Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Record your answers on your separate answer sheet. [48]

1 On the set of axes below, $\triangle AB'C'$ is the image of $\triangle ABC$.

Use this space for computations.

Omit #20

$\pi \Leftrightarrow 360°$

$BC(k) = B'C'$

$\dfrac{2K}{2} = \dfrac{4}{2}$

$k = 2$
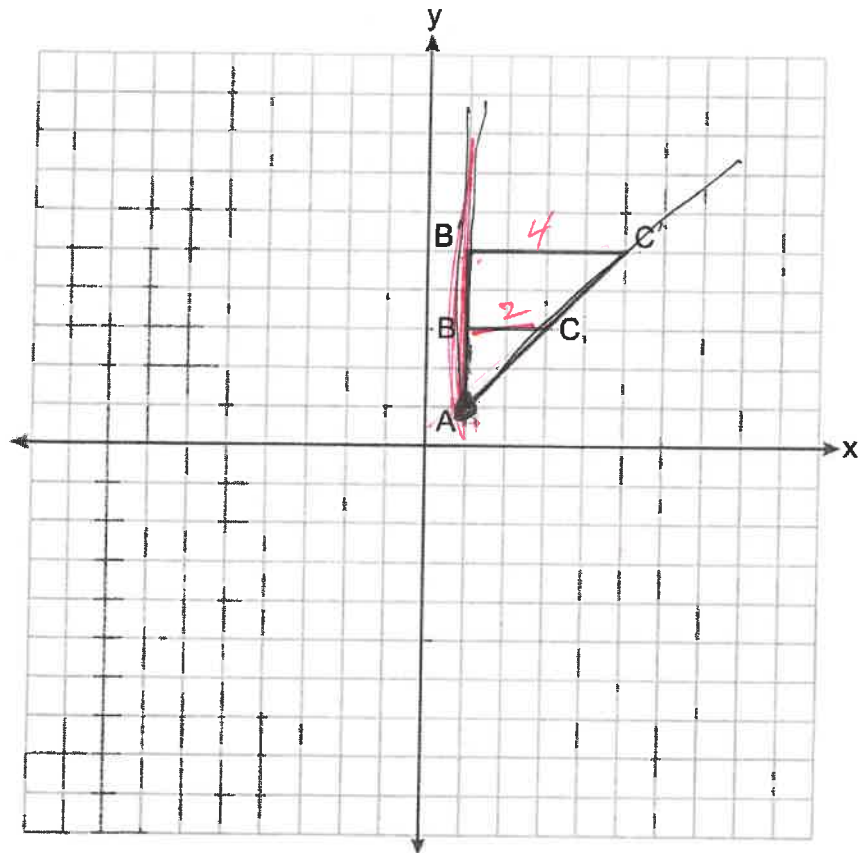
What is the scale factor and center of dilation that maps $\triangle ABC$ onto $\triangle AB'C'$?

(1) $\frac{1}{2}$ and the origin

(3) $\frac{1}{2}$ and vertex A

(2) 2 and the origin
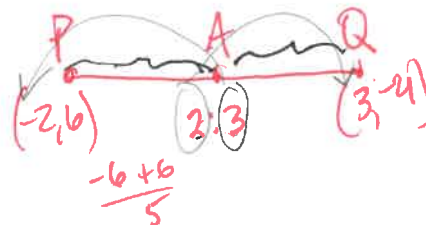
(4) 2 and vertex A

$\dfrac{24.7}{10}$

2 Line segment *PAQ* has endpoints whose coordinates are $P(-2,6)$ and $Q(3,-4)$. What are the coordinates of point *A*, such that *PA*:*AQ* = 2:3?
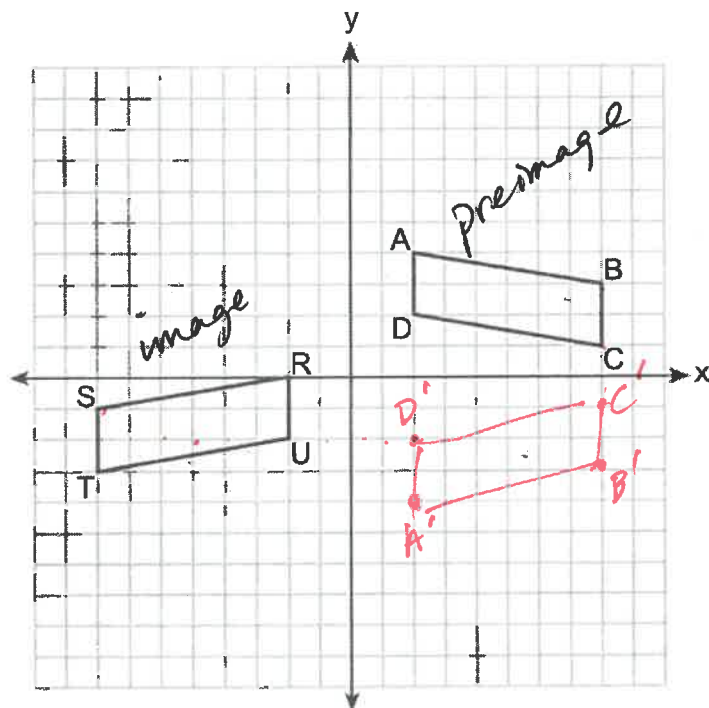
(1) $(1,0)$

