TMUA

COMMUNITY PAPERS

Unattributed TMUA Mock Set A 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: Unattributed

tmua.me editorial edition: corrections applied; original question numbering retained.
20 active questions.
Credit remains with the original author. Editorial history: model-answers/ALTERED-QUESTIONS.md in the repository.

Question 1

f(x) is a quadratic function in x.

The graph of $y = \text{f}(x)$ passes through the point $(-1, 12)$ and has a turning point at $(3, -4)$.

Find an expression for f(x).

A $x^2 + 6x + 5$

B $x^2 - 6x + 5$

C $4x^2 + 24x + 32$

D $4x^2 - 24x + 32$

E $x^2 + 6x + 8$

F $x^2 - 6x + 8$

Question 2

Let $a > 0$.

The sum of all binomial coefficients in the expansion of $\left(2x - \frac{a}{\sqrt{x}}\right)^n$ is 64, and the constant term in the expansion is 60. What is the value of a?

A 2

B 1

C -1

D 4

E -4

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Question 3

$\{a_n\}$ and $\{b_n\}$ are two arithmetic sequences, where $\frac{a_k}{b_k}$ $(1 \leq k \leq 5)$ is a constant value.

Given $a_1 = 288$, $a_5 = 96$ and $b_1 = 192$, what is the value of b_3?

A 64

B 128

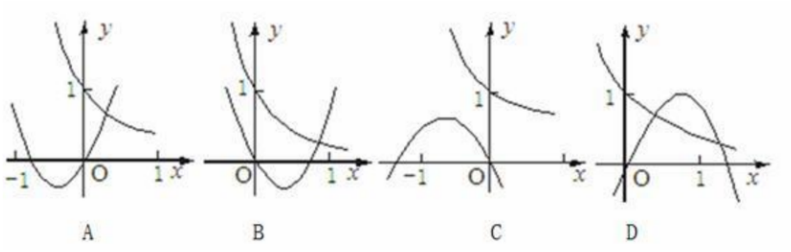
C 256

D 512

E 1024

Question 4

The graphs of a quadratic function $y = ax^2 + bx$ and an exponential function $y = \left(\frac{b}{a}\right)^x$ can be:



A none of them

B A

C B

D C

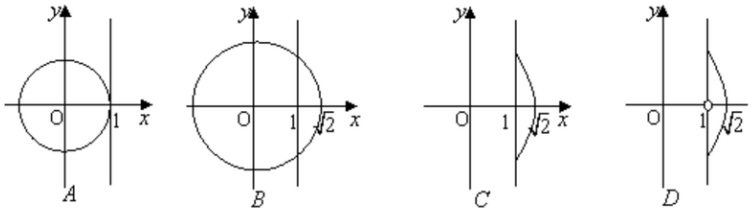
E D

Question 5

The graph of the curve represented by the equation

$$\sqrt{x-1}\,\log_{10}\left(x^2+y^2-1\right)=0$$

is



A none of them

B A

C B

D C

E D

Question 6

If the circle C: $(x-1)^2+y^2=1$ is tangent to the circle C_2: $x^2+y^2-8x+8y+m=0$, then the value of m can be

