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www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

**CBSE Board**
**Class XI Mathematics**
**Sample Paper – 6**

Q1. Statement – 1: $S_n = n^3 + 3n^2 + 5n + 3$ is divisible by 3.

Statement – 2 : $t_n = 3\lambda$.

(a) If both statement -1 and statement -2 are true and statement -2 is the correct explanation of statement -1.

(b) If both statement -1 and statement -2 are true but statement -2 is not the correct explanation of statement -1

(c) If statement -1 is true but statement -2 is false

(d) If statement -1 is false and statement -2 is true

Sol. (a)

$$S_n = n^3 + 3n^2 + 5n + 3$$

$$\therefore t_n = S_n - S_{n-1}$$

$$= (n^3 + 3n^2 + 5n + 3)$$

$$- \{((n-1)^3 + 3(n-1)^2 + 5(n-1) + 3\}$$

$$= 3n^2 + 3n + 3 = 3(n^2 + n + 1) = 31.$$

Q2. If $C_r = \binom{30}{r}$ , $then\ C_0 + C_4 + C_8 + \cdots + C_{28} =$

(a) $2^{28}$

(b) $2^{29}$

(c) $2^{30}$

(d) $2^{15}$

Sol. (a)

$$(1+x)^{30} = C_0 + C_1x + C_2x^2 + \ldots + C_{30}x^{30}$$

Set x = 1, i and - i one by one and then adding, we get

$$C_0 + C_4 + C_8 + \ldots + C_{28}$$

$$= \frac{1}{4}[2^{30} + (1+i)^{30} + (1-i)^{30}]$$

$$= \frac{1}{4}[2^{30} + (2i)^{15} + (-2i)^{15}] = 2^{28}.$$

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Q3. Statement – 1 : Let n (U) = 1000, n (S) = 720 , n (T) = 450 then least value e of n(S∩T) is 170.

Statement – 2 : n (S ∪T) is max. when n (S ∩ T) is least.

(a) If both statement -1 and statement -2 are true and statement -2 is the correct explanation of statement -1.
(b) If both statement -1 and statement -2 are true but statement -2 is not the correct explanation of statement -1
(c) If statement -1 is true but statement -2 is false
(d) If statement -1 is false and statement -2 is true

Sol. (a)

$$n(S\cup T)=n(S)+n(T)-n(S\cap T)$$
$$=720+450-n(S\cap T)$$
$$=1170-n(S\cap T)\le n(\cup)(\therefore S\cup T\subset U)$$
$$\therefore 1170-n(S\cup T)\le 1000$$
$$\Rightarrow n(S\cap T)\ge 170$$
$$\therefore least\ \ value\ \ of\ \ n(S\cap T)=170.$$

Q4. If P : 4 is an even prime number q : 6 is a divisor of 12 and r: the HCF of 4 and 6 is 2, then which one of the following is true?
(a) $(P\ \wedge\ q)$
(b) $(p\wedge\ q)\hat{}\ \sim r$
(c) $\sim\ (P\ \hat{}\ q)\ \ \vee p$
(d) $\sim p\ \vee (q\ \wedge r)$

Sol. (d)

After seeing the given statements we can say that p is false and q and r ate true. In the given option only (d) can be true because it is $\sim p\ \vee\ (q\ \wedge r)$ which means not p or (q and r) which means p is not correct and q and r are correct.

Q5. The maximum number of intersection of 8 circles is
(a) 16
(b) 24
(c) 28
(d) 56

Sol. (d)

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Q6. If n is an integer between 0 and 21 ; then the minimum value of n! (2l - n)! is
(a) 9 ! 12!
(b) 10! 11!
(c) 20!
(d) 21!

