



SECONDARY 3 (GRADE 9) 2021 CONTEST PAPER

NAME: _____

Index Number: _____

SCHOOL: _____

INSTRUCTIONS:

1. Please **DO NOT OPEN** the contest booklet until the Proctor has given permission to start
2. TIME: **1 hour 30 minutes**.
3. There are 25 questions with 100 total points:
Section A: Questions 1 to 15 score 3 points each, no points are deducted for an unanswered or wrong answer.
Section B: Questions 16 to 25 score 5 points each, no points are deducted for an unanswered or wrong answer.
Section C: Questions 21 to 25 score 6 points each, no points are deducted for an unanswered or wrong answer.
4. Shade your answers neatly using a **2B lead pencil** in the Answer Entry Sheet.
5. PROCTORING: No one may help any student in any way during the contest.
6. No electronic devices capable of storing and displaying visual information are allowed during the course of the exam. Strictly **No Calculators** are allowed.
7. All students must write and shade their **Name, School and Index Number** in the Answer Entry Sheet and Contest booklet.
8. MINIMUM TIME: Students must stay in the exam hall for at least 1 hour.
9. A student must show detailed working and transfer answers to the Answer Entry Sheet.
10. **No exam papers and written notes can be taken out by any contestant.**



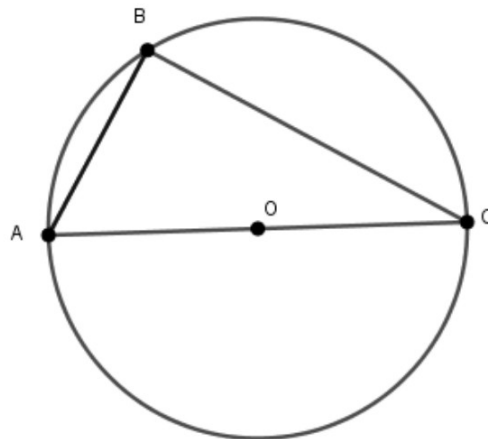
ROUGH WORKING

Section A: 15 Multiple Choice Questions

3 points each

Question 1

In the figure below, point O is the center of the circle, AC is a circle diameter and has a length of 24 inches, point B is on the circle. AB has the same length as the circle radius. What is the length of the arc BC in inches?



- A. Not enough information
- B. inches
- C. inches
- D. inches
- E. inches

Question 2

Let S_n be the sum of all the positive integers in $\{1, 2, \dots, n\}$, where n is a positive integer. What is S_{100} ?

- A.
- B.
- C.
- D.
- E.

Question 3

A round table has a diameter of 12 feet. If two people choose to sit randomly around the table. What is the probability that they will be at least 6 feet apart?

- A.
- B.
- C.
- D.
- E.

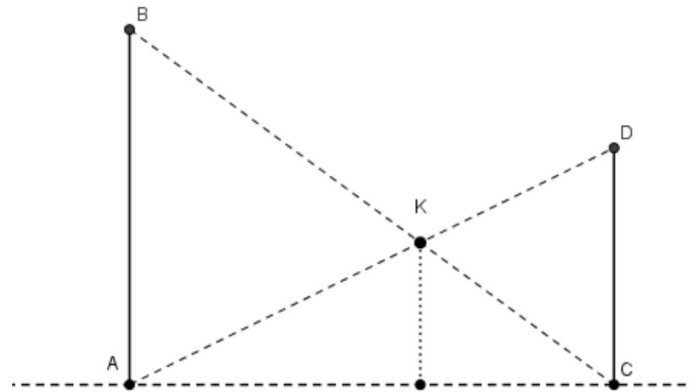
Question 4

Define two functions and over real numbers. What is the value of the following expression?

- A. 16
- B. 5
- C. 17
- D.
- E. 19

Question 5

In the figure below, two poles are mounted upright on the ground. Ropes are then used to connect the top of one pole to the foot of the other. The ropes are tight, intersecting at point K . We know that AB is six feet tall and CD is four feet tall. What is the height of point K with respect to the ground?



- A. Not enough information
- B. 2 feet
- C. 2.4 feet
- D. 2.5 feet
- E. 3.2 feet

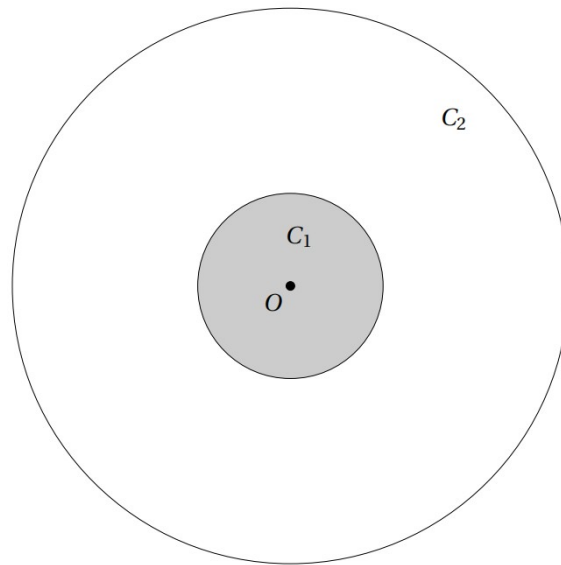
Question 6

If the following equation is true, what is the sum of values of x and y ?

