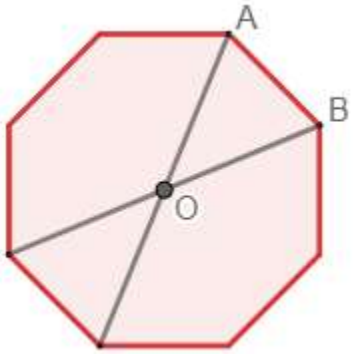
NTSE -21 SAMPLE PAPER- MATHEMATICS

1

The figure shows a regular octagon. Which of the following is the ratio of angles of triangle OAB?

A) 1:3:3 B) 1:2:2 C) 2:3:3 D) 3:4:2



ANS: C) 2:3:3

Solution: $\angle AOB = \frac{360}{8} = 45°$

$OA = OB \Rightarrow \angle A = \angle B$

$\angle A + \angle B + \angle O = 180°$, $\angle A = \angle B = \frac{135°}{2}$

Ratio $\angle O : \angle A : \angle B = 45° : \frac{135°}{2} : \frac{135°}{2} \Rightarrow 1 : \frac{3}{2} : \frac{3}{2} \Rightarrow$ 2: 3: 3

2

$2^{122} + 4^{62} + 8^{42} + 4^{64}$ is divisible by the number _____

A) 3 B) 17 C) 7 D) 13

ANS : B) 17

Solution:

$2^{122} + 4^{62} + 8^{42} + 4^{64} = 2^{122} + 2^{124} + 2^{126} + 2^{128}$

$= 2^{122}(1 + 2^2 + 2^4 + 2^6) = 2^{122} \times 85$

$2^{122} \times 5 \times 17$

Divisible by 2, 5 or 17 Option B)

3

In an AP, 17 is the 3rd term and -25 is the 17th term. Then which term is – 4?

A) 10 B) 9 C) 8 D) 11

ANS: A) 10

Solution :

$a_3 = 17$, $a_{17} = -25$

$a + 2d = 17$

$a + 16d = -25$

$14d = -42$, $d = -3$, a = 23

$a_n = a + (n-1)d$

$-4 = 23 + (n-1)(-3)$

$\frac{-27}{-3} = n - 1 \Rightarrow n = 10$

4

If $(b * a * c) = ab - c$, then $(4 * 3 * 5) + (6 * 5 * 7) =$_____

A) 20 B) 31 C) 32 D) 30

ANS: D) 30

Solution

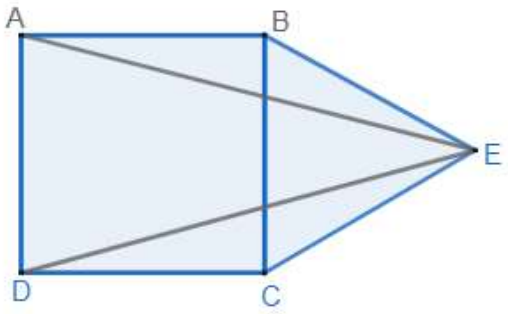
$(b * a * c) = ab - c \Rightarrow (4 * 3 * 5) + (6 * 5 * 7) = 12 - 5 + 30 - 7$

42-12 = 30

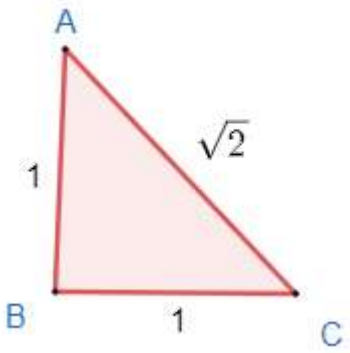
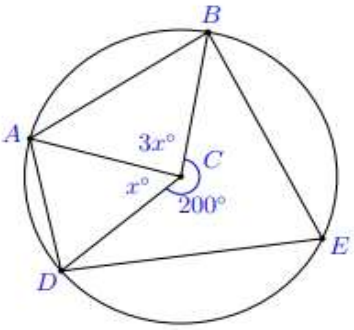
5

A square mirror has a 20 cm diagonal, then the perimeter of the mirror is_____ cm.