(3) $(-1,4)$

(2) $(2,-2)$

(4) $(0,2)$

3 On the set of axes below, congruent parallelograms *ABCD* and *RSTU* are graphed.

Which sequence of transformations maps *ABCD* onto *RSTU*?

(1) a reflection over the *x*-axis followed by a translation ten units to the left and one unit up

(2) a translation four units down followed by a reflection over the *y*-axis

(3) a reflection over the *y*-axis followed by a translation of two units down

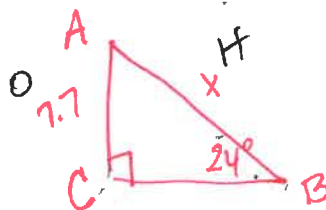(4) a translation ten units to the left followed by a reflection over the *x*-axis

4 Triangle ABC has a right angle at C. If $AC = 7.7$ and $m\angle B = 24°$, what is AB, to the *nearest tenth*?

(1) 18.9

(2) 17.3

(3) 8.4

(4) 3.1

Handwritten work:
A, O, 7.7, H, x, C, 24°, B

$\sin 24 = \dfrac{7.7}{x}$

$x = \dfrac{7.7}{\sin 24}$

5 Given $\triangle PQR$ and $\triangle LMN$ with $\overline{PQ} \cong \overline{LM}$, which additional statement is sufficient to always prove $\triangle PQR \cong \triangle LMN$?

(1) $\overline{QR} \cong \overline{MN}$ and $\angle R \cong \angle N$ — ASS

(2) $\overline{QR} \cong \overline{MN}$ and $\angle Q \cong \angle M$

(3) $\overline{QR} \cong \overline{MN}$ and $\angle P \cong \angle L$ — ASS

(4) $\overline{QR} \cong \overline{MN}$ and $\angle P \cong \angle M$ — don't correspond

Handwritten diagram: Q, P, R, M, L, N

6 The equation of a circle is $x^2 + 6y = 4x - y^2 + 12$. What are the coordinates of the center and the length of the radius?

Handwritten work:
$x^2 - 4x + y^2 + 6y = 12$

$\left(\dfrac{4}{2}\right)^2$ $\left(\dfrac{6}{2}\right)^2$

$(x^2 - 4x + 4) + (y^2 + 6y + 9) = 12 + 13$

$(x-2)^2 + (y+3)^2 = 25$

$= 25$ $(4+9)$

(1) center $(2,-3)$ and radius 5

(2) center $(-2,3)$ and radius 5

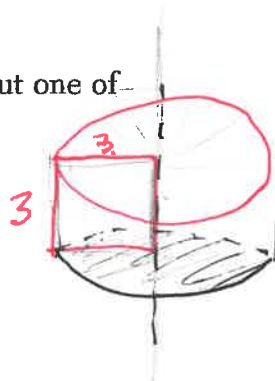(3) center $(2,-3)$ and radius 25

(4) center $(-2,3)$ and radius 25

7 A square with a side length of 3 is continuously rotated about one of its sides. The resulting three-dimensional object is a

(1) cube with a volume of 9.

(2) cube with a volume of 27.

(3) cylinder with a volume of 27π.

(4) cylinder with a volume of 54π.

Handwritten work:
3, 3

$V = Bh$

$(\pi r^2)h$ $(\pi 3^2)3$

27π

(handwritten top: $\frac{4y}{4} = \frac{7x}{4} - \frac{3}{4}$)

8 Line k is represented by the equation $4y + 3 = 7x$. Which equation represents a line that is perpendicular to line k and passes through the point $(-5, 2)$?

