information:

Temperature outside Car (Degrees Fahrenheit)	Temperature inside Car (Degrees Fahrenheit)
70^o	90^o
85^o	102^o

Assuming that the relationship between the two temperatures is linear, **what is the temperature inside the car when the temperature outside the car is 90^o Fahrenheit?**

Answer: _____^{o}

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Problem # 2

3 minutes, 3 points

Do NOT turn the page until you are told to do so.

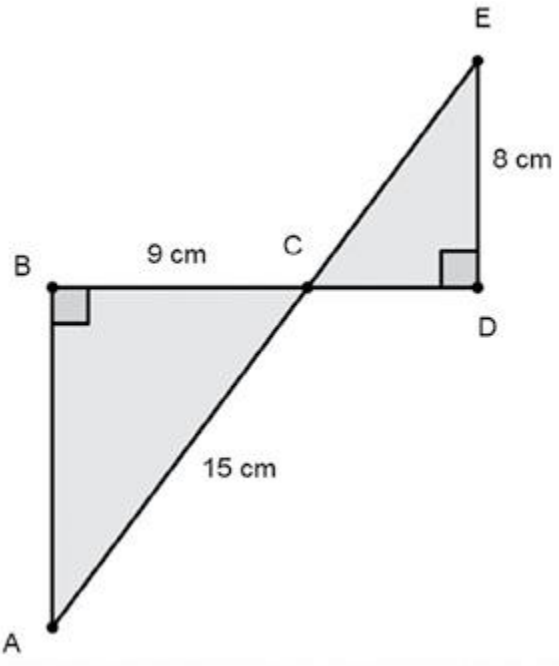
Team Number: _____ School: _____

Problem 2 *(3 points, 3 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, March 2016

In the figure, line BD intersects line AE at point C. The length of BC is 9 cm, the length of AC is 15 cm, and the length of ED is 8 cm.

Find the combined area of triangle ABC and triangle DEC.

Hint: Use the Pythagorean Thm: $a^2 + b^2 = c^2$ to find AB and set up similar triangles.



Answer: _____ sq. units

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Problem # 3

1 minute, 1 point

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 3 *(1 point, 1 minute)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, February 2016

What percentage of 5/6 is 1/24?

Answer: _____ %

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Problem # 4

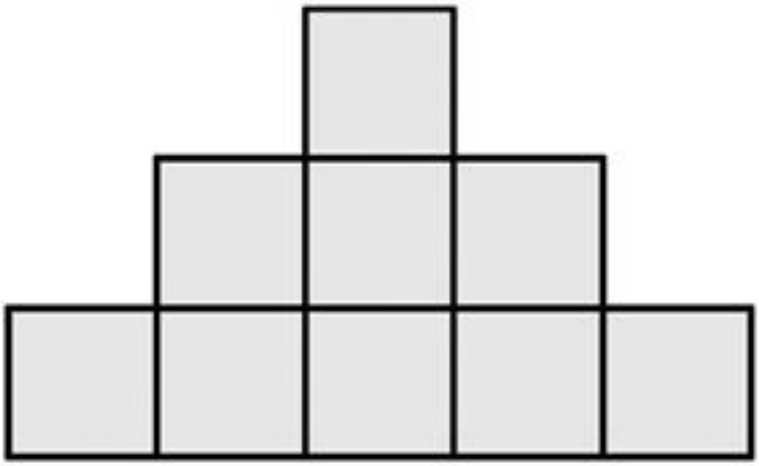
2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 4 *(2 points, 2 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, February 2016

How many rectangles, of any size, are in the figure below?



Answer: _____

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Problem # 5

2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 5 *(2 points, 2 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, February 2016

In the correct, two-decimal-place subtraction shown below, the letters *a, b,* and *c* represent single digits.

