



Clavis TMUA Set B 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

$$\int_0^4 \sqrt{x}(x-6) \, dx$$

A -48

B -32

C -24

D $-\frac{96}{5}$

E -16

F $-\frac{64}{5}$

Question 2

An arithmetic progression has 20 terms.

The sum of the first 10 terms is 145, and the sum of the last 10 terms is 445.

Find the common difference.

A 2

B $\frac{5}{2}$

C 3

D $\frac{7}{2}$

E 4

Question 3

The line $y = 2x + c$ is a tangent to the circle with equation

$$x^2 + y^2 - 6x + 4y + 8 = 0$$

Find the possible values of c .

A $c = -13$ or $c = -3$

B $c = -13$ only

C $c = -3$ only

D $c = -8$ or $c = 2$

E $c = 3$ or $c = 13$

F $c = -5$ or $c = 5$

Question 4

How many distinct solutions does the equation

$$2 \sin^2 x = 3 \cos x + 3$$

have in the interval $-2\pi \leq x \leq 2\pi$?

A 2

B 3

C 4

D 5

E 6

F 7

G 8

Question 5

The angle θ satisfies $0 < \theta < \frac{\pi}{2}$ and

$$\sin^2 \theta + \sin^4 \theta + \sin^6 \theta + \sin^8 \theta + \cdots = 3$$

Find the value of $\cos \theta$.

A $\frac{1}{4}$

B $\frac{1}{3}$

C $\frac{1}{2}$

D $\frac{1}{\sqrt{3}}$

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

F $\frac{3}{4}$

Question 6

The diagram shows a circle with centre O and radius 6.

The chord AB subtends an angle of $\frac{2\pi}{3}$ at O .

Find the exact area of the shaded minor segment.

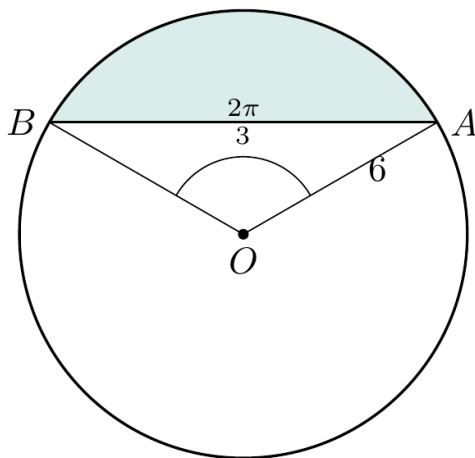


Diagram not to scale.

- A** $6\pi - 9\sqrt{3}$
- B** $12\pi - 18\sqrt{3}$
- C** $12\pi - 9$
- D** $24\pi - 9\sqrt{3}$
- E** $12\pi + 9\sqrt{3}$
- F** $12\pi - 9\sqrt{3}$

Question 7

In the expansion of $(1 + 2x)^n$, where n is an integer with $n \geq 3$, the coefficient of x^3 is six times the coefficient of x^2 .

Find the value of n .

A 8

B 9

C 10

D 11

E 12

F 14

Question 8

The tangent to the curve $y = x^3 - 4x$ at the point where $x = 2$ meets the y -axis at the point $(0, c)$.

Find the value of c .

A -16

B -8

C -4

D 0

E 4

F 8

Question 9

The equation $x^2 + (k - 3)x + k = 0$ has two distinct real roots, and both roots are positive.

Find the complete set of values of k .

A $0 < k < 1$

B $k < 1$

C $0 < k < 1$ or $k > 9$

D $k > 9$

E $1 < k < 9$

F $k < 1$ or $k > 9$

Question 10

Find the value of

$$\int_{-2}^3 |x - 1| \, dx$$

A 4

B $\frac{9}{2}$

C $\frac{11}{2}$

D $\frac{13}{2}$

E $\frac{15}{2}$

F $\frac{17}{2}$

Question 11

The positive numbers x and y satisfy

$$x^2y = 32 \quad \text{and} \quad \frac{x}{y^3} = \frac{1}{2}$$

Find the value of x .

A $\frac{1}{2}$

B 1

C 2

D 4

E 8

Question 12

The graph of $y = f(x)$ meets the x -axis at $x = -2$ and at $x = 6$, and nowhere else.

At which values of x does the graph of $y = f(2x + 4)$ meet the x -axis?

A $x = -1$ and $x = 5$

B $x = -3$ and $x = 1$

C $x = -8$ and $x = 8$

D $x = -4$ and $x = 2$

E $x = 0$ and $x = 4$

F $x = -6$ and $x = 2$

Question 13

The points $A(-1, 4)$, $B(5, 2)$ and $C(k, k)$ are such that angle ABC is a right angle.

Find the value of k .

A 4

B $\frac{9}{2}$

C 5

D $\frac{11}{2}$

E 6

F $\frac{13}{2}$

Question 14

The trapezium rule with 3 strips of equal width is used to estimate

$$\int_1^4 \log_{10} x \, dx$$

Which one of the following is the estimate?

- A** $\log_{10} 6$
- B** $\log_{10} 12$
- C** $\log_{10} 18$
- D** $\log_{10} 24$
- E** $\log_{10} 36$
- F** $\log_{10} 144$

Question 15

The first three terms of a geometric progression are

$$k + 16, \quad k + 4, \quad k$$

where k is a positive constant.

Find the sum to infinity of the progression.

A 24

B 27

C 36

D 40.5

E 54

F 81

Question 16

Find the complete set of values of x for which

$$|2x - 1| > |x + 3|$$

A $-\frac{2}{3} < x < 4$

B $-4 < x < \frac{2}{3}$

C $x < -4$ or $x > \frac{2}{3}$

D $x > 4$ only

E $x < -\frac{2}{3}$

F $x < -\frac{2}{3}$ or $x > 4$

Question 17

The ten numbers $x_1, x_2, \dots, x_{10}$ have mean 12, and the mean of their squares is 200.

Find the value of

$$\sum_{i=1}^{10} (x_i - 12)^2$$

A 320

B 440

C 560

D 680

E 800

Question 18

Box A contains 2 red counters and 3 blue counters. Box B contains 3 red counters and 1 blue counter.

A fair coin is tossed. If it lands heads, a counter is taken at random from box A ; if tails, a counter is taken at random from box B .

The counter taken is red. Find the probability that it came from box B .

A $\frac{1}{5}$

B $\frac{3}{8}$

C $\frac{23}{40}$

D $\frac{3}{5}$

E $\frac{15}{23}$

F $\frac{3}{4}$

Question 19

The polynomial $p(x) = x^3 + ax^2 + bx - 6$ is divisible by $(x - 1)$, and leaves a remainder of -12 when divided by $(x + 2)$.

Find the value of ab .

A -6

B 0

C 2

D 5

E 6

F 9

Question 20

The curve with equation $y = x^3 - 3x^2 + k$, where k is a real constant, meets the x -axis at exactly two distinct points.

Find the possible values of k .

- A** $k = 0$ only
- B** $k = 4$ only
- C** $k = 0$ or $k = 4$
- D** $0 < k < 4$
- E** $k < 0$ or $k > 4$
- F** $k = -4$ or $k = 0$