Part I

Key

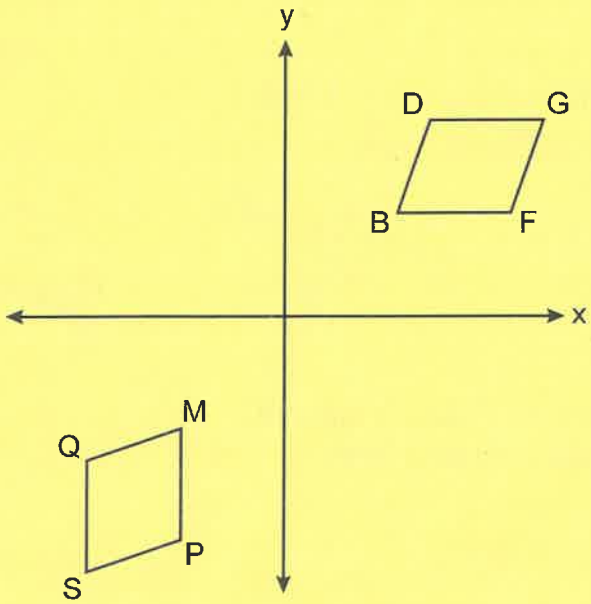
Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For each statement or question, choose the word or expression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

Use this space for computations.

1 An equilateral triangle is continuously rotated around one of its altitudes. The three-dimensional object formed is a

(1) cone
(2) sphere
(3) cylinder
(4) pyramid

2 On the set of axes below, quadrilateral $BDGF$ is rotated 90 degrees clockwise about the origin and then reflected over the y-axis. The image of quadrilateral $BDGF$ is quadrilateral $MQSP$.



Side $\overline{BD}$ will always map onto

(1) $\overline{MP}$
(2) $\overline{PS}$
(3) $\overline{MQ}$
(4) $\overline{SQ}$

Use this space for computations.

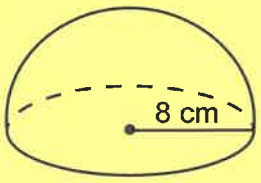
3 In right triangle JOE, hypotenuse $JO = 31.8$ and $m\angle J = 38°$. To the *nearest tenth*, the length of $\overline{EJ}$ is

(1) 19.6
(2) 25.1
(3) 40.4
(4) 51.7

$31.8(\cos 38 = \frac{x}{31.8})31.8$

$x(\tan 38 = \frac{31.8}{x})x$

4 The hemisphere below has a radius of 8 cm.



To the *nearest cubic centimeter*, the volume of the hemisphere is

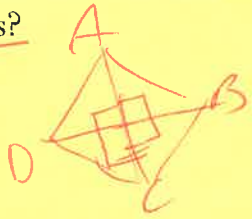
(1) 201
(3) 1072
(2) 268
(4) 2145

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\cdot\pi(8)^3 = \frac{4}{3}\cdot\pi(512) = \frac{2048\pi}{3} = 2144.66$

$\frac{1}{2} \rightarrow 2$ a sphere $\rightarrow$ 1072

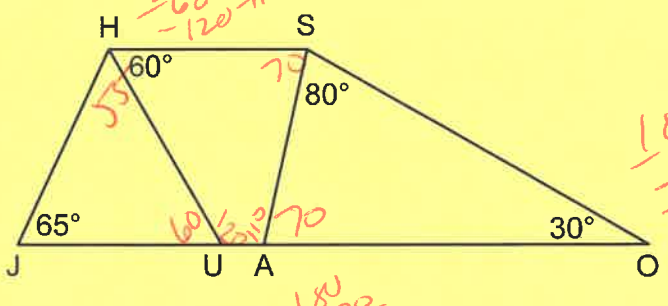
5 In parallelogram $ABCD$, diagonals $\overline{AC}$ and $\overline{BD}$ intersect at E. Which information is sufficient to prove $ABCD$ is a rhombus?

(1) $\overline{AE} \cong \overline{EC}$
(3) $\overline{AB} \perp \overline{BC}$
(2) $\overline{AC} \cong \overline{BD}$
(4) $\overline{AC} \perp \overline{BD}$



perp = 90

6 Trapezoid $JOSH$, shown below, has non-parallel sides $\overline{JH}$ and $\overline{OS}$, $m\angle J = 65°$, $m\angle O = 30°$, $m\angle OSA = 80°$, and $m\angle SHU = 60°$.