Which digit does *c* represent?

$$\begin{array}{r} ab \\ -\,ba \\ \hline c4 \end{array}$$

Answer: C = _____

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Problem # 6

2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 6 *(2 minutes, 2 points)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, February 2016

Find **two** pair of integers (x, y) that satisfy both

$$x + y = 2 \text{ and } x + y^2 = 4$$

Answers: (____, ____) and (____, ____)

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Problem # 7

3 minutes, 3 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 7 *(3 minutes, 3 points)*

Palette of Problems, NCTM Mathematics Teaching in the Middle School, November 2015

At Matt's house, it takes 23 seconds for hot water to reach the faucet after the water is turned on. **How many gallons of water are wasted each year** if it takes 4 seconds to fill an 8-ounce cup of water and Matt "waits for hot water" 3 times a day? *(Hint: There are 128 ounces in a gallon.)*

Answer: _____ gallons

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Problem # 8

3 minutes, 3 points

Do NOT turn the page until you are told to do so.

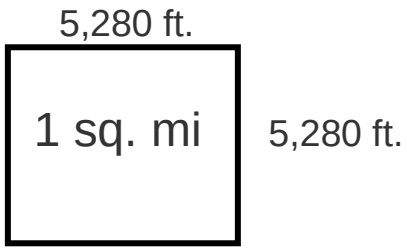
Team Number: _____ School: _____

Problem 8 *(3 points, 3 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, October 2015

The dry weather has caused several fires across the U.S. this fall and spring.

The “Big Burn” was the largest forest fire in U.S. history. It burned about 3 million acres in Washington, Idaho, and Montana in August of 1910.

How many square miles are equivalent to 3 million acres?
(Hint: An acre is equal to 43,560 ft.^{2}.)



Answer: _____sq. miles

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Problem # 9

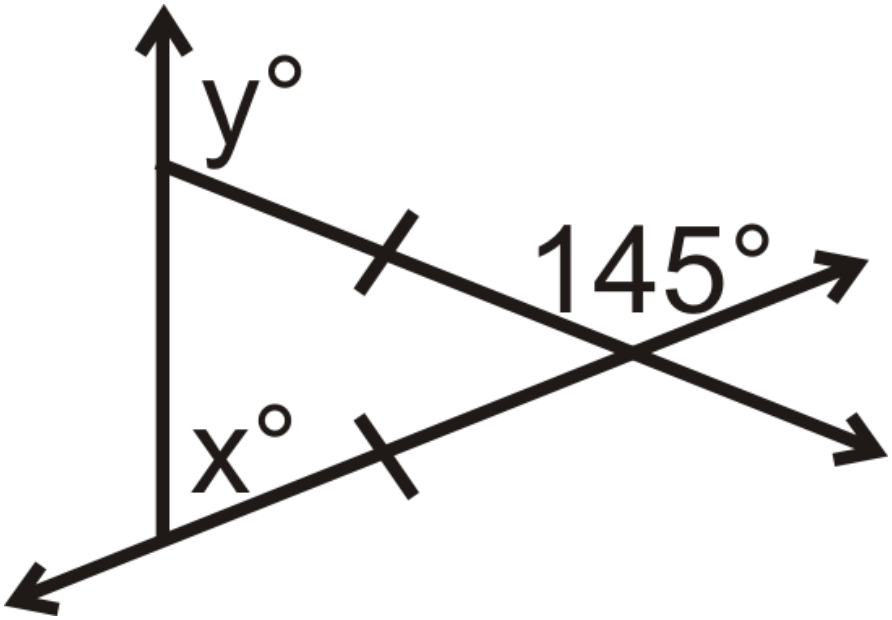
1 minute, 1 point

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 9 *(1 point, 1 minute)*

Find the angle measures of x and y in the diagram below.



x^o = _____

y^o = _____

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Problem # 10

2 minutes, 2 points

Do NOT turn the page until you are told to do so.

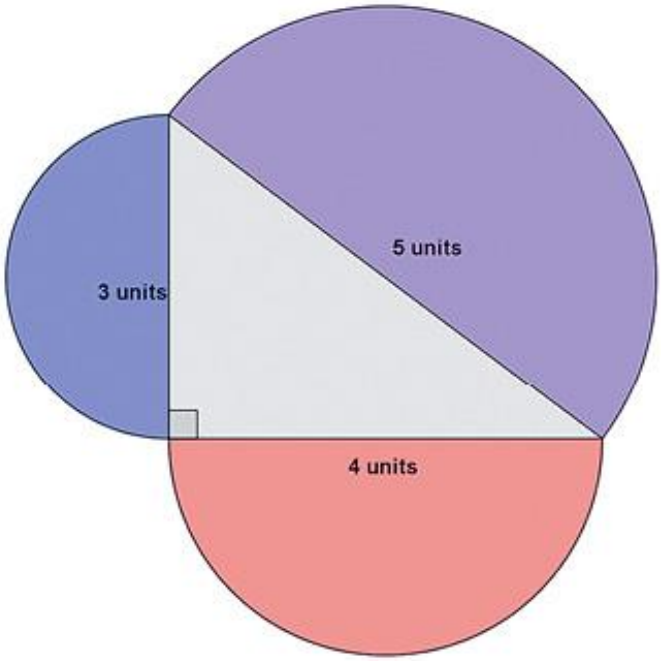
Team Number: _____ School: _____

Problem 10 *(2 points, 2 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, October 2015

A semicircle is constructed on each of the legs of a 3-4-5 right triangle as shown in the diagram below.

Find the exact area for each semicircle **in terms of π.**

Answers can be fractions or decimals. Round any decimal values to the nearest tenth.



Answers:

Smallest Circle:_____ π units^2

Medium sized Circle:_____ π units^2

Largest Circle:_____ π units^2

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Problem # 11

2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 11 *(2 points, 2 minutes)*
Adapted from Palette of Problems, NCTM Mathematics Teaching in the Middle School, October 2015

Simplify. Keep your answer in fraction form.

$$\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{3+\frac{1}{2}}}}$$

Answer: _____

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Problem # 12

1 minute, 1 point

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 12 *(1 point, 1 minute)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, October 2015

The sum of the odd integers between 1 and 99 (inclusive) is 2500.

What is the sum of the even integers between 2 and 100 (inclusive)?

Answer: _____

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Problem # 13

3 minutes, 3 points

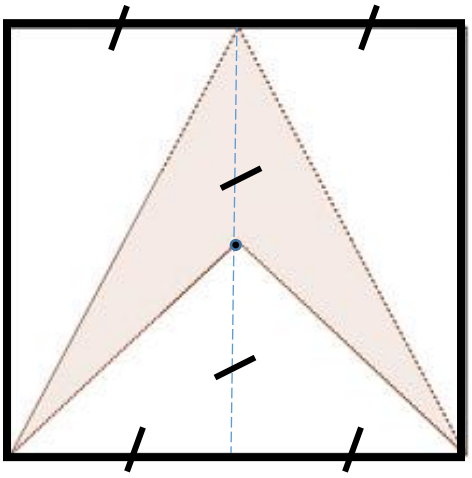
Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 13 ***(3 points, 3 minutes)***

Adapted from Palette of Problems, NCTM Mathematics Teaching in the Middle School, December.2015

The arrow, or dart, shown in the figure **lies inside a square** with **side length 2**. The arrow was drawn by connecting two corners of the square to the midpoint of the opposite side and to the **center** of the square. **What is the area of the dart?** (A center line was added to help you.)



2 units

Answer: _____sq. units

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Problem # 14

1 minute, 1 point

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 14 *(1 point, 1 minute)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, December.2015

If you combine some or all the numbers 2, 3, and 5 using addition and subtraction, you can produce many different results. For example, 2 – 3 + 5 = 4. In fact, you can produce all the whole numbers from 1 to 10 in this way except one number. **Which one number 1-10 <u>cannot</u> be made?**

Answer: _____

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Problem # 15

2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 15 (2 points, 2 minutes)

Palette of Problems, NCTM Mathematics Teaching in the Middle School, August.2015

What fraction is located **3/4 of the distance** between 1 2/3 and 4 1/2?