- A. 4
- B. 5
- C. 6
- D. 7
- E. 8

Question 7

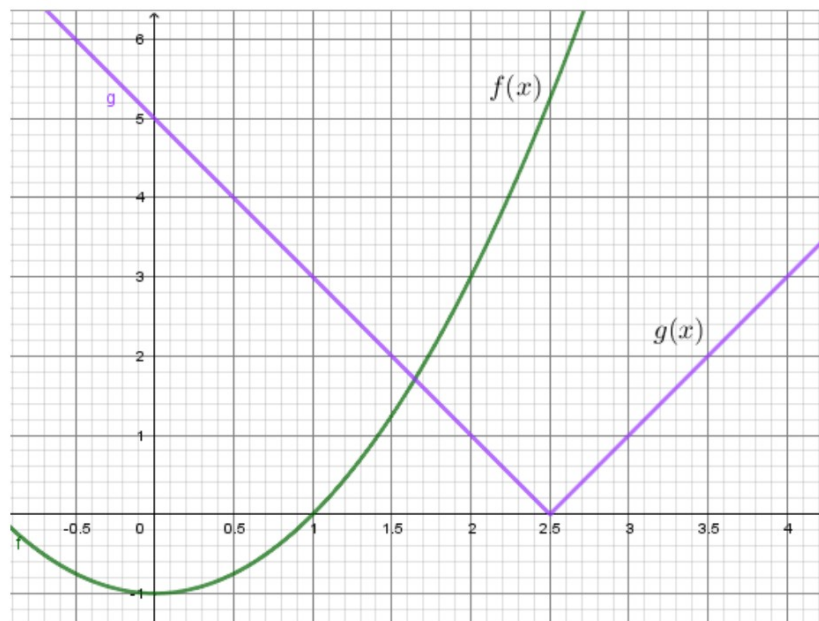
David is throwing darts at a circular target shown in the figure. There are two concentric circles on the target. Circle C_1 has a diameter of 9 inches; circle C_2 has a diameter of 3 inches. Assuming all the darts will hit the big circle and will land at a random point. What is the probability that a dart will land within the shaded circle?



- A.
- B.
- C.
- D.
- E.

Question 8

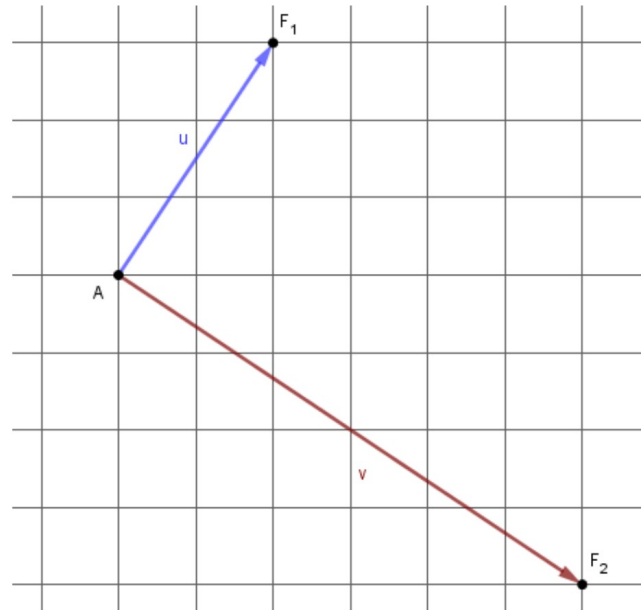
In the figure below, the graphs of two functions, f and g , are shown. Both functions are defined over real numbers. What is the value of



- A.
- B.
- C.
- D.
- E.

Question 9

In the figure below, an object is located at point A . There are two forces represented by vectors u and v acting on the object. What is the combined effect of u and v in terms of a vector?



- A.
- B.
- C.
- D.
- E.

Question 10

Two players, Adam and Bob, are playing five rounds of a chess game. The first player to win three rounds wins the whole game and takes the award. Based on the history of the players' performance, Adam has a probability of 0.6 winning a round. Bob has a probability of 0.4 winning a round. What is the probability, rounded to the second decimal place, that Bob wins the chess game of five rounds?

- A. 0.21
- B. 0.24
- C. 0.32
- D. 0.41
- E. 0.64

Question 11

What is the remainder of the following polynomial division?

- A.
- B. 0
- C. -2
- D. 5
- E. 7

Question 12

What is the product of all the non-real roots of the following equation?

- A.
- B.
- C.
- D.
- E.

Question 13

What is the solution to the following system of equations represented in a matrix form?

- A.
- B.
- C.
- D.
- E.

Question 14

Let x, y, z . If x, y, z are each randomly assigned a number from $\{1, 2, 3, 4, 5\}$, what is the probability that $x + y + z = 10$?

