**NAM DINH DEPARTMENT OF EDUCATION AND TRAINING**

**OFFICIAL**

**CONTEST OF MATH AND SCIENCE IN ENGLISH**
**School year: 2020 - 2021**
**Subject: MATH - Grade 10**
*Time allowed: 90 minutes*

**CODE: 205**

## I. PART I. MULTIPLE CHOICE QUESTIONS (7,0 points)

*Write the correct answer (A, B, C or D) for each of the following questions in the correspondingly numbered space on your answer sheet.*

**Question 1.** Among the following propostions, whose inverse proposition is **true**?

**A.** If a quadrilateral is an isosceles trapezoid then its two diagonals have the same length.

**B.** If two triangles are congruent then their corresponding angles are equal.

**C.** If $n$ is a natural number then $n$ is a real number.

**D.** If a triangle is not regular then it has at least one interior angle less than 60 degrees.

**Question 2.** Given $\Delta ABC$. Let $M$ and $N$ be the mid-points of sides $AB$ and $AC$, respectively. Find the scalars $m$ and $n$ such that $\overrightarrow{NM} = m\overrightarrow{AB} - n\overrightarrow{AC}$.

**A.** $m = \frac{1}{2},\ n = -\frac{1}{2}.$ **B.** $m = \frac{1}{2},\ n = \frac{1}{2}.$ **C.** $m = -\frac{1}{2},\ n = -\frac{1}{2}.$ **D.** $m = -\frac{1}{2},\ n = \frac{1}{2}.$

**Question 3.** Given equation $(x^2 - x + 1)(x - 1)(x + 1) = 0.$ Which of the following equations is equivalent to the given equation?

**A.** $x + 1 = 0.$ **B.** $x^2 - x + 1 = 0.$ **C.** $(x - 1)(x + 1) = 0.$ **D.** $x - 1 = 0.$

**Question 4.** Given two equations $mx^2 - 2(m-1)x + m - 2 = 0$ and $(m-2)x^2 - 3x + m^2 - 15 = 0.$ How many values of $m$ which make these above equations equivalent?

**A.** 1**.** **B.** 2. **C.** 0. **D.** 3.

**Question 5.** In the $Oxy$ coordinate plane, let $A(-3;-5); B(2;5).$ Determine the slope of line $AB$.

**A.** -3. **B.** 2. **C.** 5. **D.** -5.

**Question 6.** Given a right triangle $ABC$ at $A$. Which of the following statements is **false?**

**A.** $\overrightarrow{AC}.\overrightarrow{BC} < \overrightarrow{BC}.\overrightarrow{AB}.$ **B.** $\overrightarrow{AC}.\overrightarrow{CB} < \overrightarrow{AC}.\overrightarrow{BC}.$ **C.** $\overrightarrow{AB}.\overrightarrow{BC} < \overrightarrow{CA}.\overrightarrow{CB}.$ **D.** $\overrightarrow{AB}.\overrightarrow{AC} < \overrightarrow{BA}.\overrightarrow{BC}.$

**Question 7.** A man travels from city X to city Y by train, then returns to city Y by his car. Given that the distance between these two cities is 200 km and the average speed of his car is 10 km/h faster than the train's average speed. His journey takes 9 hours, find the sum of average speeds of the train and his car.

**A.** 90. **B.** 100. **C.** 60**.** **D.** 80**.**

**Question 8.** Given an isosceles triangle $ABC$ with the right angle $A$, inscribed in a circle with center $O$ and radius $R$. Let $r$ be the radius of the incircle of triangle $ABC$. The ratio of $R$ to $r$ is

**A.** $\frac{R}{r} = \frac{1+\sqrt{2}}{2}.$ **B.** $\frac{R}{r} = \frac{\sqrt{2}-1}{2}.$ **C.** $\frac{R}{r} = 1+\sqrt{2}.$ **D.** $\frac{R}{r} = \frac{2+\sqrt{2}}{2}.$

**Question 9.** Given two sets $X = \{A;1;2;4;6\},\ Y = \{3;7;4;\varnothing\},$ the union of $X$ and $Y$ is

**A.** $\{A;1;2;3;4;6;7\}.$ **B.** $\{A;1;2;3;4;6;7;\varnothing\}.$ **C.** $\{1;2;3;4;5;6;7\}.$ **D.** $\{1;2;3;4;6;7\}.$

**Question 10.** In the $Oxy$ coordinate plane, given two vectors $\vec{a} = (6;-4)$ and $\vec{b} = (-10,-2)$. Compute the angle between two vectors $\vec{a}$ and $\vec{b}$.