(1) $y + 2 = \frac{4}{7}(x - 5)$

(3) $y + 2 = -\frac{4}{7}(x - 5)$
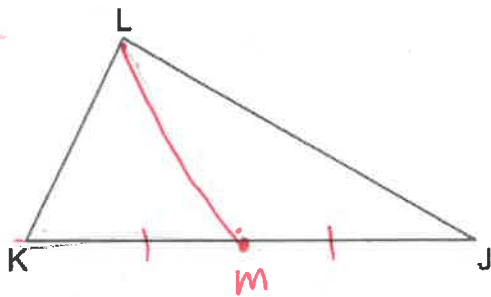
(2) $y - 2 = \frac{4}{7}(x + 5)$

(4) $y - 2 = -\frac{4}{7}(x + 5)$

(handwritten: $\perp_m = -\frac{4}{7}$)

(handwritten: $y - y_1 = m(x - x_1)$ $\frac{y - y_1}{(x - x_1)} = m$)

9 Scalene triangle JKL is drawn below.

If median $\overline{LM}$ is drawn to side $\overline{KJ}$, which statement is always true?
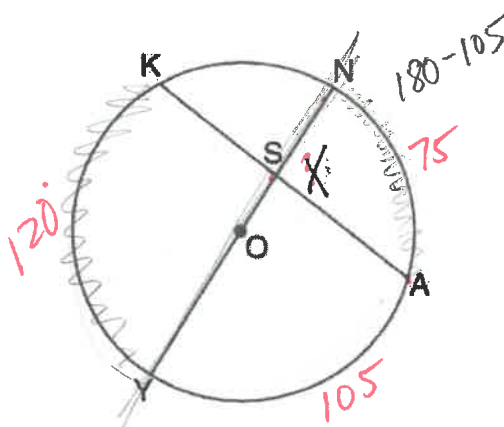
(1) $LM = KM$

(3) $\overline{LM} \perp \overline{KJ}$

(2) $KM = \frac{1}{2}KJ$

(4) $\angle KLM \cong \angle JLM$

10 In circle O, chord $\overline{KA}$ intersects diameter $\overline{YN}$ at S.

(handwritten: $180 - 105$ 75 $\frac{195}{2} =$ $120 + 75 = $ angle $\frac{120 + 75}{2} = $ angle 120 105)

If $m\overarc{YK} = 120°$ and $m\overarc{YA} = 105°$, what is $m\angle ASN$?
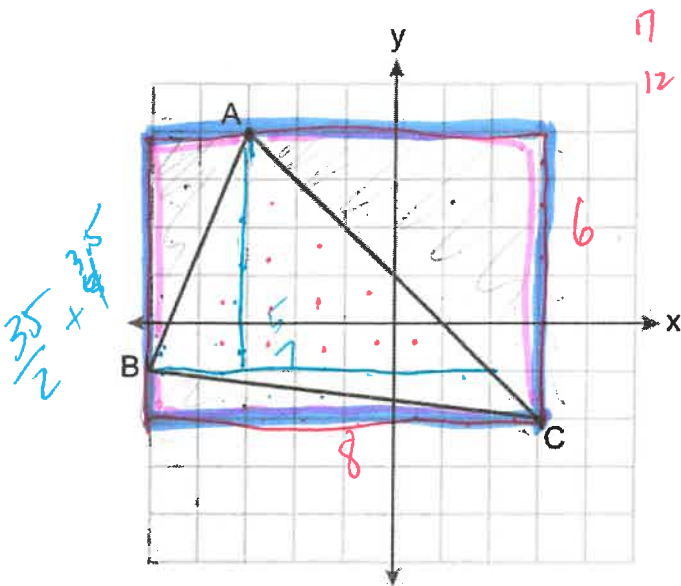
(1) $22.5°$

(3) $97.5°$

(2) $75°$

(4) $120°$

11 Triangle ABC is graphed on the set of axes below. The vertices of $\triangle ABC$ have coordinates $A(-3,4)$, $B(-5,-1)$, and $C(3,-2)$.

$$\frac{10}{2} + \frac{8}{2} + \frac{36}{2} = 27$$

$$6(8) - \left[\frac{1}{2}(2\cdot5) + \frac{1}{2}(6\cdot6) + \frac{1}{2}(1\cdot8) \right] =$$
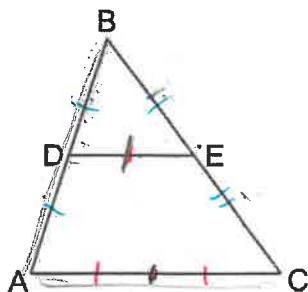
$$48 - 27 = 21$$

What is the area of $\triangle ABC$?