- A.
- B.
- C.
- D.
- E.

Question 15

In the base-ten number system, ten digits $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ are used for number representation. The base-ten number 923 therefore means $9 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$. Similarly, in the base-five number system, five digits $\{0, 1, 2, 3, 4\}$ are used for number representation. A base-five number 3212_5 means $3 \times 5^3 + 2 \times 5^2 + 1 \times 5^1 + 2 \times 5^0$. What is the base-five representation of the base-ten number 237?

- A. 3212
- B. 1422
- C. 2214
- D. 4122
- E. 4321

Section B: 5 Open-Ended Questions

5 points each

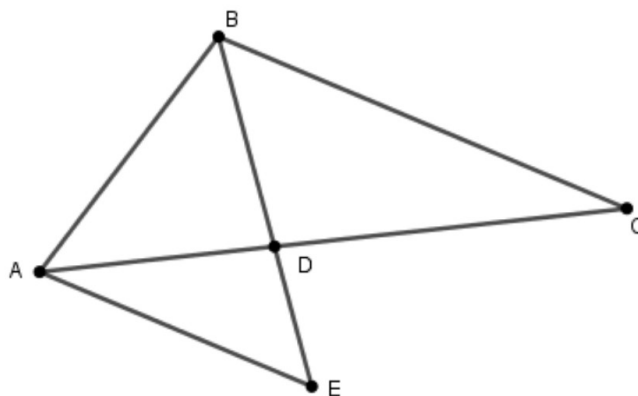
Question 16

What is the value of the following expression?

Your Answer:

Question 17

In the figure below, $\overline{AD}$ is the angle bisector of $\angle BAC$ within $\triangle ABC$, intersecting $\overline{BC}$ at D ; We know that $AB = 6$ cm, $AC = 8$ cm, and $AD = 4$ cm. What is the length of BD in cm?



Your Answer:

Question 18

Four friends, Adam, Beth, Carla, and David are to be seated randomly at a round table for lunch. Let p represent the probability that Beth and David will be sitting next to each other. What is $30p$?

Your Answer:

Question 19

Let $\frac{a}{b}$ and $\frac{c}{d}$ be the two fractions in simplest form such that $\frac{a}{b} + \frac{c}{d} = \frac{1}{2}$. What is the sum of the numerator and the denominator of the greater fraction?

Your Answer:

Question 20

For a positive integer n , define $\phi(n)$ to be the number of positive integers that are less than n and relatively prime to n . What is the value of $\phi(2021)$?

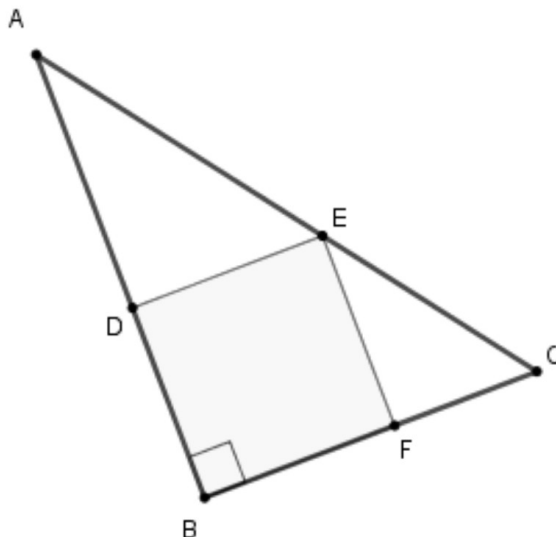
Your Answer:

Section C: 5 Open-Ended Questions

6 points each

Question 21

In the figure below is a right triangle. Square is inscribed inside inches and inches. Let represent the length of . What is ?



Your Answer:

Question 22

What is the simplified value of the following expression?

Your Answer:

Question 23

The deer population in a certain region is 5000 in 2021. Based on extensive research, it is found that the deer population growth in the future tends to follow the following logistic function, where t represents the number of years from 2021. What is the maximum deer population that can be sustained in the region?

Your Answer:

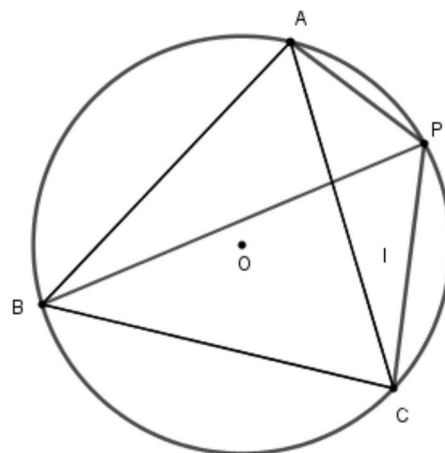
Question 24

What is the smallest value of the following expression over the domain of real numbers?

Your Answer:

Question 25

In the figure below $\triangle ABC$ is equilateral. Point P is on the circle, with $AP = 3$ inches and $BP = 4$ inches. What is the length of CP in inches?



Your Answer:
