



TMUA TOPIC TEST

Multivariate Factorisation 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

The positive integers x and y satisfy $xy + 2x + 3y = 42$. How many ordered pairs (x, y) are there?

A 5

B 4

C 6

D 8

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Question 2

For all positive real numbers a and b , the inequality $a^3 + b^3 \geq c ab(a + b)$ holds. What is the greatest value of the constant c for which this is always true?

A $\frac{1}{2}$

B 1

C $\frac{2}{3}$

D 2

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Question 3

The expression $a^2(b - c) + b^2(c - a) + c^2(a - b)$ is identically equal to which of the following?

- A** $(a - b)(b - c)(c - a)$
- B** $(a + b)(b + c)(c + a)$
- C** $-(a - b)(b - c)(c - a)$
- D** $(a - b)(b - c)(c + a)$

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Question 4

Let $a > 0$ and $f(x) = \frac{1}{2}x^4 + ax^3 - \frac{3}{2}a^2x^2 - 2a^3x$. What is the x -coordinate of the local maximum of f ?

A $-2a$

B $-a$

C $\frac{a}{2}$

D $-\frac{a}{2}$

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Question 5

Positive real numbers x and y satisfy $x + y = 3$.

For which values of x is $x^3 - 2x^2y - xy^2 + 2y^3 > 0$?

A $0 < x < \frac{3}{2}$

B $\frac{3}{2} < x < 2$

C $0 < x < \frac{3}{2}$ or $2 < x < 3$

D $\frac{3}{2} < x < 3$

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Question 6

The equation $2 \sin^3 x - \sin x = 2 \cos^3 x - \cos x$ has four solutions in $0 \leq x < 2\pi$. What is the sum of these four solutions?

You may use the result $\sin(2x) = 2 \sin x \cos x$ for all real values of x .

A 3π

B $\frac{7\pi}{2}$

C 4π

D $\frac{9\pi}{2}$

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Question 7

Let $a > 0$. The curve $y = x^3 - 3a^2x$ and the line $y = -2a^3$ enclose a finite region. What is the area of this region?

A $\frac{27a^4}{4}$

B $\frac{9a^4}{2}$

C $\frac{27a^3}{4}$

D $\frac{81a^4}{8}$

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Question 8

What is the sum of the x -coordinates of all real solutions (x, y) of the simultaneous equations $x^2 + xy - 2y^2 + x - y = 0$ and $2x^2 - 5xy + 2y^2 + 3x - 6y = 0$?

You are also given that the system have exactly 4 solutions.

A $-\frac{9}{2}$

B -5

C $-\frac{51}{10}$

D $-\frac{49}{10}$

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Question 9

In a non-degenerate triangle ABC , the side lengths opposite A , B , C are a , b , c respectively. Suppose $a^2 + ab - ac - 2b^2 + bc = 0$ and $c^2 = 3ab$. What is the value of C ?

- A $\frac{\pi}{3}$
- B $\frac{\pi}{2}$
- C $\frac{2\pi}{3}$
- D $\frac{3\pi}{4}$

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Question 10

How many points (x, y) on the circle $2x^2 + 2y^2 = 5$ satisfy $2x^3 - 5x^2y - 4x^2 + xy^2 + 12xy + 2y^3 - 8y^2 = 0$?

A 2

B 4

C 5

D 6

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