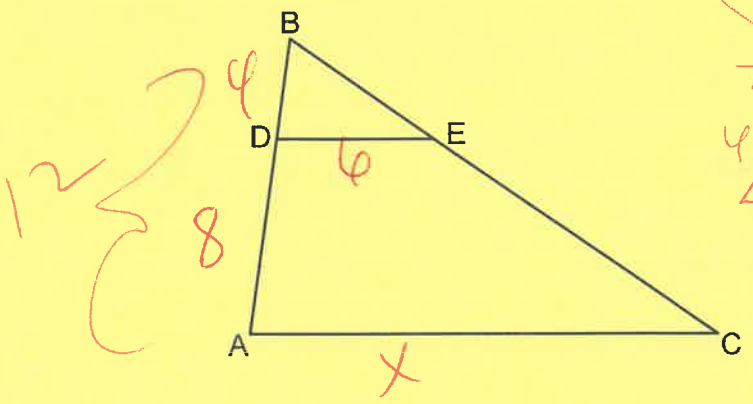


What is $m\angle HSA$?

(1) 55°
(3) 65°
(2) 60°
(4) 70°

Use this space for computations.

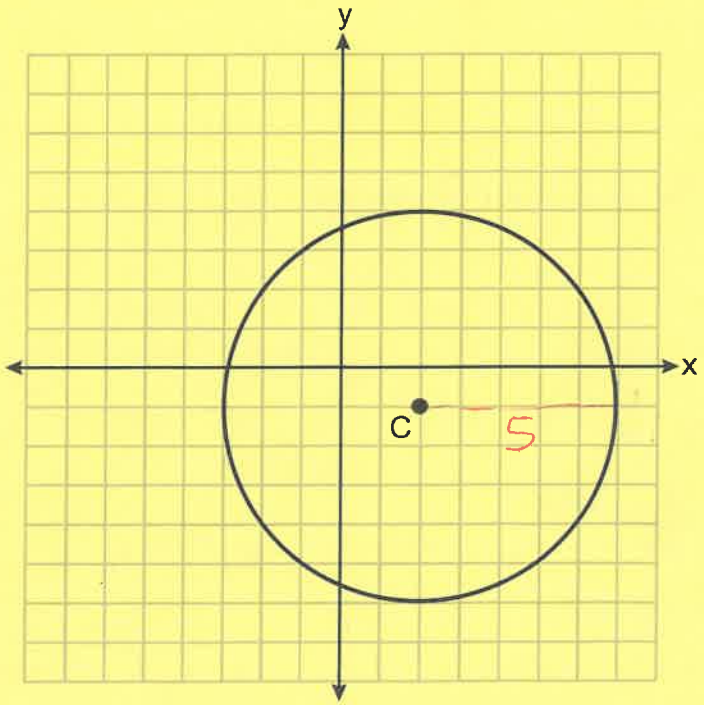
7 In $\triangle ABC$ below, points D and E are on $\overline{AB}$ and $\overline{CB}$, respectively, such that $\overline{DE} \parallel \overline{AC}$.



If $AD = 8$, $DB = 4$, and $DE = 6$, what is the length of $\overline{AC}$?

(1) 24
(2) 18
(3) 12
(4) 10

8 On the set of axes below, circle C has a center with coordinates (2,–1).

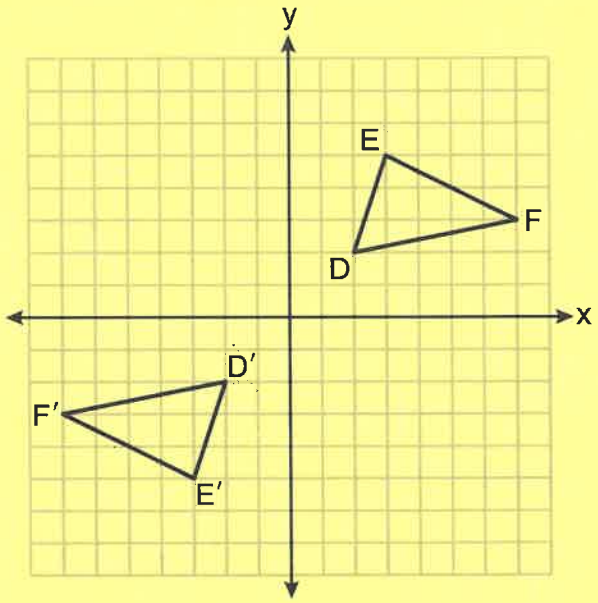


Which equation represents circle C?

(1) $(x-2)^2 + (y+1)^2 = 25$
(2) $(x-2)^2 + (y+1)^2 = 16$
(3) $(x+2)^2 + (y-1)^2 = 25$
(4) $(x+2)^2 + (y-1)^2 = 16$

Use this space for computations.

