BRAINIACS OLYMPIAD

GRADES 9-10

MATHEMATICS SAMPLE PAPER

PRACTICAL PART

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MATHEMATICS SAMPLE PAPER-GLOBAL FINAL
Grade: 9-10
Time: 120 minutes
Total points: 100

Q1.
A diagram of a standard examination desk is provided below. The scale of the drawing is $1:15$.
Practical Task: Use your ruler to measure the length of the desk in the diagram to the nearest millimeter.
Question: Based on your measurement, what is the actual surface area of the desktop in square meters (m^2)?

A) $0.45\ m^2$

B) $0.54\ m^2$

C) $0.63\ m^2$

D) $0.72\ m^2$

Q2.
A student sits at a point P and looks at the top of a clock hanging on the wall. The horizontal distance from the student to the wall is 4.5 meters.
Practical Task: Using the provided protractor on the side-view diagram (not to scale), measure the angle of elevation x from the student's eye level to the top of the clock.
Question: If the student's eye level is 1.2 meters above the floor, which mathematical expression represents the height of the top of the clock from the floor?

A) $1.2 + 4.5\cos(x)$

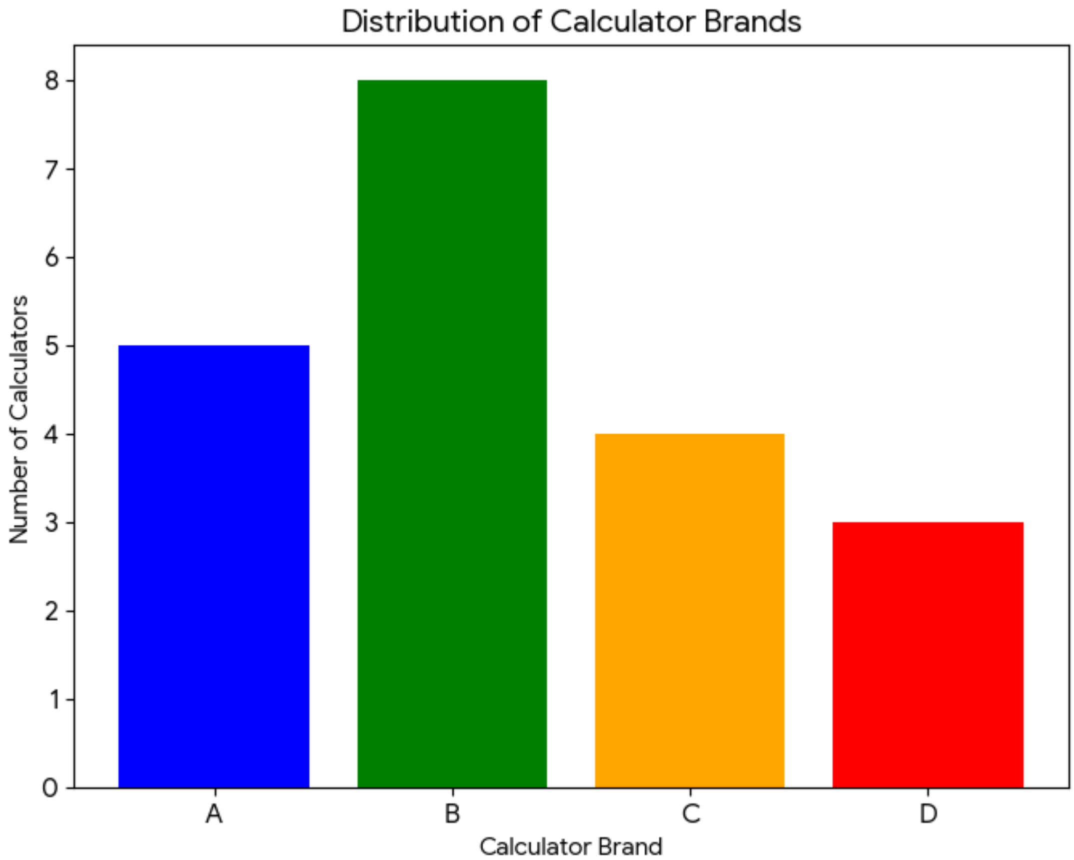
B) $1.2 + 4.5\tan(x)$

C) $1.2 + 4.5\sin(x)$

D) $4.5\tan(x) - 1.2$

Q3.