A 16 or -4

B 7 or -7

C 7 or -4

D 16 or -7

E 4 or -4

F 16 or -16

Question 7

In the sequence $\{a_n\}$, $a_1 = -\frac{1}{4}$ and

$$a_n = 1 - \frac{1}{a_{n-1}} \quad (n > 1)$$

then the value of a_{2014} is

A $-\frac{1}{4}$

B 5

C $\frac{4}{5}$

D none of the above

E $\frac{1}{4}$

Question 8

The greatest value which the function

$$\mathrm{f}(x) = \left(3\sin^2(10x + 11) - 7\right)^2$$

takes, as x varies over all real numbers, equals

A -9

B 16

C 49

D 100

E 3

Question 9

The number of roots of the equation

$$\sqrt{x} - \ln x - 2 = 0$$

is

A 0

B 1

C 2

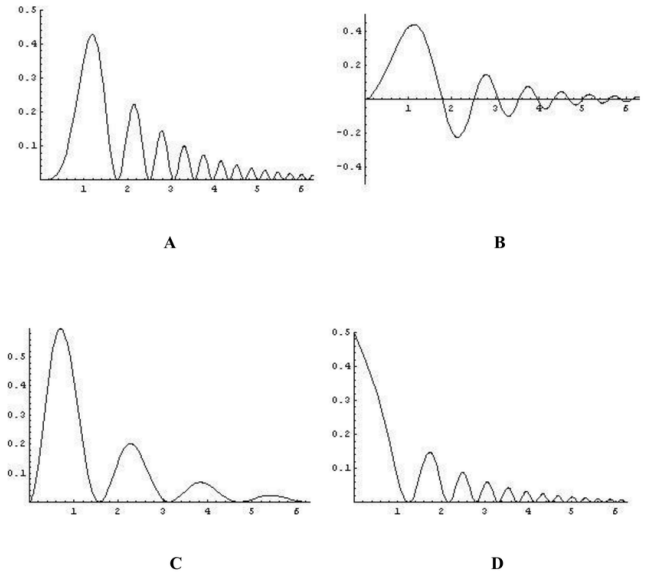
D 3

E 4

Question 10

Which of the following graphs is the graph of the function

$$y = 2^{-x} \sin^2\left(x^2\right) \ ?$$



A A

B B

C C

D D

Question 11

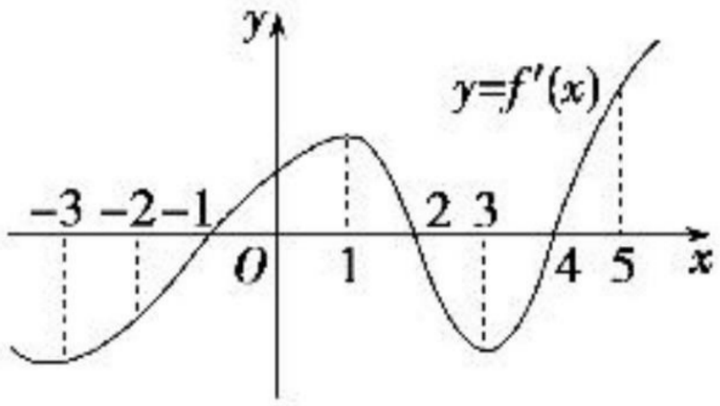
The graph of the derivative function $y = \mathrm{f}'(x)$ of the function $y = \mathrm{f}(x)$ is shown in the figure. How many of the following conclusions are correct?

I. $\mathrm{f}(x)$ is increasing on $(-3, -1)$.

II. $\mathrm{f}(x)$ is increasing on $(1, 2)$.

III. $\mathrm{f}(x)$ is decreasing on $(1, 3)$.

IV. $\mathrm{f}(x)$ obtains a minimum value when $x = 4$.



A 0

B 1

C 2

D 3

E 4

Question 12

$\mathrm{f}(x) = \sin(ax + b)$, where $a > 0$ and $|b| \leq \dfrac{\pi}{2}$.

$x = -\dfrac{\pi}{4}$ is a zero of $\mathrm{f}(x)$, and $\mathrm{f}(x) \leq \left|\mathrm{f}\left(\dfrac{\pi}{4}\right)\right|$ for all x.

If there is a minimum but no maximum in the interval $\left(-\dfrac{\pi}{12}, \dfrac{\pi}{24}\right)$, then the maximum value of a is

A 11

B 13

C 15

D 17

E 19

Question 13

The tangent to the curve $y = \dfrac{2x}{x-1}$ at the point $P(2,\ 4)$ is parallel to the line l, and the distance between them is $2\sqrt{5}$.

Then the equation of the line l is

A $2x + y + 2 = 0$

B $2x + y + 2 = 0$ or $2x + y - 18 = 0$

C $2x - y - 18 = 0$

D $2x - y + 2 = 0$ or $2x - y - 18 = 0$

Question 14

The derivative of the function $\mathrm{f}(x)$ is $\mathrm{f}'(x)$. If there exists x_0 such that $\mathrm{f}(x_0) = \mathrm{f}'(x_0)$, then x_0 is a **coincidence point** of $\mathrm{f}(x)$.