Answer: _____

TEAM #: _____ **School Name** _____

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Grade 5

Problem # 16

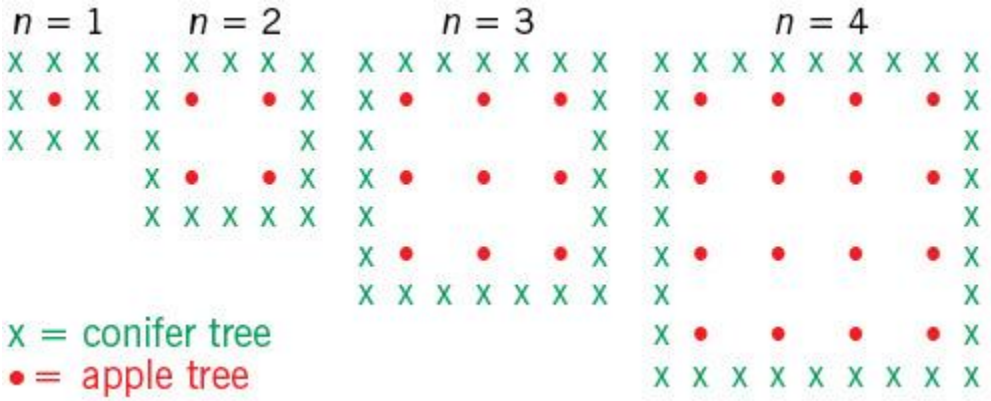
2 minutes, 2 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 16 *(2 points, 2 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, August.2015

A farmer plants apple trees in a square pattern. To protect the apple trees against the wind, he plants conifer trees all around the orchard. The diagram below shows the pattern of apple trees and conifer trees for any number of rows (*n*) of apple trees. **How many apple and conifer trees are needed for *n* = 5?** (Source: PISA released items)



Answers:

Apple Trees:_____

Conifers: _____

TEAM #: _____ **School Name** _____

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Problem # 17

3 minutes, 3 points

Do NOT turn the page until you are told to do so.

Team Number: _____ School: _____

Problem 17 *(3 points, 3 minutes)*
Palette of Problems, NCTM Mathematics Teaching in the Middle School, August 2015

Amanda has purchased a new aquarium that is built in the shape of a cylinder. The **diameter of the cylinder is 2 feet**, and its fill **height is 15 inches.**

What is the whole number of gallons of water Amanda should purchase to have enough to fill her aquarium?
*(Hint: There are **231 cubic inches** in a gallon.)*

$$V = \pi r^2 h$$

Answer: _____gallons

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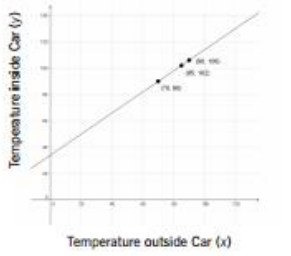
Answer Key

#	PTS	Ans.	Solutions - Process
1	2	106º	**106º** 4. The slope of the line connecting any two points of the form (temperature outside, temperature inside) is a constant. First find the slope, m, of the line that passes through (70, 90) and (85, 102): $m = \frac{102-90}{85-70} = \frac{12}{15} = \frac{4}{5}$ One slope interpretation is as follows, "For every 5 degree increase in outside temperature, there is a 4 degree increase in inside temperature." Apply this interpretation of slope to conclude that when the temperature outside is 85 + 5 = 90 degrees, the temperature inside will be 102 + 4 = 106 degrees. A graphical representation of this analysis is shown below.  *Palette of Problems, NCTM Mathematics Teaching in the Middle School, March 2016*
2	3	78cm²	**78** $AB^2 + 9^2 = 15^2 \Rightarrow AB^2 + 81 = 225 \Rightarrow AB^2 = 144 \Rightarrow AB = 12$ The ratio of lengths of corresponding sides in the two similar triangles is equal to $AB/ED = 12/8 = 3/2.$ $\frac{3}{2} = \frac{9}{CD} \Rightarrow 3 \cdot CD = 18 \Rightarrow CD = 18 \div 3 \Rightarrow CD = 6$ With these lengths now in hand, compute the two areas of the two triangles: The combined area of the two triangles is 54 + 24 = 78 cm². *Palette of Problems, NCTM Mathematics Teaching in the Middle School, March 2016*
3	1	5%	**5%** (1/24) / (5/6) = 0.05 = 5% *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Feb. 2016*