Sol. (b)

Q7. Every man who has lived on earth has made a certain number of handshakes. The number of men who have made an odd number of handshakes is
(a) Exactly 2
(b) Exactly 3
(c) Odd
(d) Even

Sol. (d)

Q8. If a+b+c and $\frac{1}{a}+\frac{1}{c}+\frac{1}{a-b}+\frac{1}{c-b}=0$ *then* $\frac{1}{a},\frac{1}{b},\frac{1}{c}$ are in
(a) A.P
(b) G.P
(c) H.P.
(d) None of these

Sol. (a)

$$\left(\frac{1}{a}+\frac{1}{c-b}\right)+\left(\frac{1}{c}+\frac{1}{a-b}\right)=0$$

$$\frac{(a+c-b)}{a(c-b)}+\frac{(a+c-b)}{c(a-b)}=0$$

$$\Rightarrow \frac{1}{a(c-b)}+\frac{1}{c(a-b)}=0$$

$$\Rightarrow c(a-b)+a(c-b)=0 \Rightarrow b=\frac{2ca}{c+a.}$$

Q9. If the line $6x-7y+8+\lambda\,(3x-y+5)=0$ is parallel to y – axis, then λ =
(a) -2
(b) -7
(c) 1
(d) None of these

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Sol. (b)

$line..parallel..to..y.axis..y.coefficient..in..the..equation..of..the..line..is.. = 0.$

$-7-\theta = 0$

$\theta = -7..$

Q10. The equation of the pair of lines through (2,3) and ^ to the pair of lines $2x^2 - 4xy + 3y^2 = 0$ are

(a) $3x^2 - 4xy + 2y^2 = 0$
(b) $3\,(x-2)^2 + 4\,(x-2)\,(y-3) + 2(y-3)^2 = 0$
(c) $3\,(x-2)^2 + 4\,(x-2)(y-3) - 2(y-3)^2 = 0$
(d) None of these

Sol. (b)

The equation of the pair of lines through (2,3) and ^ to the pair of lines $2x^2 - 4xy + 3y^2 = 0$ are $3\,(x-2)^2 + 4\,(x-2)\,(y-3) + 2(y-3)^2 = 0$

Q11. A circle through origin cuts equal intercepts of -2 on the coordinate axes. Then its equation is

(a) $x^2 + y^2 - 4x - 4y = 0$
(b) $x^2 + y^2 + 2x + 2y = 0$
(c) $x^2 + y^2 + 4x + 4y = 0$
(d) $x^2 + y^2 - 2x - 2y = 0$

Sol. (b)

We have to find the equation of the circles passes through

(-2, 0), (0, -2)

Q12. The equation $\sqrt{(x+4)^2 + (y+2)^2} - \sqrt{(x-4)^2 + (y-2)^2} = 8$ represents

(a) A line segment
(b) A parabola
(c) An ellipse
(d) A hyperbola

Sol. (d)

This equation represents hyperbola

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Q13. The perpendicular dance of the point (2,4, -1) from the line $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9}$ is

(a) 3
(b) 5
(c) 7
(d) 9

Sol. (c)

Q14. The line $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-k}{2}$ lies exactly in the plane 2x-4y + z = 7, then value e of K is

(a) 7
(b) -7
(c) 1
(d) No real value

Sol. (a)

Q15. $\frac{\tan 70° - \tan 20°}{\tan 50°}$

(a) 3
(b) 0
(c) 1
(d) 2

Sol. (d)

$$\tan 50 = \tan(70-20) = \frac{\tan\ 70° - \tan\ 20°}{1+\tan\ 70\tan 20}$$

$$\frac{\tan\ 70° - \tan\ 20°}{\tan\ 50°} = 1 + \tan\ 20 \tan\ 70 = 1+1 = 2$$

Q16. The angles A, B, C of a ΔABC are in A.P., b : c = √3 : √2 Then A =

(a) 30°
(b) 15°
(c) 75°
(d) 45°

Sol. (c)

