

HU Collection
Test of Mathematics for University Admission
Mock Set C Paper 1
Applications of Mathematical Knowledge

Time allowed: **75 minutes**
Questions: 20 multiple choice
Calculators: not permitted
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Date written: 23 September 2026

Name: _____
Date sat: _____
Score: _____ / 20

Instructions

Answer all 20 questions. Each question has exactly one correct option and is worth one mark. No marks are deducted for wrong answers. All angles are in radians. This set is pitched well above the 2025 TMUA and weighted towards integration tricks and trigonometric inequalities. Nothing beyond the TMUA specification is needed, but almost nothing yields to a routine method.

Q	1	2	3	4	5	6	7	8	9	10
Ans										
Q	11	12	13	14	15	16	17	18	19	20
Ans										

Question 1

Real numbers $a > 1$ and $b > 1$ satisfy $\log_a b = 2 \log_b a$. Find the value of $\log_{ab} a$.

- A $\frac{1}{3}$
- B $\frac{1}{2}$
- C $\sqrt{2} - 1$
- D $2 - \sqrt{2}$
- E $\frac{\sqrt{2}}{2}$
- F $\sqrt{2} + 1$

Question 2

When the polynomial $p(x)$ is divided by $(x - 1)^2$ the remainder is $2x + 1$, and when $p(x)$ is divided by $x + 1$ the remainder is -3 . Let $r(x)$ be the remainder when $p(x)$ is divided by $(x - 1)^2(x + 1)$. Find $r(3)$.

- A 1
- B 2
- C 3
- D 4
- E 5
- F $\frac{15}{2}$

Question 3

How many integers x satisfy

$$|x^2 - 5|x| + 4| < 2?$$

- A 4
- B 5
- C 6
- D 7
- E 8
- F infinitely many

Question 4

Find the minimum value of $x^2 + \frac{16}{x}$ for $x > 0$.

- A $6\sqrt[3]{2}$
- B 8
- C $8\sqrt{2}$
- D 12
- E 16
- F 20

Question 5

The set of values of x with $0 < x < \frac{\pi}{2}$ for which

$$\tan x + \cot x < 4$$

is an interval. Find its length.

- A $\frac{\pi}{24}$
- B $\frac{\pi}{12}$
- C $\frac{\pi}{8}$
- D $\frac{\pi}{6}$
- E $\frac{\pi}{4}$
- F $\frac{\pi}{3}$

Question 6

For a real number k , say that the equation

$$\sum_{n=0}^{\infty} (2 \sin x)^n = k$$

is *solvable* if there is a real x for which the series converges and its sum is k . For how many of the values $k = \frac{1}{3}, \frac{1}{2}, \frac{2}{3}, 2, 4$ is the equation solvable?

- A 1
- B 2
- C 3
- D 4
- E 5

Question 7

For how many integers k does the equation

$$2 \sin^2 x + 3 \sin x + k = 0$$

have exactly two solutions with $0 \leq x < 2\pi$?

- A 1
- B 2
- C 3
- D 4
- E 5
- F 6

Question 8

Find the total length of the set of values of x in $[0, 2\pi]$ for which

$$\sin x + \sin 2x + \sin 3x > 0.$$

- A $\frac{\pi}{2}$
- B $\frac{2\pi}{3}$
- C $\frac{5\pi}{6}$
- D $\frac{\pi}{6}$
- E $\frac{7\pi}{6}$
- F $\frac{4\pi}{3}$

Question 9

Find the complete set of real values of a for which the equation

$$x^3 - 3ax^2 + 4 = 0$$

has exactly one real solution.

- A $a < 1$
- B $a < 1$ and $a \neq 0$
- C $0 < a < 1$
- D $a > 1$
- E $a \neq 1$
- F $a < -1$

Question 10

The two tangents from the origin to the circle $(x - 4)^2 + (y - 3)^2 = 4$ meet at an acute angle θ . Find $\tan \theta$.

- A $\frac{2}{5}$
- B $\frac{2}{\sqrt{21}}$
- C $\frac{12}{17}$
- D $\frac{4\sqrt{21}}{21}$
- E $\frac{4\sqrt{21}}{17}$
- F $\frac{\sqrt{21}}{2}$

Question 11

The function F is defined for all real x by

$$F(x) = \int_0^x (x - t) \sin t \, dt.$$

Find $F(\pi)$.

- A 0
- B 1
- C $\pi - 2$
- D 2
- E 3
- F π

Question 12

The function f is continuous and satisfies $f(x + 3) = f(x)$ for all real x , and $\int_0^3 f(x) \, dx = 2$. Find

$$\int_0^{675} f(3x + 1) \, dx.$$

- A 150
- B 225
- C 450
- D 900
- E 1350
- F it cannot be determined from the information given

Question 13

Evaluate

$$\int_0^4 \frac{1}{1 + 2^{x-2}} \, dx.$$

- A 2
- B 1
- C $\frac{2}{\ln 2}$
- D $4 - \frac{2}{\ln 2}$
- E $\ln 5$
- F $\frac{5}{2}$

Question 14

Let $f(x) = x^3 + 3x$, and let f^{-1} be the inverse function of f . Find

$$\int_4^{14} f^{-1}(x) dx.$$

- A $\frac{33}{4}$
- B $\frac{63}{4}$
- C $\frac{79}{4}$
- D $\frac{95}{4}$
- E $\frac{111}{4}$
- F $\frac{129}{4}$

Question 15

Let $f(x) = \frac{1}{2}(x^3 + x)$. Find the area of the finite region in the first quadrant bounded by the graphs of $y = f(x)$ and $y = f^{-1}(x)$.

- A $\frac{1}{16}$
- B $\frac{1}{8}$
- C $\frac{1}{6}$
- D $\frac{1}{4}$
- E $\frac{1}{3}$
- F $\frac{1}{2}$

Question 16

The continuous function f satisfies

$$f(x) = x^2 + x \int_0^1 t f(t) dt \quad \text{for all } x.$$

Find $\int_0^1 f(x) dx$.

- A $\frac{11}{24}$
- B $\frac{25}{48}$
- C $\frac{13}{24}$
- D $\frac{7}{12}$
- E $\frac{5}{8}$
- F $\frac{2}{3}$

Question 17

Find the total length of the set of values of x in $[0, 2\pi]$ for which

$$|\sin x| + |\cos x| > \sqrt{\frac{3}{2}}.$$

- A $\frac{\pi}{3}$
- B $\frac{\pi}{2}$
- C $\frac{2\pi}{3}$
- D $\frac{\pi}{6}$
- E $\frac{7\pi}{6}$
- F $\frac{4\pi}{3}$

Question 18

Find the complete set of real values of a for which

$$a \sin x + \cos 2x \leq 1 + a \quad \text{for all real } x.$$

- A $0 \leq a \leq 4$
- B $0 \leq a \leq 8$
- C $-1 \leq a \leq 8$
- D $a \geq -1$
- E $a \geq 0$
- F all real a

Question 19

The tangent to the curve $y = x^3$ at the point $P(1, 1)$ meets the curve again at Q . Find the area of the region enclosed between the curve and the line segment PQ .

- A $\frac{9}{4}$
- B $\frac{27}{8}$
- C $\frac{27}{4}$
- D 8
- E $\frac{27}{2}$
- F $\frac{81}{4}$

Question 20

Find

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{n}{(n+k)^2}.$$

- A $2 \ln 2 - 1$
- B $\frac{1}{2}$
- C $\ln 2$
- D $\frac{\pi}{4}$
- E 1
- F the limit does not exist

END OF PAPER