**A.** $60^0.$ **B.** $45^0.$ **C.** $120^0.$ **D.** $135^0.$

**Question 11.** Given a right triangle $ABC$ at $B$ with $AB = 2a,\ AC = 5a.$ Compute the dot product $\overrightarrow{AB}.\overrightarrow{CA}.$

**A.** $5a^2$ **B.** $-5a^2$ **C.** $4a^2.$ **D.** $-4a^2$

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**A.** What a nice day!
**B.** If "$3+x=4$" then "$x=1$".
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**A.** $G(1;4)$. **B.** $G(3;12)$. **C.** $G(1;-4)$. **D.** $G(-1;4)$.

**Question 15.** In the $Oxy$ coordinate plane, let $M$ be the vertex of Parabol $y=ax^2+bx+c\,(a\neq 0)$. The coordinates of $M$ are

**A.** $\left(\frac{b}{2a};\frac{4ac-b^2}{4a}\right)$. **B.** $\left(\frac{-b}{2a};\frac{b^2-4ac}{4a}\right)$. **C.** $\left(\frac{-b}{2a};\frac{4ac-b^2}{4a}\right)$. **D.** $\left(\frac{-b}{4a};\frac{4ac-b^2}{4a}\right)$.

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**A.** $2x-1>0$ and $2x-1+\frac{1}{2x^2+1}>\frac{1}{2x^2+1}$.
**B.** $5x-1+\frac{1}{x-2}>\frac{1}{x-2}$ and $5x-1>0$.
**C.** $-2x+1>0$ and $2x-1<0$.
**D.** $3x^2+1\le 2x-1$ and $3x^2-2x+2\le 0$.

**Question 17.** In the $Oxy$ coordinate plane, given $A(1;-3)$ and $B(-5;4)$. The coordinates of vector $\overrightarrow{BA}$ are

**A.** $\overrightarrow{BA}=(6;-7)$. **B.** $\overrightarrow{BA}=(-6;7)$. **C.** $\overrightarrow{BA}=(6;7)$ **D.** $\overrightarrow{BA}=(-4;1)$.

**Question 18.** In the $Oxy$ coordinate plane, given $\Delta ABC$. Points $M(-2;3)$, $N(4;-1)$, $P(1;1)$ are the mid-points of sides $BC$, $CA$ and $AB$, respectively. The coordinates of vertex $A$ are

**A.** $A(10;0)$. **B.** $A(-10;0)$. **C.** $A(-7;3)$. **D.** $A(7;-3)$.

**Question 19.** Given two non-zero vectors $\vec{a}$ and $\vec{b}$. Which of the following statements is **false?**

**A.** Two vectors $\vec{a}$ and $-3\vec{a}$ have the same direction.
**B.** Two vectors $\vec{a}$ and $k\vec{a}$ are parallel.
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**Question 21.** In the $Oxy$ coordinate plane, given Parabol $(P):y=x^2-5x+2m$. Let $S$ be the set of all values of $m$ such that the Parabol $(P)$ cuts $Ox$ at two distinct points $A,B$ satisfying $OA=4OB$. Determine the sum of all elements of $S$.

**A.** 2. **B.** $\frac{-32}{9}$. **C.** $\frac{2}{9}$. **D.** $\frac{-16}{9}$.

**Question 22.** Find all values of $m$ such that function $y=(m-1)x+2021$ is decreasing on its domain.

**A.** $m\le 1$. **B.** $m>1$. **C.** $m<1$. **D.** $m\ge 1$.

**Question 23.** Let $a,b,c$ be three positive real numbers satisfying $a+b+c=3$. Determine the maximum value of $T=\sqrt{ab}+\sqrt{bc}+\sqrt{ca}$.

**A.** 3. **B.** 6. **C.** 4. **D.** 2.

**Question 24.** Given rectangle $ABCD$ with $AD = 2$. Suppose that $E$ is the point which lies on the side $AB$ such that $AE = 2BE$ and $\sin\widehat{BDE} = \frac{1}{5}$. Compute the length of the segment $AB$.

**A.** $AB = \sqrt{6}$. **B.** $AB = \sqrt{3}$. **C.** $AB = 2\sqrt{2}$. **D.** $AB = 3\sqrt{3}$.

**Question 25.** Given three distinct points $A$, $B$ and $C$. Which of the following statements is **true?**

**A.** $\overrightarrow{BA} - \overrightarrow{BC} = \overrightarrow{AC}$. **B.** $\overrightarrow{BA} + \overrightarrow{AC} = \overrightarrow{CB}$. **C.** $\overrightarrow{CA} - \overrightarrow{AB} = \overrightarrow{CB}$. **D.** $\overrightarrow{AB} + \overrightarrow{CA} = -\overrightarrow{BC}$.

**Question 26.** Given $\Delta ABC$ with $AB = 13$, $BC = 2\sqrt{33}$, $CA = 17$. Compute the length of the median $AM$ of $\Delta ABC$.