An invigilator has a box containing different types of calculators used by students. The bar chart shows the distribution of four brands (A, B, C, and D) in the box.



Question: If the invigilator picks two calculators at random without replacement, what is the probability that both are Brand A?

A) $\frac{1}{19}$

B) $\frac{1}{20}$

C) $\frac{5}{19}$

D) $\frac{25}{361}$

Q4.

A rectangular piece of A4 paper has a fixed perimeter. If the length is x cm and the width is $(15 - x)$cm, the area A can be modeled by the quadratic function

$A = -x^2 + 15x$.

Practical Task: Determine the maximum possible area of such a rectangle by interpreting the vertex of the graph of $A = -x^2 + 15x$.

Question: What is the domain of x for which the area of the rectangle is at least 50 cm^2

A) $5 \leq x \leq 10$

B) $0 < x < 15$

C) $x \leq 5$ or $x \geq 10$

D) $5 < x < 10$

Q5.

The sound level L in decibels (dB) in the examination hall is given by the formula

$$L = 10 \cdot \log_{10}\left(\frac{I}{I_0}\right),$$

where I is the sound intensity and

$I_0 = 10^{-12}\ W/m^2$

is the threshold of hearing.

Question: During a quiet period, the intensity I is measured as

$10^{-8}\ W/m^2$.

If a student drops a heavy ruler and the intensity increases by a factor of 1000, what is the new decibel level?

A) $40\ dB$

B) $110\ dB$

C) $70\ dB$

D) $80\ dB$

Q6.

A study was conducted on 10 students comparing the number of hours spent practicing geometry (h) and their score on a construction task (s). The scatter plot shows a strong positive correlation.

The equation of the line of best fit is

$s = 8h + 20$.

Question: If a student practiced for 7.5 hours, what is their predicted score, and what type of correlation does this represent?

A) 80; Negative Correlation

B) 80; Positive Correlation

C) 60; Positive Correlation

D) 75; No Correlation

Q7.

Practical Task: Using only a ruler and compasses, construct a triangle $ABC$where $AB = 8$ cm, $BC = 10$ cm .

Construct the perpendicular bisector of $AC$to locate the midpoint M.

Problem: If the angle

$\angle ABC = 60^{\circ}$,

use the Law of Cosines to calculate the length of the median BM.

Give your answer to two decimal places and show all construction arcs on your paper.

(Answer: $AC = 2\sqrt{21}, BM = \sqrt{61}$)

Q8.

A student has a water bottle consisting of a cylindrical base and a conical top (frustum).

Practical Task: Measure the radius $r$of the base and the height $h_1$of the cylindrical part from the diagram provided *(Scale $1:2$)*.

Note: For all calculations in this problem, take $\pi = 3$.

Problem: Calculate the total volume of the bottle if the conical top has a vertical height

$h_2 = 5$ cm

and tapers to a small circular opening with radius 1 cm.

If the bottle is filled with water at a constant rate of 20 ml/s, how long will it take to fill the cylindrical portion?

Q9.

Sequences and Patterns in Architecture

The floor of the examination hall is covered with square tiles arranged in a specific pattern.

- The first ring of tiles around a central point uses 8 grey tiles.
- The second ring uses 16 grey tiles.
- The third ring uses 24 grey tiles.

Problem:

1) Find an expression for the number of grey tiles in the n-th ring.

(Answer: $a_n = 8n$)
2) Determine the total number of grey tiles used to complete 25 full rings.
(Answer: 2600)
3) If each tile has a side length of $30\ cm$, calculate the total area covered by the first 10 rings in square meters.
(Answer: 39.6 m^2)

Q10.
An organizer is planning the seating arrangement for the Global Round. The hall has a total usable area of $300\ m^2$. Each student requires a desk area of $1.5\ m^2$ and a buffer zone around them.
The number of students x and invigilators y must satisfy the following conditions:
$1.5x + 3y \leq 240$(Space constraint)$y \geq \frac{x}{20}$(Supervision ratio)
$x + y \leq 150$(Fire safety limit)
Problem:
1) Represent these inequalities on a coordinate grid, shading the unwanted regions.
(Answer: $y \leq 80 - 0.5x$, $y \geq x/20$, $y \leq 150 - x$)
2) Determine the maximum number of students that can be accommodated in the hall.
(Answer: 142)
3) If the registration fee is $\$50$ per student and the cost per invigilator is $\$120$, calculate the maximum potential profit for this hall.
(Answer: \$6160)