(1) 16

(2) 20

(3) 21

(4) 24

12 In $\triangle ABC$ below, $\overline{DE}$ is a midsegment, and $\overline{BD} \cong \overline{DE}$.

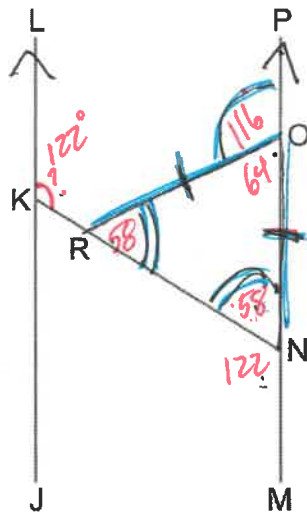Which statement is always true?

(1) $\triangle ABC$ is isosceles ✔

(2) $\triangle ABC$ is scalene

(3) $\overline{BD} \cong \overline{BE}$

(4) $\overline{DA} \cong \overline{EC}$

13 As shown in the diagram below, $\overleftrightarrow{JKL} \parallel \overleftrightarrow{MNOP}$, $\overline{KRN}$, and $\overline{OR} \cong \overline{ON}$.

(handwritten annotations on diagram)

L — 122° — K — ? 122° — R 68°

P — 116 — 64 — O

$\frac{180-64}{2} = 58°$

58°

122° N

J   M

If m∠POR = 116°, what is m∠LKN?

(1) 58°
(2) 116°
(3) 122° *(circled)*
(4) 128°

14 The ratio of similarity of square ABCD to square WXYZ is 2:5. If $AB = x + 3$ and $WX = 3x + 5$, then the perimeter of ABCD is

(1) 8
(2) 20
(3) 32 *(circled)*
(4) 80

(handwritten work)

8

A x+3 B
8 [2] 8
D 8 C

P=?

3x+5
W [5] X
Z Y

$$\frac{x+3}{3x+5} = \frac{2}{5}$$
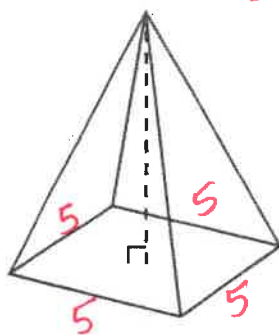
$$5x + 15 = 6x + 10$$

$$5 = x$$
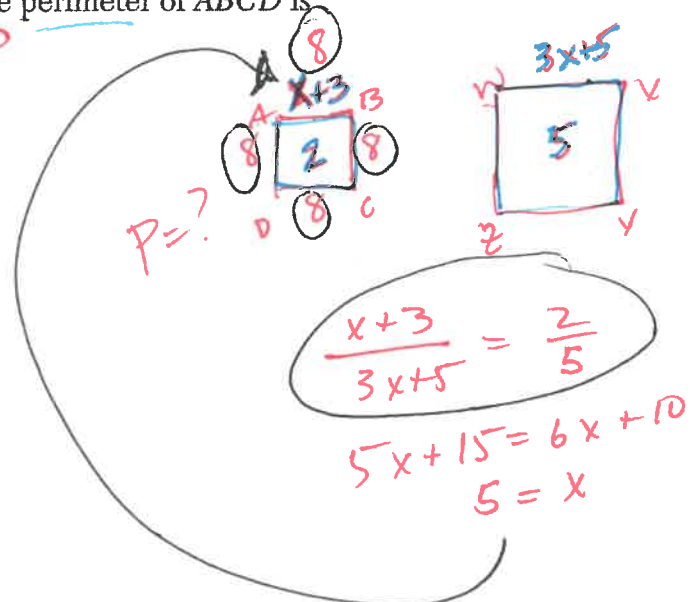
15 In parallelogram $ABCD$ below, diagonals $\overline{AC}$ and $\overline{BD}$ intersect at E.
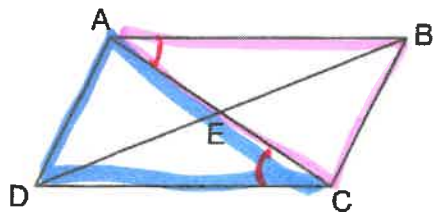
Which transformation would map $\triangle ABC$ onto $\triangle CDA$?