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$$\frac{b}{c} = \frac{\sqrt{3}}{\sqrt{2}} = \frac{\frac{\sqrt{3}}{2}}{\frac{\sqrt{2}}{2}} = \frac{\sin B}{\sin C}$$

$$\sin B = \frac{\sqrt{3}}{2}$$

$$B = 60$$

$$C = 45$$

$$A, B, C..are..in..AP$$

$$2B = A + C$$

$$A = 75$$

Q17. The complex number $\frac{(-\sqrt{3}+3i)\ (1-i)}{3+\sqrt{3}i\ \ (i)\ (\sqrt{3}+\sqrt{3}\ i)}$ ,when represents d in the Argand diagram, lies

(a) On the X – axis (real axis)

(b) On the Y – axis (imaginary axis)

(c) In the first quadrant

(d) In the second quadrant

Sol. (b)

$$\frac{(-\sqrt{3}+3i)(1-i)}{(3+\sqrt{3}i)i(\sqrt{3}+\sqrt{3}i)} = \frac{(-\sqrt{3}+3i)(1-i)}{(3i+\sqrt{3}i^2)\sqrt{3}(1+i)} = \frac{(3i-\sqrt{3})(1-i)}{(3i-\sqrt{3})\sqrt{3}(1+i)} = \frac{(1-i)(1-i)}{\sqrt{3}(1-i)(1+i)}$$

$$= \frac{1-2i+i^2}{\sqrt{3}(1-i^2)} = -\frac{i}{\sqrt{3}}$$

Here real part=0

The given complex number lies on the Y -axis (imaginary axis)

Q18. Let AB and CD be parallel chords of the circle $|z| = 1$ . Let the points A, B, C, D be represented by the complex numbers $z_1, z_2, z_3, z_4$ respectively.

Statement – 1 : The distance between the chords AB and CD is $\frac{1}{2}\ |z_1 - z_3|\ |z_2 - z_3|$

Statement – 2 : The area of the triangle ABC = abc/4.

(a) If both statement -1 and statement -2 are true and statement -2 is the correct explanation of statement -1

(b) If both statement -1 and statement -2 are true but statement -2 is not the correct explanation of the statement- 1

(c) If statement -1 is true but statement -2 is false

(d) If statement -1 is false and statement -2 is true.

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Sol. (a)

$$\text{Area of } \Delta ABC = \frac{|z_1 - z_2||z_2 - z_3||z_3 - z_1|}{4}$$

$AB = |z_1 - z_2|$, the base of triangle

$$\text{The altitude } = \frac{2(\text{Area})}{\text{base}} = \frac{1}{2}|z_1 - z_3||z_2 - z_3|$$

Q19. If $z^4 = i,\ then\ Z =$

(a) 1

(b) i

(c) cis π/4

(d) cis π/8

Sol. (d)

$$\{\text{cis } \frac{\pi}{8}\}^4 = \left(\cos\frac{\pi}{8} + i\sin\frac{\pi}{8}\right)^4 = i$$

*then*

$$z = cis\,\frac{\pi}{8}$$

Q20. If the minimum value f(x) = $x^2 + 2bx + 2c^2$ is greater than maximum value of $p(x) = -x^2 - 2cx + b^2$ then for x is real

(a) $|c| > |b|\sqrt{2}$

(b) $|x|\sqrt{2} > b$

(c) $0 < c < \sqrt{2}b$

(d) No real value of b and c

Sol. (a)

$$f(x) = x^2 + 2bx + 2c^2$$

$$= (x+b)^2 + 2c^2 - b^2$$

$$\therefore (\text{Minimum of f(x)})_{x=-b} = 2c^2 - b^2 \text{ and } P(x) = -(x^2 + 2cx) + b^2$$

$$= -\left[(x+c)^2 - c^2\right] + b^2$$

$$= -(x+c)^2 + b^2 + c^2$$

$$(p(x))_{\substack{\max\text{ at}\\ x=-c}} \text{ and maximum value} = b^2 + c^2$$

