JZ Maths

TMUA TOPIC TEST

Cauchy-Schwarz and AM-GM Inequalities Topic Test

Time limit: 40 minutes

Calculators: not permitted

Format: 10 multiple-choice questions

This is a TMUA-style topic test: a timed set of TMUA-style questions, with a particular focus on a given topic. You can also sit this test online at jzmaths.com, where the result will count towards your mastery score.

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Question 1

For $x > 0$, what is the minimum value of $x + \frac{9}{x}$?

A 5

B 6

C 7

D 8

E $\frac{11}{2}$

Question 2

For positive real numbers x and y, what is the smallest possible value of $(4x^2 + 9y^2)\left(\frac{1}{x^2} + \frac{1}{y^2}\right)$?

A 13

B 25

C 30

D 36

E 49

Question 3

For $x > 1$, what is the smallest possible value of $\dfrac{x^2}{x-1}$?

A 4

B 3

C $\dfrac{9}{2}$

D 5

E $2+\sqrt{2}$

Question 4

Let x and y be positive real numbers with $2x + y = 8$. What is the maximum value of xy?

A 5

B 6

C 8

D 9

E 12

Question 5

Let a, b and c be positive real numbers. What is the minimum value of $\frac{a}{b} + \frac{b}{c} + \frac{c}{a}$?

A 1

B $\frac{3}{2}$

C 2

D 6

E 3

Question 6

Let k be the smallest real number such that $(3x + 4y)^2 \leq k(x^2 + 2y^2)$ for all real numbers x and y. What is the value of k?

A 13

B 15

C 16

D 17

E 25

Question 7

For $-1 \leq x \leq 1$, what is the greatest possible value of $\sqrt{3x+3} + \sqrt{5-5x}$?

A $2\sqrt{2}$

B $\sqrt{10}$

C $\sqrt{15}$

D $\sqrt{17}$

E 4

Question 8

A point $P = (x, y)$ lies on the line $5x + 12y = 30$. What is the smallest possible distance from P to the point $(1, 1)$?

A 1

B $\frac{4}{3}$

C $\sqrt{2}$

D $\frac{5}{4}$

E $\frac{4}{5}$

Question 9

Let $f(x) = ax + b$, where a and b are real numbers satisfying $a^2 + 4b^2 = 4$. Let $I = \int_0^2 f(x)\,dx$. What is the greatest possible value of I?

A $\sqrt{5}$

B 4

C 5

D $4\sqrt{5}$

E $2\sqrt{5}$

Question 10

The quadratic equation $x^2 - 10x + c = 0$ has two positive real roots a and b, allowing $a = b$. What is the greatest possible value of $\frac{ab}{(a+1)(b+1)}$?

A $\frac{5}{7}$

B $\frac{5}{6}$

C $\frac{25}{36}$

D $\frac{25}{121}$

E $\frac{10}{21}$