(1) a reflection over $\overline{AC}$

(2) a reflection over $\overline{DB}$

(3) a clockwise rotation of 90° about point E

(4) a clockwise rotation of 180° about point E

16 The square pyramid drawn below has a volume of 175.

$$V = \frac{1}{3}Bh$$

$175 = \frac{1}{3}B \cdot 21$

$25 = B =$ is a square $= x^2$

$5 =$ side

If the height of the pyramid is 21, what is the perimeter of the base?

(1) 5

(2) 10

(3) 20

(4) 25

17 A glass fish tank is designed to be placed on a stand in the corner of a room with perpendicular walls. The tank can be modeled using part of a cylinder, as shown below. The inner length of the fish tank along the wall is 22 inches, and the height of the tank is 27 inches.

¼th of a cylinder

22 in | 22 in

27 in

Fish tank

Fish tank stand
Fih tank s and

Fish tank stand
Stand
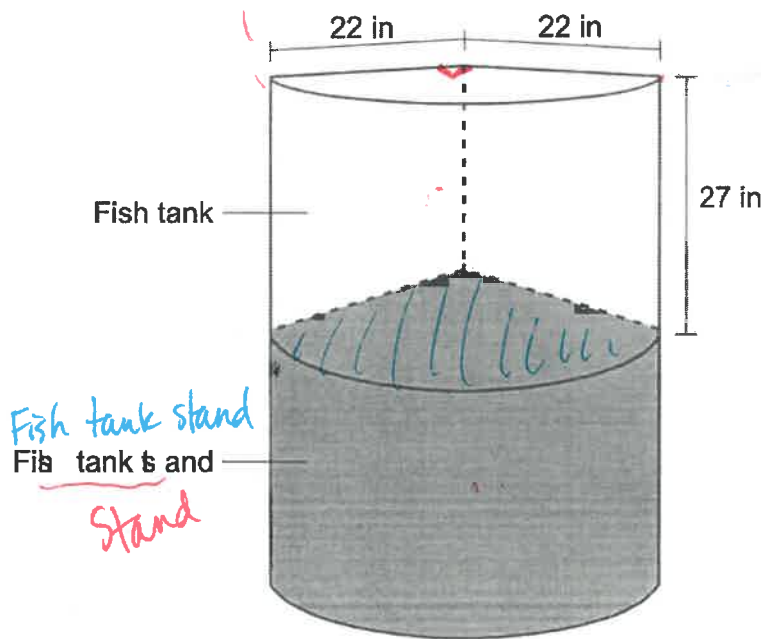
$V = \frac{1}{4}(Bh)$

$\frac{1}{4}(\pi 22^2)27$

$\frac{3267\pi \ in^3}{231 \ in^3} = gal$

How much water, to the *nearest gallon*, does the fish tank hold?
[1 gal = 231 in³]

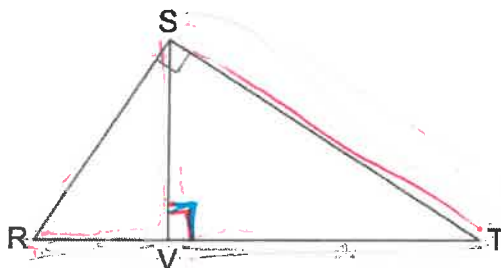(1) 44

(3) 89

(2) 59

(4) 178

---

rate of change

18 Line *m*, whose equation is $y = -2x + 8$, is dilated by a scale factor of $\frac{1}{2}$ centered at the origin. Which equation represents the image of line *m*?

lengths
points get multiplied by k

(1) $y = -x + 4$

(3) $y = -x + 8$

(2) $y = -2x + 4$

(4) $y = -2x + 8$

19 In right triangle RST below, altitude $\overline{SV}$ is drawn to hypotenuse $\overline{RT}$.

Which statement is always true?

(1) $\dfrac{RT}{ST} = \dfrac{ST}{VT}$ ✓

(2) $\dfrac{VR}{VT} = \dfrac{VT}{VS}$

(3) $\dfrac{RV}{SV} = \dfrac{SV}{RT}$ ✗ VT

(4) $\dfrac{TR}{VR} = \dfrac{VR}{SR}$

20 What is the measure, in radians, of a central angle that intercepts an arc length of 12π cm in a circle with a diameter of 36 cm?