9 On the set of axes below, $\triangle D'E'F'$ is the image of $\triangle DEF$.



A transformation that maps $\triangle DEF$ onto $\triangle D'E'F'$ is a

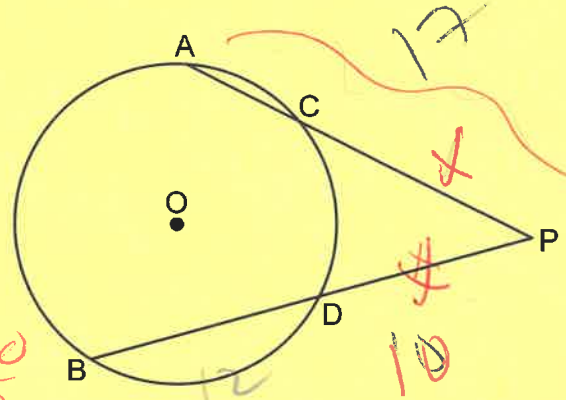
(1) reflection over the line $y = x$

(2) reflection over the line $y = -x$

(3) point reflection through the origin

(4) translation 4 units left and 4 units down

10 In circle O below, secants $\overline{PCA}$ and $\overline{PDB}$ are drawn from external point P.



If $PA = 17$, $PD = 10$, and $BD = 12$, what is the length of $\overline{PC}$, to the *nearest tenth*?

(1) 7.1

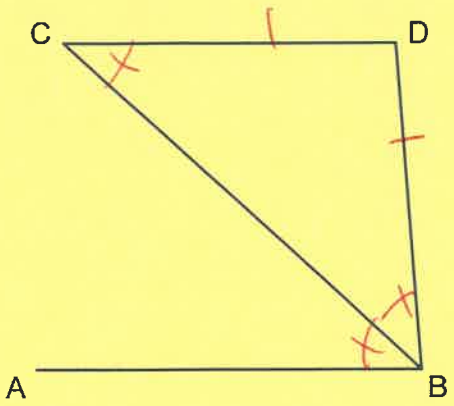
(2) 7.7

(3) 12.9

(4) 14.2

Use this space for computations.

11 In the diagram below, $\overline{CD} \parallel \overline{AB}$, and $\overline{CB}$ bisects $\angle ABD$.



Which statement must be true?

(1) $\overline{CD} \cong \overline{AB}$

(2) $\overline{AB} \cong \overline{BD}$

(3) $\triangle CDB$ is a right triangle

(4) $\triangle CDB$ is an isosceles triangle

12 Line h is represented by the equation $y = \frac{2}{3}x - 4$.

Which equation represents the line that is perpendicular to line h and passes through the point (6,1)?

(1) $y - 1 = \frac{2}{3}(x - 6)$

(2) $y + 1 = \frac{2}{3}(x + 6)$

(3) $y - 1 = -\frac{3}{2}(x - 6)$

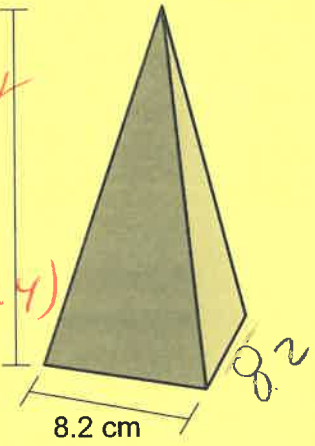
(4) $y + 1 = -\frac{3}{2}(x + 6)$

$y - y_1 = m(x - x_1)$

$(y - 1) = -\frac{3}{2}(x - 6)$

Use this space for computations.

13 A wooden toy block can be modeled by a pyramid with a square base, as shown below. The height of the block is 17.4 cm and the square base has a side length of 8.2 cm.



$V = \frac{1}{3}Bh$ height, area of Base

$V = \frac{1}{3}(8.2)(8.2)(17.4)$

$V = 389.992$

389.992

$0.77 D = \frac{m}{V}$ $\frac{x}{389.992}$

The block is made of solid oak, which has a density of 0.77 g/cm^3. What is the mass of the block, to the *nearest gram*?

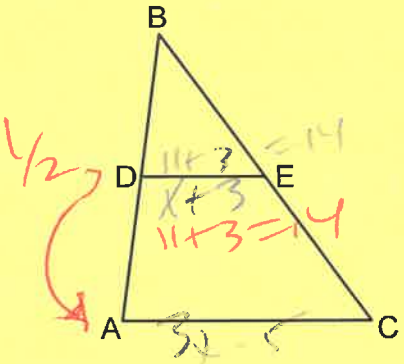
Density = Mass / Volume

(1) 300 (2) 506 (3) 637 (4) 901

$389.992\left(0.77 = \frac{x}{389.992}\right)389.992$

$x = 300$

14 In $\triangle ABC$ below, midsegment $\overline{DE}$ is drawn.



$DE = \frac{1}{2}AC$

$x + 3 = \frac{1}{2}(3x - 5)$

$2x + 6 = 3x - 5$

$11 = x$

If $DE = x + 3$ and $AC = 3x - 5$, what is the length of $\overline{DE}$?