**A.** $AM = 2\sqrt{35}$. **B.** $AM = \sqrt{194}$. **C.** $AM = 14$. **D.** $AM = 15$.

**Question 27.** Given an isosceles right triangle $ABC$ with sides $AB = AC = 42\,cm$. Two medians $BE$ and $CF$ intersect at point $G$. The area of the triangle $GEC$ is

**A.** 147 $cm^2$. **B.** $7\sqrt{21}$ $cm^2$. **C.** 174 $cm^2$. **D.** $21\sqrt{7}$ $cm^2$.

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**A.** $m < -1$ or $m > 1$. **B.** $1 < m < \frac{5}{3}$. **C.** $\frac{-5}{3} < m < -1$. **D.** $-1 < m < 1$.

**Question 29.** The domain of the function $y = \frac{2}{\sqrt{6-2x}}$ is

**A.** $D = (3; +\infty)$. **B.** $D = (-\infty; 3)$. **C.** $D = (-\infty; 3]$. **D.** $D = \mathbb{R} \setminus \{3\}$.

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**A.** Fourteen has four positive factors. **B.** Fourteen is not a composite number.

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**A.** $C\left(2\sqrt{6}; -4\right)$ or $C\left(-2\sqrt{6}; -4\right)$. **B.** $C(-4; 24)$ or $C(-4; -24)$.

**C.** $C(24; -4)$ or $C(-24; -4)$. **D.** $C\left(-4; -2\sqrt{6}\right)$ or $C\left(-4; 2\sqrt{6}\right)$.

**Question 32.** Let $a, b, c$ be real numbers and $a + 2021c > b + 2021c$. Which of the following statements is **true**?

**A.** $\frac{1}{a} > \frac{1}{b}$. **B.** $a^2 > b^2$. **C.** $-2020a > -2020b$. **D.** $2021a > 2021b$.

**Question 33.** Given the fact that the system of equations $\begin{cases} x^3(2+3y) = 8 \\ (y^3 - 2)x = 6 \end{cases}$ has exactly two distinct solutions $(x_1, y_1); (x_2, y_2)$. The value of $S = x_1^4 + y_1^4 + x_2^4 + y_2^4$ is

**A.** 36. **B.** 28. **C.** 40. **D.** 34.

**Question 34.** A ball is thrown straight up from 60 meters above the ground with a velocity of 20 meters per second (20 m/s). The height of the ball at second $t$ after throwing can be computed by the quadratic function $s(t) = -5t^2 + 20t + 60$, where $s(t)$ is in meters. After how many seconds does the ball hit the ground?

**A.** $t = 2$. **B.** $t = 4$. **C.** $t = 1$. **D.** $t = 6$.

**Question 35.** Given $\Delta ABC$ with the sides $AC = 3\sqrt{3}$, side $BC = 3\sqrt{2}$, $A = 45^0$ and $B > A + C$. Compute the degree measure of $\widehat{ABC}$.

**A.** $\widehat{ABC} = 150^0$. **B.** $\widehat{ABC} = 30^0$. **C.** $\widehat{ABC} = 120^0$. **D.** $\widehat{ABC} = 60^0$.

**II. PART II. PROBLEM SOLVING (3,0 points)**

*Write the solutions to the following problems in the provided space on your answer sheet.*

**Problem 1. (1,0 point)**

To measure the height of the Cham temple tower Po Klong Garai in Ninh Thuan province (Figure 1), two points $A$ and $B$ which are chosen on the ground with the length $AB = 16m$ and the bottom $C$ of the tower are collinear (Figure 2). Two total stations whose tripods have a height $h = 1,6m$ are put at point $A$ and point $B$. Let $D$ be the top of the tower and two points $A_1$, $B_1$ be collinear to $C_1$ on height $CD$ of the tower. The measurements are $\widehat{DA_1C_1} = 54^0$ and $\widehat{DB_1C_1} = 32^0$. Caculate the height $CD$ of the tower then round the result to 3 decimal places.

*Figure 1*

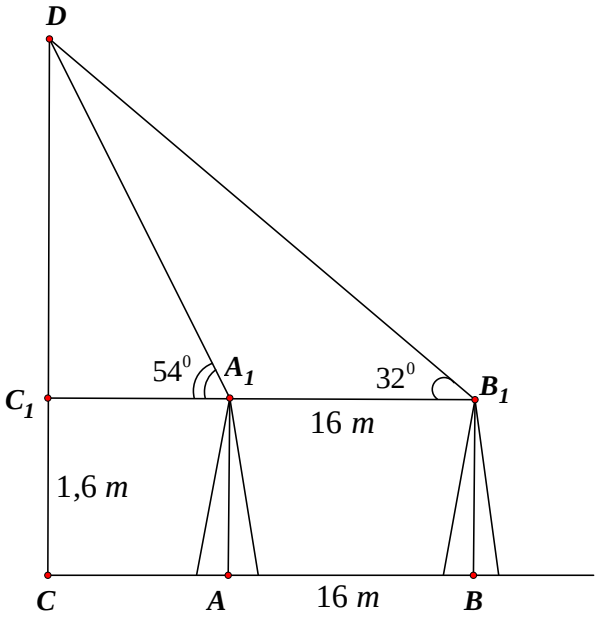


*Figure 2*

**Problem 2 (1,0 point).**

Let $f(x) = ax^3 + bx^2 + cx + d$ be a cubic function with $f(0) = k$, $f(1) = 2k$, $f(-1) = 3k$, where $k$ is a given constant. What is the value of $f(2) + f(-2)$?