(1) $\dfrac{\pi}{6}$

(2) $\dfrac{\pi}{3}$

(3) $\dfrac{2\pi}{3}$

(4) $\dfrac{3\pi}{2}$

$l = \dfrac{x}{360}C$

$12\pi = \dfrac{x}{2\pi}(36\pi)$

$360 = 2\pi$

$\dfrac{12\pi}{18} = \dfrac{18x}{18}$

9 sides

21 A regular nonagon has a center point, P. What degree of rotation about point P will carry the nonagon onto itself?

(1) $60°$ $60/40$

(2) $90°$ $90/40$

(3) $180°$ $180/40$

(4) $200°$ $200/40$

5 turns

$\dfrac{360}{9} = 40°$

22 If two sides of a triangle have lengths of 2 and 7, the length of the third side could be

(1) 9   (3) 5

(2) 8   (4) 4

Handwritten: $7-2 < x < 7+2$
$5 < x < 9$

23 The car tire shown in the photograph below has a diameter of $2\frac{1}{4}$ feet.

Handwritten: 5280 ft/mi
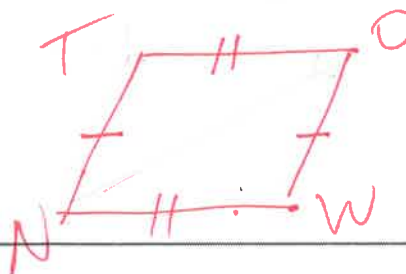
$C = \pi d = 2.25\pi$ ft / 1 rotation

$\dfrac{5280}{2.25\pi}$ rotations / mile

$\dfrac{ft}{mi} \cdot \dfrac{1\ rotation}{ft}$

Approximately how many rotations will the tire make in one mile?

(1) 373   (3) 1328

(2) 747   (4) 2347

24 In quadrilateral *TOWN*, $\overline{OW} \cong \overline{TN}$ and $\overline{OT} \cong \overline{WN}$. Which additional information is sufficient to prove quadrilateral *TOWN* is a rhombus?

(1) $\overline{ON} \perp \overline{TW}$

(2) $\overline{TO} \perp \overline{OW}$

(3) $\overline{OW} \parallel \overline{TN}$

(4) $\overline{ON}$ and $\overline{TW}$ bisect each other.

Answer all 7 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [14]

25 In the diagram below, quadrilateral *BCDE* maps onto quadrilateral *JKLM* using a sequence of rigid motions.

M

J 117° L

70°

K

C 70° 117° B

91° E

D

117
70
91
278

15
2̶8̶6̶0̶
-278
82
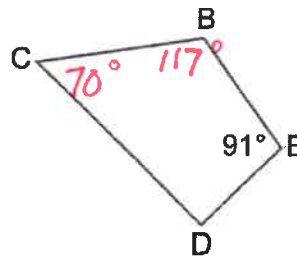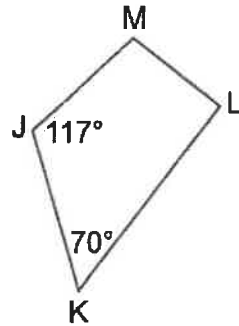
Determine and state the degree measure of angle *D*.

$m \angle D = 82°$

sum of quad ∠s = 360°

26 Given $\overline{AB}$ below, use a compass and a straightedge to construct a segment that is $\frac{1}{4}AB$. [Leave all construction marks.]

A ———————————————————————————— B

27 A dog sees a bird in a tree. The angle of elevation from the dog's eyes to the bird is 36°, as modeled below.

36°   18.5

2.5 ft

18.5 ft

X   +3

+ 2.5
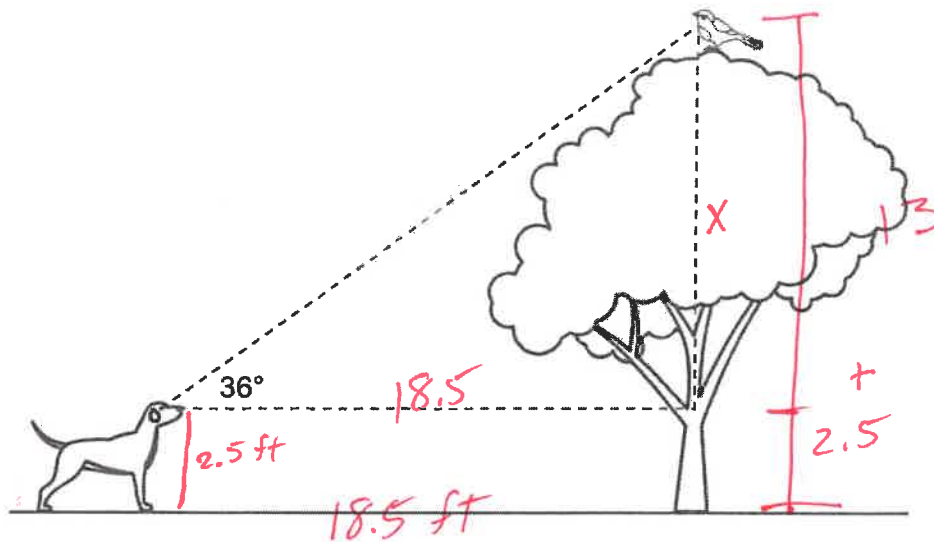
The dog is 18.5 feet away from the base of the tree, and his eyes are 2.5 feet above the ground. Determine and state how high the bird is above the ground, to the *nearest foot*.