(1) 28 (2) 14 (3) 7 (4) 4

$2\left(x + 3 = \frac{1}{2}(3x - 5)\right)2$

$2x + 6 = 3x - 5$

$-2x \quad -2x$

$6 = x - 5$

$x = 11$

Use this space for computations.

15 Triangle DUG is an isosceles right triangle with the right angle at G. If $DU = 10\sqrt{2}$, what is the length of $\overline{GU}$?

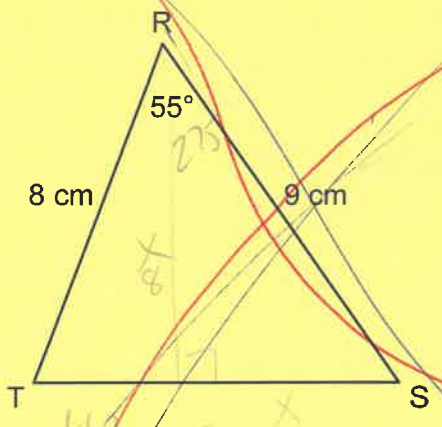
(1) 5

(2) $5\sqrt{2}$

(3) 10

(4) $10\sqrt{2}$

16 In $\triangle RST$ below, $RS = 9$ cm, $RT = 8$ cm, and $m\angle TRS = 55°$.



What is the area of $\triangle RST$, to the *nearest square centimeter*?

(1) 59

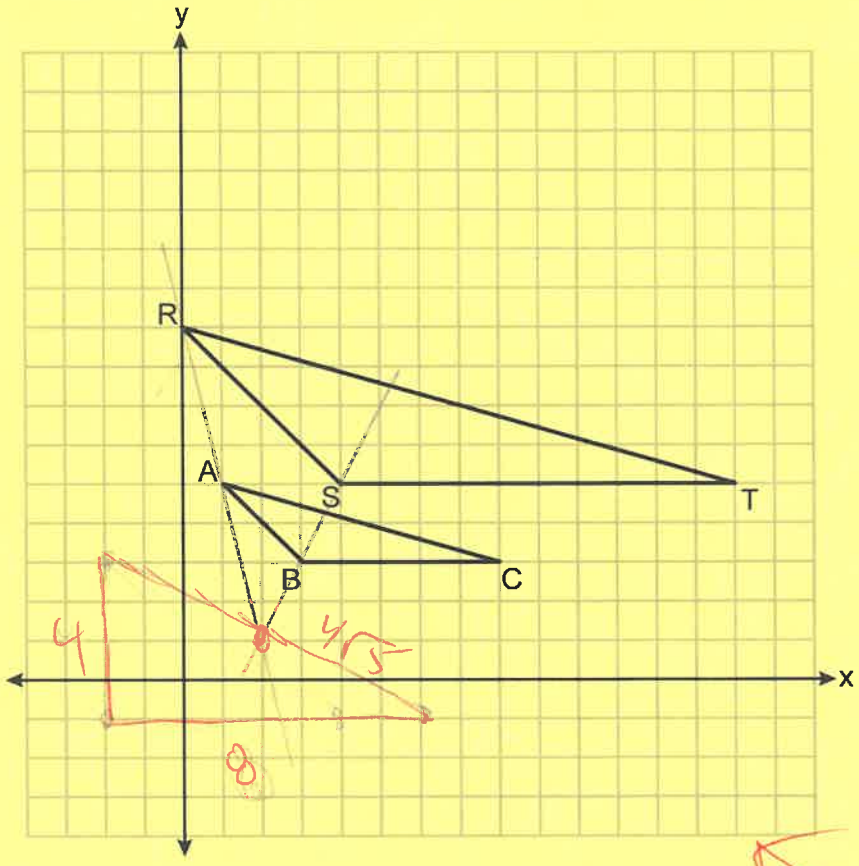
(2) 36

(3) 29

(4) 21

Use this space for computations.

17 Triangle ABC is dilated by a scale factor of 2 to map onto its image, $\triangle RST$, on the set of axes below.



What are the coordinates of the center of this dilation?

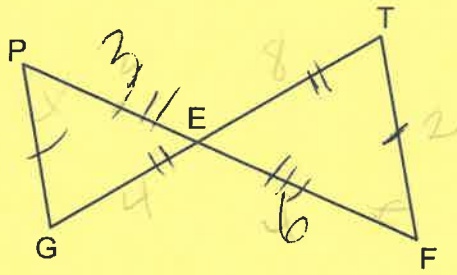
(1) (1,–1)
(2) (2,1)
(3) (3,3)
(4) (0,0)

18 What is the perimeter of $\triangle ABC$, where the vertices have coordinates $A(-2,3)$, $B(-2,-1)$, and $C(6,-1)$?

(1) 16
(2) 92
(3) $16\sqrt{5}$
(4) $12 + 4\sqrt{5}$

Use this space for computations.

19 In the diagram below, $\overline{GT}$ and $\overline{PF}$ intersect at E, and $\angle P \cong \angle F$.



Which equation is always true?

(1) $\frac{PE}{FE} = \frac{FT}{PG}$

(3) $\frac{PE}{GE} = \frac{TE}{FE}$

(2) $\frac{GE}{TE} = \frac{FT}{PG}$

(4) $\frac{PE}{FE} = \frac{PG}{FT}$

20 A section of sidewalk in the shape of a rectangular prism is being replaced. The sidewalk is 10 feet long, 4 feet wide, and 4 inches deep. A brand of concrete mix yields 0.6 cubic foot of concrete per bag. What is the minimum number of bags of concrete mix that must be purchased to completely replace this sidewalk?

(1) 22

(3) 26

(2) 23

(4) 27

21 The line $4x - 6y = 24$ is transformed by a dilation of scale factor 3 centered at the origin. Which equation represents the image of the line after this dilation?

(1) $y = \frac{2}{3}x - 12$

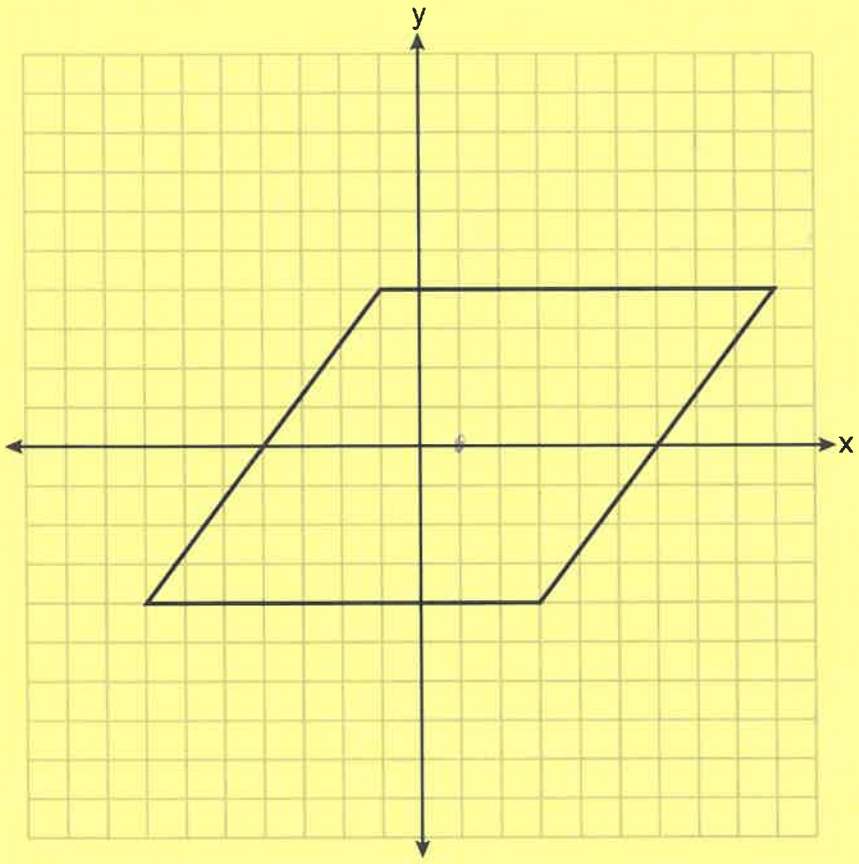
(3) $y = 2x - 12$

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

(4) $y = 2x - 4$

Use this space for computations.

22 A rhombus is graphed on the set of axes below.



Which transformation does *not* carry the rhombus onto itself?

(1) a rotation of 180° about the origin

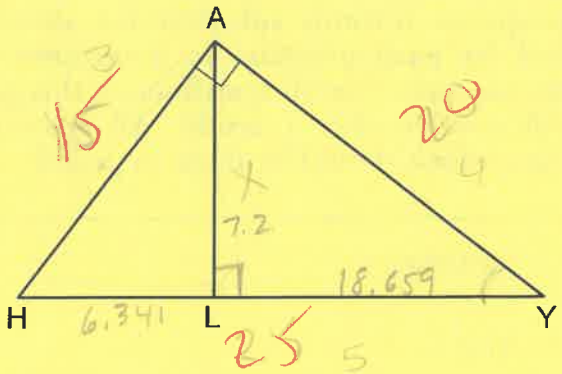
(2) a rotation of 180° about point (1,0)

(3) a reflection over the line $y = \frac{1}{2}x - \frac{1}{2}$

(4) a reflection over the line $y = -2x + 2$

23 In right triangle HAY below, altitude $\overline{AL}$ is drawn to hypotenuse $\overline{HY}$.

Use this space for computations.