4	**2**	**30**	**30 rectangles**
5	**6**	**5**	11. The difference between the numbers ab and ba is 10(a – b) + (b – a) = 9(a – b), showing that the difference must be divisible by 9. There is only one two-digit multiple of 9 that ends in a 4 that is 6 × 9 = 54. Therefore, c represents the digit 5. *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Feb. 2016*
6	**2**	**(0,2) (3,-1)**	**(0,2) and (3,-1)** Subtract the equations to learn that y 2 – y = 2. This tells us that either y = 2 or y = –1. So the pairs are (0, 2) and (3, –1). A single y added to each y will give 2. *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Feb. 2016*
7	**3**	**393.5 gal. +/- 1 gal.**	**Approximately 393.5 gallons** $8 \times \left(\frac{23}{4}\right) = 46$ oz. of water. Three such "waits for hot water" will waste $3 \times 46 = 138$ oz. of water per day. In 365 days, daily waits for hot water will waste $138 \times 365 = 50{,}370$ oz. of water per year. Since there are 128 ounces in a gallon, the amount of water wasted is $50{,}370 \text{ oz.} \times \left(\frac{1 \text{ gal.}}{128 \text{ oz.}}\right) = \frac{25{,}185}{64} \approx 393.5 \text{ gal.}$ per year. *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Nov. 2015*
8	**3**	**4,687.5 mi.^{2}**	**4,687.5 mi.^{2}** There are 5,280 feet in a mile, so 1 square mile has 5,280 × 5,280 = 27,878,400 ft.^{2} . The fire burned about 3,000,000 acres, or 3,000,000 × 43,560 = 130,680,000,000 ft.^{2} . To convert to square miles, divide the last result by the number of square feet in a mile, that is, 130,680,000,000 ÷ 27,878,400 = **4687.5 mi.^{2}** . *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Oct. 2015*
9	**1**	**x = 72.5º y = 107.5º**	**x = 72.5º; y = 107.5º** Vertex angle = 180 – 145 = 35. Isosceles triangle, so base angles = (180-35)/2 = 145/2 = 72.5º Exterior angle = 180-72.5 = 107.5º
10	**2**	$\frac{9\pi}{8}$, 2π, $\frac{25\pi}{8}\pi$	$\frac{9\pi}{8} = 1.125\pi$, 2π, and $\frac{25\pi}{8} = 3.125\pi$ blue semicircle is 1/2(3) = 3/2 units and the area is: $A_{blue} = \frac{1}{2}\pi\left(\frac{3}{2}\right)^2 = \frac{1}{2}\pi\left(\frac{9}{4}\right) = \frac{9\pi}{8}$ Similarly, the area of the red semi-circle is: $A_{blue} = \frac{1}{2}\pi\left(\frac{4}{2}\right)^2 = \frac{1}{2}\pi\left(\frac{16}{4}\right) = \frac{16\pi}{8}$ The area of the purple is: $A_{blue} = \frac{1}{2}\pi\left(\frac{5}{2}\right)^2 = \frac{1}{2}\pi\left(\frac{25}{4}\right) = \frac{25\pi}{8}$ *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Oct. 2015*
11	**2**	**16/23**	**16/23**
12	**1**	**2550**	**2550** 11. There are 50 numbers in each of these sums, and each number in the second sum is 1 more than a number in the first sum. The evens add to (2500) + 50 = 2550. *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Oct. 2015*
13	**3**	**1**	**1 sq. unit**

			Take the area of the square,4, minus the 3 white triangles, each 1 sq. unit *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Dec. 2015*
14	**1**	9	**9** *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Aug. 2015*
15	**2**	3 19/24	**3 19/24** $\frac{3}{4}\times\frac{17}{6}=\frac{17}{8}$, add 17/8 and 1 2/3: $4\frac{1}{2}-1\frac{2}{3}=\frac{9}{2}-\frac{5}{3}=\frac{27}{6}-\frac{10}{6}=\frac{17}{6}$ $1\frac{2}{3}+\frac{17}{8}=\frac{5}{3}+\frac{17}{8}=\frac{40}{24}+\frac{51}{24}=\frac{91}{24}=3\frac{19}{24}$ *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Aug 2015*
16	**2**	**25 a 40 c**	**25 apple trees and 40 conifer trees**
17	**3**	**30**	**30 gallons** $V=\pi r^2 h$ $=\pi(12)^2 15$ $=2160\pi$ ≈ 6786 in.^{3} There are 231 in.^{3} in a gallon. Amanda will need $6786\div 231\approx 29.37$ gal. *Palette of Problems, NCTM Mathematics Teaching in the Middle School, Aug. 2015*
	35		**TOTAL POINTS**