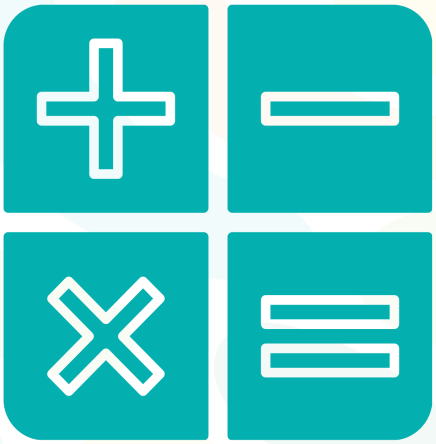
BRAINIACS OLYMPIAD

GRADES 7-8

MATHEMATICS SAMPLE PAPER

PRACTICAL PART



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MATHEMATICS SAMPLE PAPER-GLOBAL FINAL
Grade: 7-8
Time: 120 minutes
Total points: 100

Q1.
An invigilator notices that the ratio of the number of used pages to unused pages in a student's notebook is $2:7$. After the student writes on 4 more pages, the ratio of used pages to unused pages becomes $0.3\overline{3}$ (where the digit 3 repeats infinitely). How many total pages are in the notebook?
A) 52
B) 144
C) 180
D) 64

Q2.
A student notices that the floor tiles are squares. They place their water bottle on a vertex where four tiles meet. The circular base of the bottle has a circumference of 24π cm, and it is placed perfectly centered on that vertex. What is the area of the bottle's base that lies on one specific tile?
A) 6π cm^2
B) 12π cm^2
C) 36π cm^2
D) 144π cm^2

Q3.
There are 3 rows of desks in the exam hall, with 5 desks in each row. The head proctor has a bag of circular stickers: 6 red, 5 blue, and 4 green. If the proctor places one sticker at random on the top-right corner of the first desk in the first row, what is the probability that the sticker is NOT green?
A) $\frac{11}{15}$
B) $\frac{3}{5}$
C) $\frac{4}{15}$
D) $\frac{2}{3}$

Q4.

A student has a set of new pencils and used erasers.

- Two new pencils and three used erasers have a combined length of 31 cm.
- Five new pencils and one used eraser have a combined length of 45 cm.

If the student uses a linear inequality to ensure their pencil case (20 cm long) can hold one pencil and one eraser placed end-to-end, which statement is true?

A) The combined length is exactly 20 cm.

B) The combined length exceeds the case length by 1 cm.

C) The combined length is 11 cm.

D) The combined length is 7 cm shorter than the case.

Q5.

Two students, Alice and Bob, start the exam with identical 1-liter water bottles. Alice drinks her water at a constant rate, and her bottle becomes empty in exactly 80 minutes. Bob drinks at a constant rate that is 25% faster than Alice's rate. If they both start drinking at the beginning of the 120-minute exam, how many milliliters of water will be left in Bob's bottle at the exact moment Alice's bottle is half-empty?

A) 375 ml

B) 400 ml

C) 500 ml

D) 625 ml

Q6.

Two identical semi-circular protractors with a radius of 10 cm are placed on a desk so that they overlap. The diameter of the first protractor lies on the same straight line as the diameter of the second. If the distance between their centers is 10 cm, what is the area of the overlapping region?

A) $\frac{50\pi}{3} - 25\sqrt{3}$ cm^2

B) $\frac{100\pi}{3} - 50\sqrt{3}$ cm^2

C) $\frac{100\pi}{3} - 25\sqrt{3}$ cm^2

D) $\frac{50\pi}{3} - 12.5\sqrt{3}$ cm^2

Q7.

Requirement: Use your ruler to measure the standard A4 exam paper provided to you.

a) Measure the width $(w)$and length $(l)$of your exam paper to the nearest millimeter.

Calculate the ratio $\frac{l}{w}$.

b) If you fold the paper exactly in half by bringing the two shorter sides together, what is the ratio of the length to the width of the new rectangle?

Compare this result with your answer in part (a).

c) Prove that if a rectangle has the property that folding it in half creates a smaller rectangle with the same length-to-width ratio, then that ratio must be $\sqrt{2}$.

Q8.

Use your ruler and a sheet of paper from your desk.

a) Measure the total length of your pencil (to the nearest millimeter) and the width of your exam paper (to the nearest millimeter).

b) If your pencil's length were increased in the ratio $7:5$ and the paper's width were decreased by 15%, calculate the new values.

Which one would be longer?

c) A stack of 500 identical exam papers in the corner of the room is 5.5 cm thick. Using the width you measured in part (a) and assuming the paper's length is 297 mm, calculate the volume of a single sheet of paper in cm^3

Q9.

Look at the analog clock on the wall of the exam hall. Suppose the time is exactly 10:13 AM.

a) Calculate the measure of the smaller angle between the hour hand and the minute hand.

Express your answer as a mixed-number fraction.

(Answer: 131.5 = $131\frac{1}{2}^\circ$)

b) Is the degree measure of this angle a rational or irrational number?

Prove your answer by expressing it as a ratio of two integers $\frac{p}{q}$.

c) At what time between 10:00 and 11:00 will the clock hands form a perfect 90° angle for the first time?

Solve this using a linear equation.

(Answer: $10:38:11$ AM (approximately))

Q10.

An examiner is counting boxes of spare erasers and pencils in the exam hall.

a) Erasers come in packs of 8, and pencils come in packs of 12. What is the smallest number of items of each that the examiner must have in order to have the same number of erasers and pencils?

Answer: (3 packs of eraser in total 24 erasers and 2 packs of pencils in total 24 pencils)

b) The examiner notices a pattern in the serial numbers of the notebooks:

$2, 5, 11, 23, 47, \ldots$

Find a formula for the n-th term of the sequence and determine the 10th serial number.

(Answer: 1535)

c) There are 100 lockers in the hall, numbered 1 to 100.

- Student 1 opens all lockers.
- Student 2 closes every 2nd locker.
- Student 3 changes the state of every 3rd locker (opens it if it is closed, closes it if it is open).

This process continues until 100 students have each passed the lockers.

Which lockers remain open at the end? Provide a logical explanation for your answer.

(Answer: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100)