	A) $20\sqrt{2}$ B) 20 C) $40\sqrt{2}$ D) 40
	ANS: C) $40\sqrt{2}$ cm Solution Diagonal = 20 cm , side = $\frac{20}{\sqrt{2}}$ = a Perimeter = 4a = $4 \times \frac{20}{\sqrt{2}} = 40\sqrt{2}$ cm
6	In an examination, a student was asked to find $\frac{3}{14}$ of a certain number. By mistake he found $\frac{3}{4}$ of that number. His answer was 150 more than the correct answer. then the number is_____ A) 280 B) 200 C) 240 D) 400
	ANS: A) 280 Let the number = x , $\frac{3}{14}x + 150 = \frac{3}{4}x$ $\frac{3}{4}x - \frac{3}{14}x = 150$ $3x\left(\frac{1}{4} - \frac{1}{14}\right) = 150$ $3x\left(\frac{7-2}{28}\right) = 150$, $x = 280$
7	The value of $\left(1-\frac{1}{2^2}\right)\left(1-\frac{1}{3^2}\right)\left(1-\frac{1}{4^2}\right)\ldots\ldots\ldots\ldots\ldots\ldots\left(1-\frac{1}{2020^2}\right)\left(1-\frac{1}{2021^2}\right)$ is _____ A) $\frac{2022}{2020}$ B) $\frac{1011}{2020}$ C) $\frac{1011}{2021}$ D) $\frac{2022}{2021}$
	ANS: C) $\frac{1011}{2021}$ Solution : Apply $a^2 - b^2 = (a-b)(a+b)$ $\left(1-\frac{1}{2^2}\right)\left(1-\frac{1}{3^2}\right)\left(1-\frac{1}{4^2}\right)\ldots\ldots\ldots\ldots\ldots\ldots\left(1-\frac{1}{2020^2}\right)\left(1-\frac{1}{2021^2}\right)$ = $\left(1-\frac{1}{2}\right)\left(1+\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1+\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1+\frac{1}{4}\right)\ldots\ldots\ldots\ldots\ldots\ldots\left(1-\frac{1}{2021}\right)\left(1+\frac{1}{2021}\right)$ $\frac{1}{2} \times \frac{3}{2} \times \frac{2}{3} \times \frac{4}{3} \times \frac{3}{4} \times \frac{5}{4} \ldots\ldots\ldots \frac{2020}{2021} \times \frac{2022}{2021}$ (cancel Nr and Dr) $= \frac{1}{2} \times \frac{2022}{2021} = \frac{1011}{2021}$
8	If the sum of two consecutive odd numbers is 2004, then the smaller of the two numbers could be _____. A) 1001 B) 1003 C) 999 D) 1005
	ANS: A) 1001 Solution : $x + (x+2) = 2004$

	$2x = 2002 \;\; x = 1001$
9	ABCD is a square and BCE is an **equilateral triangle** constructed externally. the measure of $\angle AED =$ ___? A) 15° B) 30° C) 45° D) 20°
	ANS: B) 30°  ABCD is a square and BCE is **equilateral triangle** $AB = BC = CD = AD = BE = CE$ $\angle ABE = 90 + 60 = 150°$, $\angle BEC = 60°$ $\angle BAE = \angle BEA = 15°$ $(AB = BE)$ Similarly $\angle CED = CDE = 15°$ $\angle AED + 15 + 15 = 60°$, $\angle AED = 30°$
10	A car travels 1km distance in which each wheel makes 450 complete revolutions. Find the radius of its wheels. (A) 35.35 cm (B) 36.35 cm (C) 38.5 cm (D) 40 cm
	ANS : (A) 35.35 cm Solution One revolution distance covered = $2\pi r$ 450 complete revolutions distance covered = 900 πr distance covered = 1 km = 1000m = 100000cm 900 $\pi r = 100000$ $r = \frac{100000 \times 7}{900 \times 22}$ = 35.35 cm (app)
11	Number of zeros which are real numbers of the polynomial $P(x) = x^3 + 1$, is (A) 1 (B) 0 (C) 3 (D) 2
	ANS : (A) 1 $x^3 + 1 = 0$, $(x + 1)(x^2 - x + 1) = 0$ $(x + 1) = 0 \;\; or \;\; (x^2 - x + 1) = 0$