How many of the following functions have a coincidence point?

I. x

II. x^2

III. $\dfrac{1}{x}$

IV. $\ln x$

V. $\left(\dfrac{1}{\mathrm{e}}\right)^x$

A 0

B 1

C 2

D 3

E 4

F 5

Question 15

l is a tangent to the curve $y = x^2 - 2x + 3$, and l meets the curve at P. If the range of the x-coordinate of P is $\left[1, \frac{3}{2}\right]$, then which of the following is the range of the inclination angle of the tangent?

A $\left[0, \frac{\pi}{2}\right]$

B $\left[0, \frac{\pi}{4}\right]$

C $[0, \pi]$

D $[0, \pi)$

E $\left[\frac{3\pi}{4}, \pi\right)$

F $\left[\frac{3\pi}{4}, \pi\right]$

Question 16

The graph of the function $g(x)$ is translated to the left by $\frac{\pi}{6}$ to give the graph of $f(x) = \sin\left(2x - \frac{\pi}{6}\right)$. What is the minimum value of $y = g(x) + \cos 2x$ on the interval $\left[0, \frac{\pi}{2}\right]$?

A $\sqrt{3}$

B 2

C $-\sqrt{3}$

D $\frac{3}{2}$

E -2

F 0

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Question 17

If the function $f(x)$ $(x \in \mathbb{R})$ is even and the function $g(x)$ $(x \in \mathbb{R})$ is odd, then

A the function $f(x) + g(x)$ is an odd function

B the function $f(x)\, g(x)$ is an even function

C the function $f[g(x)]$ is an even function

D the function $g[f(x)]$ is an odd function

Question 18

$\{a_n\}$ is a geometric sequence of nonzero real numbers. Which of the following holds for any positive integer k?

A $a_k a_{k+1} > 0$

B $a_k a_{k+2} > 0$

C $a_k a_{k+1} a_{k+2} > 0$

D $a_k a_{k+3} > 0$

E $a_{k+1} a_{k+2} > 0$

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Question 19

$\mathrm{f}(x)$ is an odd function whose domain is $\mathbb{R}$, and $\mathrm{f}(1) = 0$.

When $x > 0$,

$$x\,\mathrm{f}'(x) - \mathrm{f}(x) < 0$$

What is the complete set of x for which $x^2\mathrm{f}(x) > 0$?

A $(-\infty, -1) \cup (1, +\infty)$

B $(-\infty, -1) \cup (0, 1)$

C $(-1, 0) \cup (0, 1)$

D $(-1, 0) \cup (1, +\infty)$

Question 20

There are many beautifully shaped and meaningful curves in mathematics, and the curve C:

$$x^2 + y^2 = 1 + |x|y$$

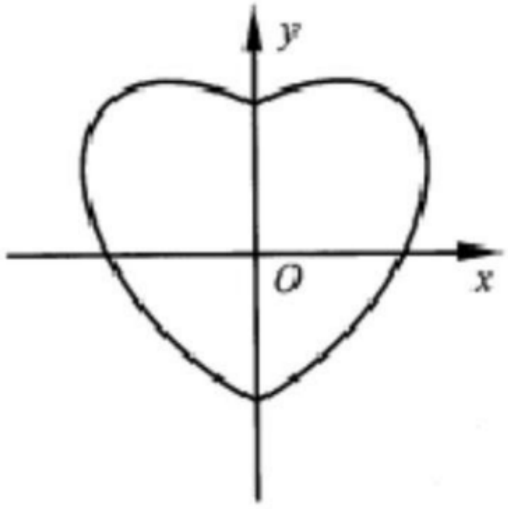
is one of them. Consider the following three statements:

I. The curve C passes through exactly 6 points whose horizontal and vertical coordinates are both integers.

II. The distance from any point on the curve C to the origin does not exceed $\sqrt{2}$.

III. The area of the heart-shaped region enclosed by the curve C is less than 3.

How many of these statements are true?



A none of them

B 1

C 2

D 3