$$\tan 36° = \frac{x}{18.5}$$

bird is
~~15.5 ft~~ 16 ft
above
the ground

28 Pure silver has a density of 10.5 g/cm³. Samantha has a pure silver charm on her necklace in the shape of a sphere. The radius of the charm is 0.5 cm.

Determine and state the mass of the charm, to the *nearest tenth of a gram.*
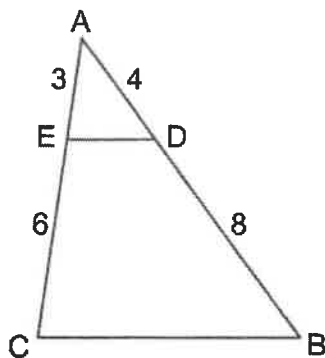
$$d = \frac{m}{V}$$

$$10.5 = \frac{m}{.5236}$$

$$\boxed{5.5_g = m}$$

$$V = \frac{4}{3}\pi(.5)^3$$

$$\boxed{mass = .5236}$$

29 In $\triangle ABC$ below, $\overline{DE}$ is drawn such that $AD = 4$, $DB = 8$, $AE = 3$, and $EC = 6$.

Explain why $\triangle ADE \sim \triangle ABC$.

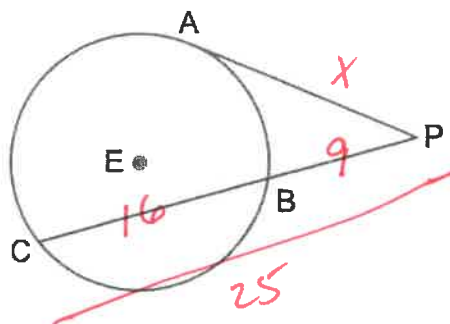$\angle A \cong \angle A$ reflexive POC

$\dfrac{3}{9} = \dfrac{4}{12}$ sides are proportional

$36 = 36$

$\dfrac{AE}{AC} = \dfrac{AD}{AB}$

By SAS ~ $\triangle ADE \sim \triangle ABC$

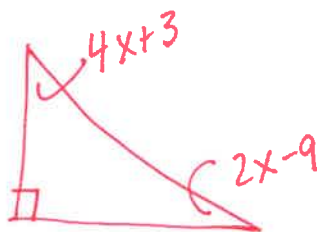**30** In circle E below, tangent $\overline{PA}$ and secant $\overline{PBC}$ are drawn.

If $PB = 9$ and $BC = 16$, determine and state the length of $\overline{PA}$.

$$x^2 = \sqrt{9(25)}$$

$$x = 3 \cdot 5 = 15 \qquad \boxed{PA = 15}$$

31 In a right triangle, $\sin(4x + 3)° = \cos(2x - 9)°$. Determine and state the value of x.

$$4x + 3 + 2x - 9 = 90$$
$$6x - 6 = 90$$
$$6x = 96$$
$$\boxed{x = 16}$$

Answer all 3 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [12]

32 Modeled by right triangles below, a surveyor (S) is taking land measurements using a cabin (C), a boulder (B), and a tree (T) as fixed points of reference. The cabin, boulder, and tree are collinear.

The surveyor is 917 meters from the cabin, 1048 meters from the boulder, and 1425 meters from the tree.
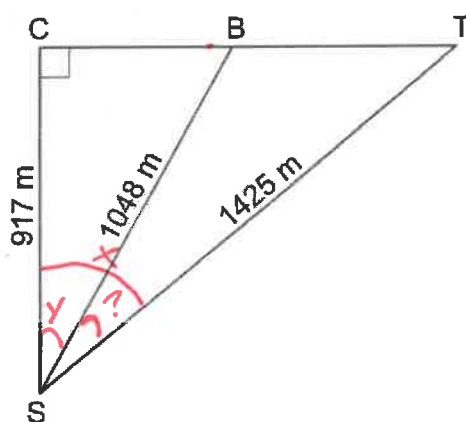
Determine and state, to the *nearest degree*, the measure of $\angle BST. = x - y = 21°$