	$x = -1 \quad or$ $x^2 - x + 1 = 0$, D = $b^2 - 4ac = 1 - 4 = -3$, No real roots
12	After five years the sum of ages of father and his son will 70. Then four years ago sum of their ages was_____ . (A) 62 (B) 66 (C) 56 (D) 52
	ANS: (D) 52 Solution Let the present ages of father and his son be x and y $x + 5 + y + 5 = 70$ $x + y = 60$ four years ago sum of the ages = Also , $x - 4 + y - 4 = x + y - 8 = 60 - 8 = 52$
13	The sum of the first 1000 positive integers is____ (A) 5050 (B) 50005 (C) 500500 (D) 50500
	ANS: (C) 500500 Solution: $S_n = \frac{n}{2}\{2a + (n-1)d\}$ OR Sum = $\frac{n(n+1)}{2} = 1000 \times \frac{1001}{2} = 500500$
14	From a point P which is at a distance of 13 cm from the centre O of a circle of radius 5 cm, the pair of tangents PQ and PR to the circle are drawn. Then the area of the quadrilateral PQOR is_____. (A) 60 cm^2 (B) 65 cm^2 (C) 30 cm^2 (D) 32.5 cm^2
	ANS: (A) 60 cm^2 Solution : POR, POQ are two right angled triangles. Area of $\Delta POR = \frac{1}{2} bh = \frac{1}{2} \times 5 \times 12 = 30$ Area of $\Delta POQ = 30$ Total area = 60 cm^2
15.	Point A is on the *y*-axis at a distance of 4 units above from the origin. If coordinates of point B are (–3, 0) then find the length of AB. (A) 10 units (B) 5 units (C) 20 units (D) 25 units
	ANS: B) 5 units Coordinates of A are (0, 4) $\Rightarrow \quad AB = \sqrt{(0-(-3))^2 + (4-0)^2} = \sqrt{9+16}$ AB = 5 units
16	If Δ ABC, $\angle$ B=90°, AB = BC. Then AB: AC=_____.

	A) 1: 3 B) 1: 2 (C) 1: $\sqrt{2}$ D) 2: 1
	ANS: C) 1: $\sqrt{2}$ Solution: AB = BC = x , AC = $\sqrt{2}$ x , ratio AB: AC = 1: $\sqrt{2}$ 
17	If 7 times the 7th term of an AP is equal to 11 times its 11th term, then its 18th term will be (A) 7 (B) 11 (C) 18 (D) 0
	ANS: (D) 0 Solution : $a_n = a + (n-1)d$ $a_7 = a + 6d$, $a_{11} = a + 10\,d$ $7 \times a_7 = 11 \times a_{11}$ $7\,(a + 6d) = 11\,(a + 10\,d)$ $7a + 42d = 11a + 110d$ $4a + 68d = 0$ $a + 17d = 0$, $a_{18} = 0$
18	In the circle shown, C is the centre and A, B , D and E all lie on the circumference. Reflex $\angle BCD = 200°$, $\angle DCA = x°$, $\angle BCA = 3x°$ as shown . The ratio of $\angle DAC$: $\angle BAC$ is _____. A) 7: 2 B) 5: 3 C) 7: 3 D) 7: 1 
	ANS: C) 7: 3 Solution $x° + 3x° = 4x° = 360 - 200 = 160°$ $\angle DCA = x° = \frac{160}{4} = 40°$ $3x° = 120°$ AC = CD = radii $\Rightarrow$ $\angle CAD = \angle CDA$, AC = BC = radii , $\Rightarrow$ $\angle CAB = \angle CBA$

	$\angle CAD = 70°,\ \angle BAC = 30°$ $\angle DAC\ :\ \angle BAC\ = 70°: 30°$ $\angle DAC\ :\ \angle BAC\ =\ 7: 3$
19.	In a polygon there are 6 right angles and the remaining angles are all equal to 200° each. Find the number of sides of the polygon. A) 10 B) 14 C) 20 D) 15
	ANS: D) 15 Solution: Let the number of sides = n. $6 \times 90° + (n-6) \times 200° = (n-2)180°$ $10(n-6) = 9(n-5)$ solve $, n = 15$
20	A cube of side 4 cm contains a sphere touching its faces. Find the volume of the gap in between in cm^3. A) $32\left(\frac{6-\pi}{3}\right)$ B) $12\left(\frac{6-\pi}{3}\right)$ C) $32\left(\frac{9-\pi}{3}\right)$ D) $32\left(\frac{6-\pi}{2}\right)$
	ANS: A) $32\left(\frac{6-\pi}{3}\right)$ Solution : Vol. of cube = 64 Volume of sphere = $\frac{4}{3}\pi \times 2^3$ Required volume = $64 - \frac{4}{3}\pi \times 8 = 32(2 - \frac{1}{3}\pi)$ $32\left(\frac{6-\pi}{3}\right)$