**Problem 3 (1,0 point).**

The sum of 2025 consecutive positive integers is a perfect square. Find the minimum value of the largest of these integers?

---------- THE END ----------

Student's full name: …… Student's ID: ……

First observer's name and signature: …… Second observer's name and signature: ……..

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**C.** $C(24; -4)$ or $C(-24; -4)$. **D.** $C\left(-4; -2\sqrt{6}\right)$ or $C\left(-4; 2\sqrt{6}\right)$.

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**A.** 36. **B.** 28. **C.** 40. **D.** 34.

**Question 34.** A ball is thrown straight up from 60 meters above the ground with a velocity of 20 meters per second (20 m/s). The height of the ball at second $t$ after throwing can be computed by the quadratic function $s(t) = -5t^2 + 20t + 60$, where $s(t)$ is in meters. After how many seconds does the ball hit the ground?

**A.** $t = 2$. **B.** $t = 4$. **C.** $t = 1$. **D.** $t = 6$.

**Question 35.** Given $\Delta ABC$ with the sides $AC = 3\sqrt{3}$, side $BC = 3\sqrt{2}$, $A = 45^0$ and $B > A + C$. Compute the degree measure of $\widehat{ABC}$.

**A.** $\widehat{ABC} = 150^0$. **B.** $\widehat{ABC} = 30^0$. **C.** $\widehat{ABC} = 120^0$. **D.** $\widehat{ABC} = 60^0$.

**II. PART II. PROBLEM SOLVING (3,0 points)**

*Write the solutions to the following problems in the provided space on your answer sheet.*

**Problem 1. (1,0 point)**

To measure the height of the Cham temple tower Po Klong Garai in Ninh Thuan province (Figure 1), two points $A$ and $B$ which are chosen on the ground with the length $AB = 16m$ and the bottom $C$ of the tower are collinear (Figure 2). Two total stations whose tripods have a height $h = 1,6m$ are put at point $A$ and point $B$. Let $D$ be the top of the tower and two points $A_1$, $B_1$ be collinear to $C_1$ on height $CD$ of the tower. The measurements are $\widehat{DA_1C_1} = 54^0$ and $\widehat{DB_1C_1} = 32^0$. Caculate the height $CD$ of the tower then round the result to 3 decimal places.

*Figure 1*

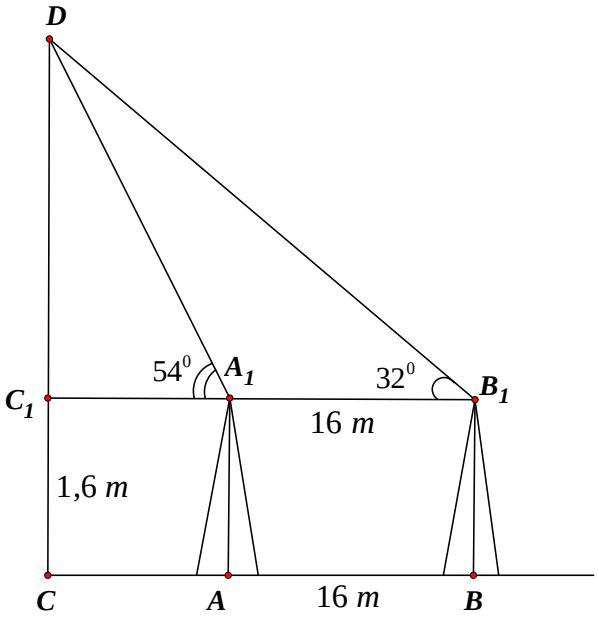


*Figure 2*

**Problem 2 (1,0 point).**

Let $f(x) = ax^3 + bx^2 + cx + d$ be a cubic function with $f(0) = k$, $f(1) = 2k$, $f(-1) = 3k$, where $k$ is a given constant. What is the value of $f(2) + f(-2)$?

**Problem 3 (1,0 point).**

The sum of 2025 consecutive positive integers is a perfect square. Find the minimum value of the largest of these integers?

---------- THE END ----------

Student's full name: …… Student's ID: ……

First observer's name and signature: …… Second observer's name and signature: ……..