

TMUA Mock Paper 2 (Paper 2)

20 questions. Recreated from the publicly available paper.

Question 1

Exactly one of the following statements is true. Which one?

A. Every integer is a rational number.

B. If $a^2 = b^2$ then $a = b$.

C. The sum of any two irrational numbers is irrational.

D. $0! = 0$.

E. Every prime number is odd.

Question 2

Consider the statement: 'if a quadrilateral is a square then it has four equal sides.' Which of the following is its converse?

- A.If a quadrilateral is a square then it has four equal sides.
- B.If a quadrilateral has four equal sides then it is a square.
- C.If a quadrilateral does not have four equal sides then it is not a square.
- D.If a quadrilateral is not a square then it does not have four equal sides.
- E.A quadrilateral is a square if and only if it has four equal sides.

Question 3

The statement ' $\forall x \in \mathbb{R}, \exists y \in \mathbb{R}$ such that $xy = 1$ ' is false. Which of the following is its negation?

A. $\forall x \in \mathbb{R}, \exists y \in \mathbb{R}$ such that $xy \neq 1$

B. $\exists x \in \mathbb{R}$ such that $\forall y \in \mathbb{R}, xy \neq 1$

C. $\exists x, y \in \mathbb{R}$ such that $xy \neq 1$

D. $\forall x, y \in \mathbb{R}, xy \neq 1$

E. $\exists x \in \mathbb{R}$ such that $\exists y \in \mathbb{R}, xy = 1$

Question 4

The line $y = mx + c$ (with $c \neq 0$) and the circle $x^2 + y^2 = a^2$ (with $a > 0$) are given. Consider statement P: 'the line is tangent to the circle', and statement Q: ' $c^2 = a^2(1 + m^2)$ '. Then Q is:

- A.necessary but not sufficient for P.
- B.sufficient but not necessary for P.
- C.both necessary and sufficient for P.
- D.neither necessary nor sufficient for P.

Question 5

To prove that $\sqrt{2}$ is irrational, a student writes $\sqrt{2} = \frac{p}{q}$ in lowest terms and correctly deduces that p and q are both even. What makes this a valid proof?

- A. It contradicts the assumption that $\frac{p}{q}$ is in lowest terms, so that assumption must be false.
- B. It shows that $\sqrt{2}$ is an even number.
- C. It proves that p and q do not exist.
- D. Even numbers cannot be written as a fraction.
- E. The argument is not actually valid.

Question 6

For a real number x , consider statement P: ' $x^2 < 9$ ', and statement Q: ' $x < 3$ '. Then P is:

- A.necessary but not sufficient for Q.
- B.sufficient but not necessary for Q.
- C.both necessary and sufficient for Q.
- D.neither necessary nor sufficient for Q.

Question 7

Consider the following argument. Line 1: $\frac{1}{4} > \frac{1}{8}$. Line 2: $(\frac{1}{2})^2 > (\frac{1}{2})^3$. Line 3: Taking $\log_{10}$ of both sides, $2 \log_{10} \frac{1}{2} > 3 \log_{10} \frac{1}{2}$. Line 4: Dividing both sides by $\log_{10} \frac{1}{2}$, $2 > 3$. At which line does the first error occur?

A.Line 1

B.Line 2

C.Line 3

D.Line 4

E.there is no error

Question 8

Consider the claim: 'for every positive integer n , the value $n^2 + n + 1$ is odd.' Which of the following is a counterexample?

A. $n = 2$

B. $n = 3$

C. $n = 5$

D. $n = 4$

E. the statement is always true, so there is no counterexample

Question 9

Which of the following statements are true? I: for every real $x > 0$, there is a real y with $y^2 = x$. II: there is a real y such that for every real $x > 0$, $y^2 = x$. III: for every real x , there is a real y with $y^3 = x$.

- A. none of them
- B. I only
- C. II only
- D. III only
- E. I and II only
- F. I and III only
- G. II and III only
- H. I, II and III

Question 10

How many ordered pairs (x, y) of positive real numbers satisfy both $\log_2 x + \log_2 y = 5$ and $x + y = 12$?

A.2

B.0

C.1

D.3

E.4

Question 11

For a positive integer n , the statement ' $n^2 \equiv 1 \pmod{8}$ ' is true if and only if:

A. n is even

B. n is prime

C. 4 divides n

D. n is odd

E. $n \equiv 1 \pmod{8}$

Question 12

A sequence is defined by $u_1 = 2$, $u_2 = 3$ and $u_{n+2} = \frac{u_{n+1}}{u_n}$. Find u_{2025} .

A.2

B.3

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

D. $\frac{3}{2}$

E. $\frac{1}{2}$

Question 13

Three boxes each carry a label. Exactly one box contains a prize, and exactly one of the three labels is true. Box 1 reads 'the prize is in Box 1'; Box 2 reads 'the prize is not in Box 2'; Box 3 reads 'the prize is not in Box 1'. Which box contains the prize?

A.Box 1

B.Box 2

C.Box 3

D.it cannot be determined

E.no arrangement is consistent

Question 14

Integers a , b and c are such that $a + b$, $b + c$ and $c + a$ are all even. Which of the following must be true? I: a , b and c all have the same parity. II: abc is even. III: $a + b + c$ is even.

A.I only

B.II only

C.III only

D.I and II

E.I and III

F.II and III

G.all of them

H.none of them

Question 15

What is the minimum value of $\frac{1}{2 + \cos x}$ over all real x ?

A. $\frac{1}{3}$

B. 1

C. $\frac{1}{2}$

D. -1

E. $\frac{1}{4}$

Question 16

In the expansion of $(x^p + x^{-q})^n$, where p , q and n are positive integers, consider statement P: 'the expansion has a term independent of x ', and statement Q: ' $p + q$ divides np '. Then Q is:

- A.necessary but not sufficient for P.
- B.sufficient but not necessary for P.
- C.both necessary and sufficient for P.
- D.neither necessary nor sufficient for P.

Question 17

Which of the following is the smallest?

A. $\log_3 5$

B. $\log_2 3$

C. $\log_4 9$

D. they are all equal

E. $\log_2 3$ and $\log_4 9$ are equal and are the smallest

Question 18

Given that $\int_0^2 f(x) \, dx = 7$, find $\int_0^2 f(2-x) \, dx$.

A.14

B.7

C.-7

D.0

E.3.5

Question 19

How many integers from 1 to 100 inclusive are divisible by neither 2 nor 3?

A.34

B.17

C.50

D.33

E.67

Question 20

For which real values of k does the equation $x^4 + kx^2 + 1 = 0$ have at least one real solution?

A. $|k| \geq 2$

B. $k \leq -2$

C. $k \geq 2$

D. $k < 0$

E. $k \leq -2$ or $k \geq 2$

Answer key

1. Answer: A
2. Answer: B
3. Answer: B
4. Answer: C
5. Answer: A
6. Answer: B
7. Answer: D
8. Answer: E
9. Answer: F
10. Answer: A
11. Answer: D
12. Answer: D
13. Answer: B
14. Answer: A
15. Answer: A
16. Answer: C
17. Answer: A
18. Answer: B
19. Answer: D
20. Answer: B

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