If $HY = 25$ and $YA = 20$, the length of $\overline{AL}$ is

(1) 9
(2) 12
(3) 15
(4) 16

24 Square $ABCD$ has an area of 36. If the square is dilated by a scale factor of $\frac{1}{2}$ centered at A, what is the area of its image?

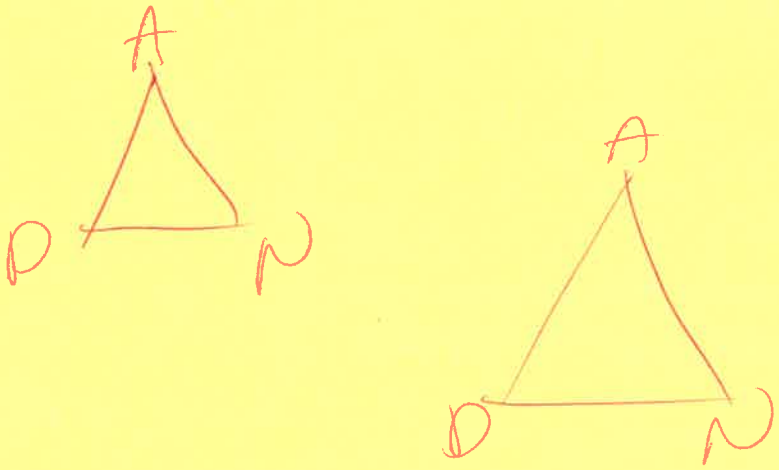
(1) 9
(2) 18
(3) 72
(4) 144

Part II

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 Triangle $D'A'N'$ is the image of $\triangle DAN$ after a translation.

Explain why $\triangle D'A'N'$ must be congruent to $\triangle DAN$.



Rigid Motion

preserves distance & angles

26 The table below lists five metals and their densities.

Metal	Density (g/cm^3)
Zinc	7.14
Tin	7.31
Iron	7.86
Copper	8.96
Silver	10.5

A solid metal cube has an edge length of 5 cm and a mass of 982.5 grams.

Using the table above, determine and state the type of metal from which this cube is made.

$D^{g/cm^3} = \frac{m^{grams}}{Volume}$

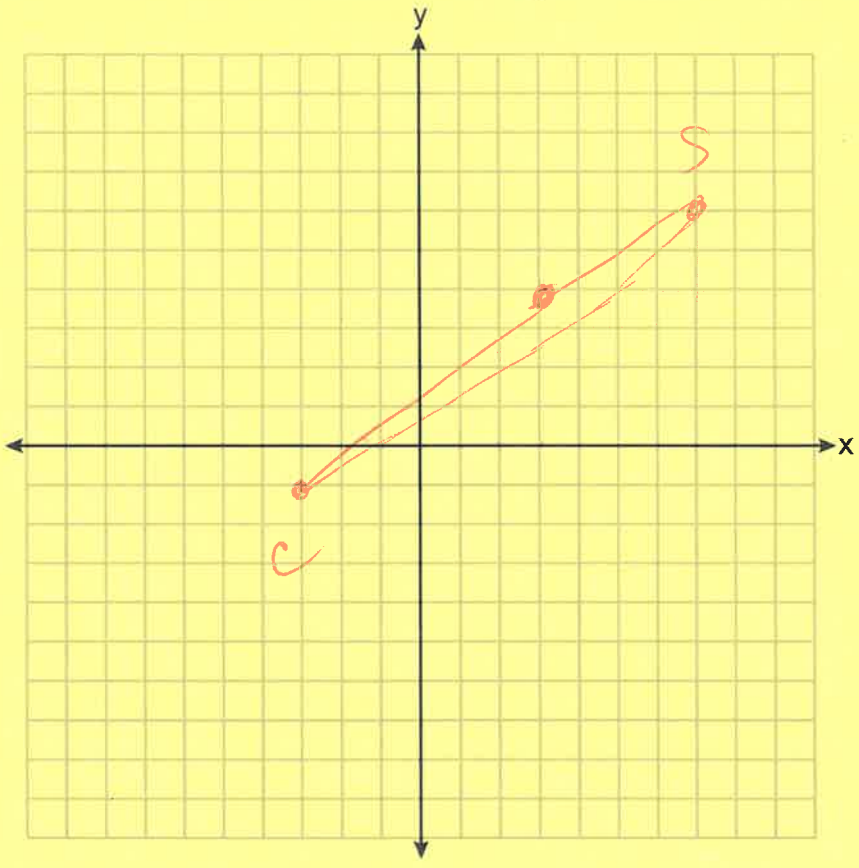
$D = \frac{982.5}{5 \cdot 5 \cdot 5} = \frac{982.5}{125}$

$D = 7.86$

IRON

27 The endpoints of $\overline{CAS}$ are $C(-3,1)$ and $S(7,6)$. Determine and state the coordinates of point A such that the ratio of $CA:AS$ is 3:2.

