



Clavis TMUA Set C Paper 1

Recommended time: 75 minutes

Calculators: not permitted

Format: 20 multiple-choice questions

This community paper is presented in a clean, print-ready format. The wording, mathematics, answer choices, and diagrams are preserved from the source paper.

Paper guidance

- Attempt every question. Select the best answer from the choices given.
- If a diagram is shown, it is reproduced from the source material and may not be drawn to scale.
- This question paper does not include worked solutions or a marked answer key.

Best of luck, and enjoy the challenge!

Source credit: Clavis

Question 1

Find the value of

$$\sum_{k=0}^{25} \sin (30+90 k)^{\circ}$$

A 0

B $\frac{1}{2}$

C $\frac{\sqrt{3}}{2}$

D 1

E $\frac{1+\sqrt{3}}{2}$

F $1+\sqrt{3}$

Question 2

Find the coefficient of x^2 in

$$(1+x)^2 + (1+x)^3 + (1+x)^4 + \cdots + (1+x)^{10}$$

- A** 45
- B** 55
- C** 120
- D** 155
- E** 164
- F** 165

Question 3

The positive real numbers x and y satisfy

$$\log_2(xy) = 5 \quad \text{and} \quad (\log_2 x)(\log_2 y) = 6$$

Find the sum of the possible values of x .

- A** 5
- B** 6
- C** 8
- D** 10
- E** 11
- F** 12

Question 4

Find the minimum value of

$$9^{\cos x} - 6(3^{\cos x}) + 11$$

for real x .

A 2

B 3

C 6

D 9

E $\frac{82}{9}$

Question 5

The following sequence of transformations is applied, in order, to the curve $y = x^2$:

1. a translation of 3 units in the positive x -direction
2. a reflection in the x -axis
3. a translation of 5 units in the positive y -direction

Find the equation of the resulting curve.

A $y = (x - 3)^2 + 5$

B $y = -(x + 3)^2 + 5$

C $y = -(x - 3)^2 + 5$

D $y = -(x - 3)^2 - 5$

E $y = -(x - 5)^2 + 3$

F $y = (x + 3)^2 - 5$

Question 6

The 1st, 2nd and 3rd terms of a geometric progression are also the 1st, 5th and 7th terms respectively of an arithmetic progression.

The geometric progression has first term 4 and common ratio r , where $r \neq 1$.

Find the value of r .

A $\frac{1}{3}$

B $\frac{1}{2}$

C 1

D $\frac{3}{2}$

E 2

Question 7

Find the coefficient of x^3 in the expansion of

$$(1 + x + x^2)^4$$

A 4

B 12

C 16

D 20

E 24

F 28

Question 8

Find the shortest distance between the curve $y = x^2 + 3$ and the line $y = 2x - 1$.

A $\frac{\sqrt{5}}{5}$

B $\frac{2\sqrt{5}}{5}$

C 1

D $\frac{6}{5}$

E $\frac{3\sqrt{5}}{5}$

F $\sqrt{5}$

Question 9

Find the sum of all the solutions of

$$2 \cos^2 x = 1 + \cos x$$

in the range $0^\circ < x < 360^\circ$.

- A** 360°
- B** 480°
- C** 600°
- D** 720°
- E** 840°
- F** 960°

Question 10

The sequence $x_1, x_2, x_3, \dots$ is defined by

$$x_1 = 256 \quad \text{and} \quad x_{n+1} = \sqrt{x_n} \quad \text{for } n \geq 1$$

Find the least value of n for which $x_n < 2$.

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

Question 11

A quantity V satisfies

$$\frac{dV}{dt} = 6\sqrt{t} \quad \text{for } t \geq 0$$

and $V = 5$ when $t = 0$.

Find the value of V when $t = 9$.

- A** 59
- B** 81
- C** 108
- D** 113
- E** 117
- F** 167

Question 12

Find the length of the tangent from the point $(7, 4)$ to the circle with equation

$$x^2 + y^2 - 4x + 2y - 4 = 0$$

A $\sqrt{35}$

B 6

C $\sqrt{41}$

D 7

E $5\sqrt{2}$

F $\sqrt{59}$

Question 13

For how many real values of a does the equation

$$(x - a)(x^2 + x + a) = 0$$

have exactly two distinct real solutions for x ?

- A** 0
- B** 1
- C** 2
- D** 3
- E** 4
- F** 5
- G** infinitely many

Question 14

The area enclosed between the line $y = mx$ and the curve $y = x^3$ is 8, where $m > 0$.

Find the value of m .

A 1

B 2

C 3

D 4

E 6

F 8

Question 15

The quadratic expression $x^2 - 10x + 16$ factorises as $(x - \alpha)(x - \beta)$, where α and β are positive real numbers.

Which one of the following has roots $\sqrt{\alpha}$ and $\sqrt{\beta}$?

A $x^2 - 3\sqrt{2}x + 4$

B $x^2 - \sqrt{10}x + 4$

C $x^2 - 3\sqrt{2}x + 16$

D $x^2 - 18x + 4$

E $x^2 - \sqrt{18}x + 16$

F $x^2 - 4x + 3\sqrt{2}$

Question 16

Find the complete set of values of x for which

$$(x + 3)(x - 1)(2 - x) > 0 \quad \text{and} \quad (x + 1)(x - 4) < 0$$

- A** $-3 < x < 1$
- B** $1 < x < 2$
- C** $-1 < x < 2$
- D** $x < -3$ or $1 < x < 2$
- E** $-1 < x < 4$
- F** $2 < x < 4$

Question 17

A set of five distinct positive integers has mean 10 and median 10.

Find the largest possible value of the greatest integer in the set.

A 14

B 18

C 20

D 22

E 24

F 26

Question 18

Find the sum of all the solutions of

$$|2 \cos x| = 1$$

in the range $0 \leq x \leq 2\pi$.

A 3π

B 4π

C 5π

D 6π

E 7π

F 8π

Question 19

Find the positive difference between the two real values of x satisfying

$$(\log_3 x)^2 - \log_3 (x^4) + 3 = 0$$

A 2

B 6

C 8

D 18

E 24

F 26

Question 20

A square has side length 8.

A second square is drawn with its vertices at the midpoints of the sides of the first square, a third square is drawn with its vertices at the midpoints of the sides of the second, and so on indefinitely.

Find the total area of all the squares.

- A** 96
- B** 112
- C** 128
- D** 144
- E** 160
- F** 192
- G** 256