$$\cos x = \frac{917}{1425} \qquad x = \cos^{-1}\left(\frac{917}{1425}\right)$$

$$\cos y = \frac{917}{1048} \qquad y = \cos^{-1}\left(\frac{917}{1048}\right)$$
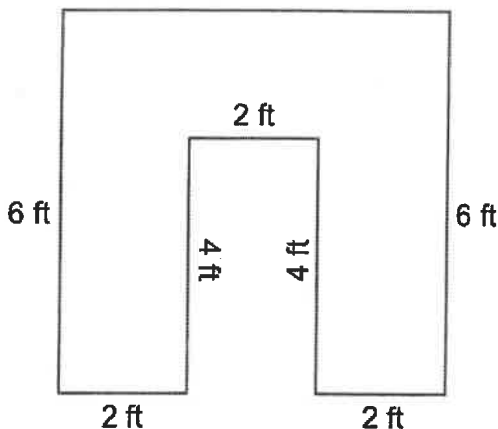
33 A garden bed, pictured below, is a square prism with a rectangular prism taken out. The inside length of the square prism is 6 feet. The rectangular prism taken out has a width of 2 feet and a length of 4 feet.

The diagram below shows the top view of the garden bed with its inside measurements.

Garden Bed

Top View of Garden Bed

The garden bed is filled with topsoil to a uniform height of 1.25 feet.

Determine and state the volume of the topsoil, in cubic feet.

$$6 \cdot 6 (1.25) - 2 \cdot 4 (1.25)$$
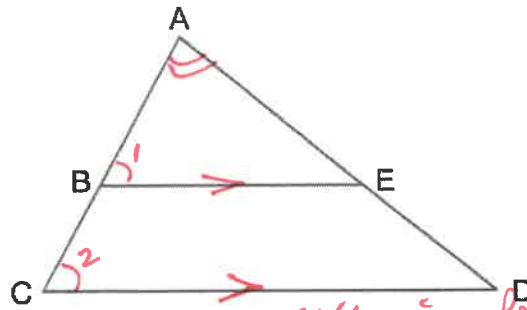$$45 - 10$$
$$\boxed{35 \text{ ft}^3}$$

Each bag of topsoil sells for $3.68 and contains 2 cubic feet of topsoil.

Determine and state the total cost of the bags of topsoil that must be purchased to fill the garden.

17.5 so   18 bags must be purchased

$$18(3.68) = \boxed{\$66.24}$$

34 Given: $\triangle ACD$ with $\overline{ABC}$, $\overline{AED}$, and $\overline{BE} \parallel \overline{CD}$

A

B ⟩ E

C ⟩ D

Prove: $AB \cdot AD = AE \cdot AC$

$\angle A \cong \angle A$ reflexive poc

$\angle 1 \cong \angle 2$ $\parallel \rightarrow$ corr $\angle s \cong$

$\triangle ABE \sim \triangle ACD$ AA~

$\therefore$ sides are proportional

$$\frac{AB}{AC} = \frac{AE}{AD}$$

$AB \cdot AD = AE \cdot AC$ Cross product property

Answer the question in this part. A correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided to determine your answer. Note that diagrams are not necessarily drawn to scale. A correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [6]

35 Triangle PET has vertices with coordinates $P(-6,4)$, $E(6,8)$, and $T(-4,-2)$.

Prove $\triangle PET$ is a right triangle.

[The use of the set of axes on the next page is optional.]

see back

State the coordinates of N, the image of P, after a 180° rotation centered at $(1,3)$.

$P(-6,4) \longrightarrow N(8,2)$

$\overrightarrow{CP} \langle -7,1 \rangle \rightarrow \overset{\overrightarrow{CN}}{\langle 7,-1 \rangle}$ 180° Rot

Question 35 is continued on the next page.

Prove *PENT* is a rectangle.

[The use of the set of axes below is optional.]

Slope of $\overline{PE} = \frac{4}{12} = \frac{1}{3}$ slope $\overline{TN}$ $\frac{4}{12} = \frac{1}{3}$

Slope of $\overline{PT} = \frac{-6}{2} = -3$ slope $\overline{EN} = \frac{-6}{2} = -3$

$\overline{PE} \perp \overline{PT}$ $\therefore$ ~~Rt. $\angle$~~

opposite sides // & rt. $\angle$ in Rectangle