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



28 The ramp shown in the diagram below has an angle of elevation of 4.8°. The ramp is built to a landing 0.6 m above the ground.

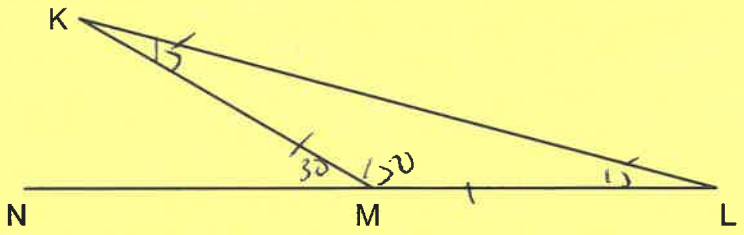
Determine and state the length of the ramp, to the *nearest tenth of a meter*.

$x(\sin 4.8) = 0.6$

$\frac{x(\sin 4.8)}{(\sin 4.8)} = \frac{0.6}{\sin 4.8}$

$x = \frac{0.6}{\sin 4.8} = 7.2$

29 Angle KML is the vertex angle of isosceles triangle KLM below. Side $\overline{LM}$ is extended through vertex M to point N.

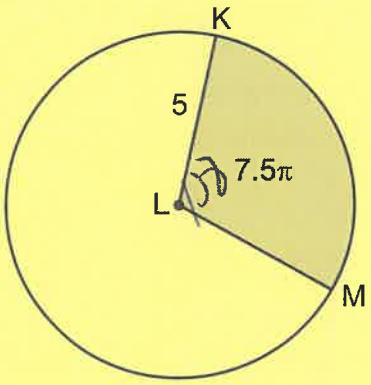


If $m\angle K = 15°$, determine and state $m\angle KMN$.

30°

180
−30
150

30 In the diagram below of circle L, the area of the shaded sector KLM is 7.5π and $LK = 5$.



108

$A = \pi r^2$

7.5π

Determine and state the degree measure of angle KLM, the central angle of the shaded sector.

$\frac{x^\circ}{360} \cdot \pi r^2$ = Area

$\frac{x}{360} \cdot \pi 5^2 = 7.5\pi$

360°

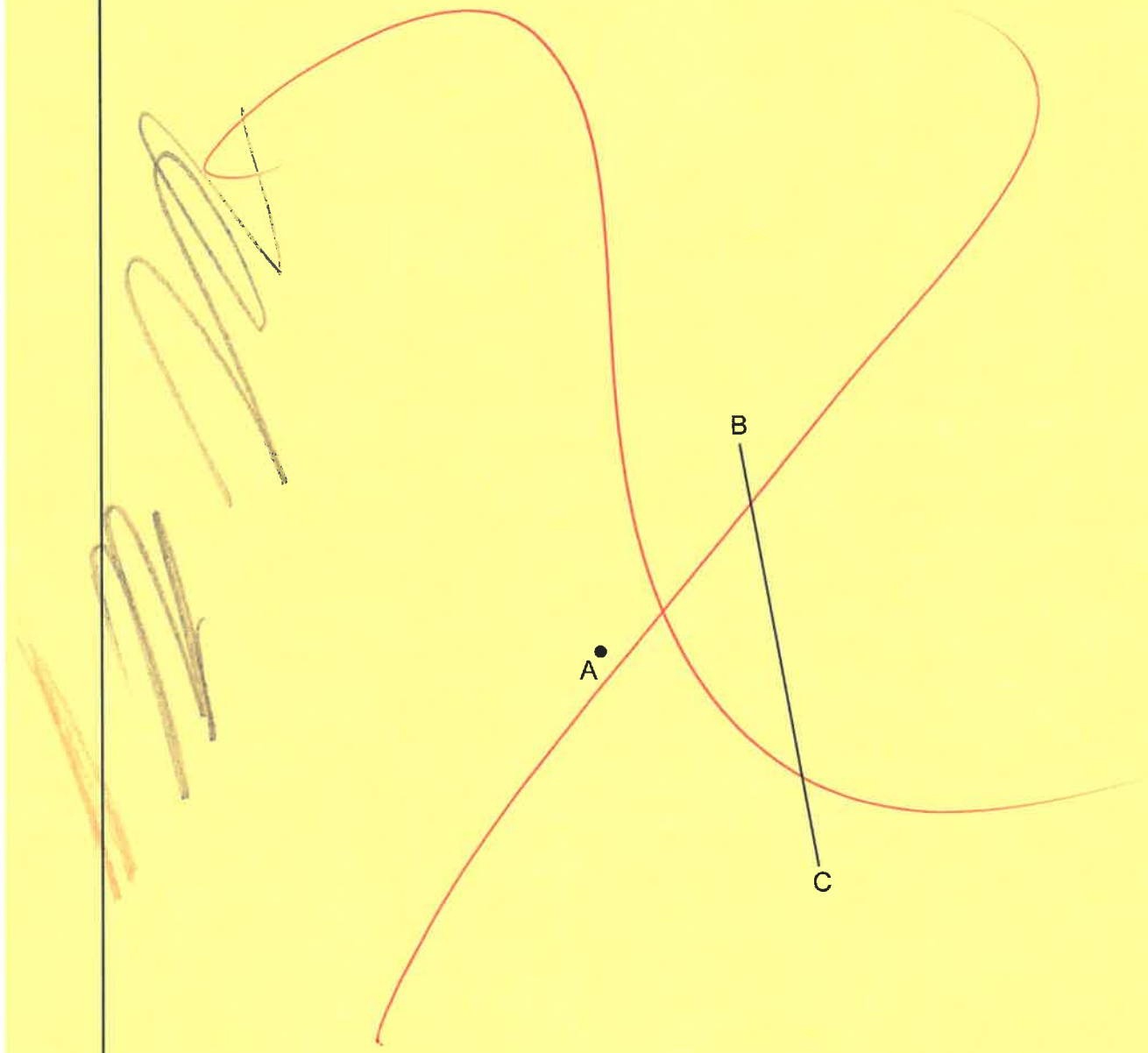
$360\left(\frac{25\pi x}{360} = 7.5\pi\right)$

$\frac{25\pi x}{25\pi} = \frac{2700\pi}{25\pi}$

$x = 108$

31 Using a compass and straightedge, construct the image of point A after a reflection over $\overline{BC}$.

[Leave all construction marks.]



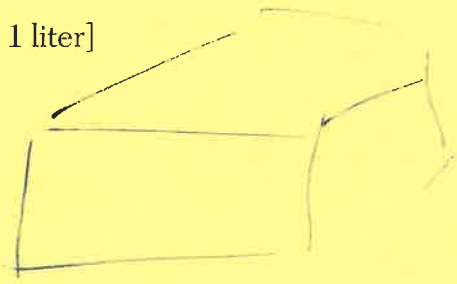
Part III

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 Joan wants to fill an empty 75-liter fish tank with water. She uses a cylindrical bucket with a diameter of 20 cm.

Determine and state the maximum number of buckets of water, filled to an exact height of 26 cm, Joan can put into the fish tank before it overflows.

[1000 cm^3 = 1 liter]



8164

75 Lt. × 1000 / 23000 / 8164 = 9.2

$V = \pi r^2 h$

$\pi 10^2 (26)$

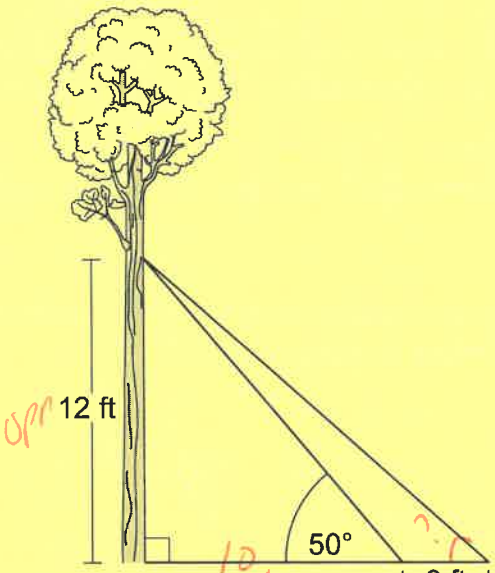
260π

8164

only 9

10 overflows

33 As modeled in the diagram below, two cables are attached from a point on a tree 12 feet above the ground. The longer cable is anchored on the ground 3 feet farther from the tree than the shorter cable is anchored. The angle of elevation between the shorter cable and the ground is 50°.



Determine and state, to the *nearest foot*, the distance from the base of the tree to the point where the longer cable is attached to the ground.

$\tan 50 = \frac{12}{x}$ $\quad \frac{12}{\tan 50}$

$10 + 3 = 13$

Determine and state, to the *nearest degree*, the angle of elevation between the longer cable and the ground.

$\tan^{-1} = \frac{12}{13}$ $\quad 43°$

34 Quadrilateral *READ* has vertices with coordinates $R(-1,3)$, $E(2,7)$, $A(10,1)$, and $D(7,-3)$.

Prove *READ* is a rectangle. [The use of the set of axes below is optional.]