$$\text{now } |2c^2 - b^2| > |b^2 + c^2|.$$

Q21. $\underset{x \to a}{Lt} \frac{\sin^2 x - \sin^2 a}{x^2 - a^2} =$

(a) 1
(b) Cos a
(c) $\frac{\sin a \cos a}{a}$
(d) None of these

Sol. (c)

$$\underset{x \to a}{Lt} \frac{\sin^2 x - \sin^2 a}{x^2 - a^2} [0/0 \, form]$$

$$= \underset{x \to a}{lt} \frac{2\sin x \cos x}{2x} = \frac{\sin a \cos a}{a}$$

Q22. A dice is tossed twice. The probability of having a number greater than 4 on each toss is

(a) 1/9
(b) 1/3
(c) 1/12
(d) 2/3

Sol. (a)

Q23. The probability that the birth days of the six different persons will fall in exactly two months is

(a) 1/6
(b) $^{12}C_2 \times \frac{2^6}{12^6}$
(c) $^{12}C_2 \times \frac{2^6-1}{126}$
(d) $\frac{341}{12^5}$

Sol. (d)

Q24. A and B are two independent t events. The probability y that both A and B occurs is 1/6 and the probability that neither of them occurs is 1/3. Then the probability y of the two events are respectively.

(a) 1/2 and 1/3
(b) 1/5 and 1/6
(c) 1/2 and 1/6
(d) 2/3 and 1/4

Sol. (a)

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Q25. The median of a set of 9 distinct observations is 20.5. if each of the largest 4 observations of the set is increased by 2, then the median of the new set

(a) Is increased by 2
(b) Is decreased by 2
(c) Is two times the original median
(d) Remains the same as that of the original set

Sol. (b)

Q26. The variance of first 50 even natural numbers is

(a) 833/4
(b) 833
(c) 437
(d) 437/4

Sol. (b)

$$\sigma^2 = \left(\frac{\sum x_i^2}{n}\right) - \bar{x}^2$$

$$\bar{x} = \frac{\sum_{r=1}^{50} 2r}{50} = 51$$

$$\sigma^2 = \frac{\sum_{r=1}^{50} 4r^2}{50} - (51)^2 = 833$$

Q27. All the students of a class performed poorly in Mathematics. The teacher decided to give grace marks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given?

(a) Mode
(b) Variance
(c) Mean
(d) Median

Sol. (b)

Variance is not changed by the change of origin.

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Q28. In a ΔPQR, if $3 \sin P \div 4 \cos Q = 6$ *and* $4 \sin Q + 3 \cos P = 1$, then the angle R is equal to

(a) 5π/6
(b) π/6
(c) π/4
(d) 3π/4

Sol. (b)

$$3 \sin P + 4 \cos Q = 6 .......(1)$$

$$4 \sin Q + 3 \cos P = 1 .......(2)$$

From (1) and (2) ∠P is obtuse.

$$(3 \sin P + 4 \cos Q)^2 + (4 \sin Q + 3 \cos P)^2 = 37$$

$$\Rightarrow 9 + 16 + 24 (\sin P \cos Q + \cos P \sin Q) = 37$$

$$\Rightarrow 24 \sin (P + Q) = 12$$

$$\Rightarrow \sin(P + Q) = \frac{1}{2} \quad \Rightarrow P + Q = \frac{5\pi}{6} \quad \Rightarrow R = \frac{\pi}{6}$$

Q29. The number of values of k for which the linear equations

$4x + ky + 2z = 0; kx + 4y + z = 0 ; 2x + 2y + z = 0$ Possess a non – zero solution is

(a) 2
(b) 1
(c) Zero
(d) 3

Sol. (a)

$$\begin{vmatrix} 4 & k & 2 \\ k & 4 & 1 \\ 2 & 2 & 1 \end{vmatrix} = 0 \Rightarrow k^2 - 6k + 8 = 0 \Rightarrow k = 4,2$$

Q30. Let $\vec{a} = \hat{j} - \hat{k}$ *and* $\vec{c} = \hat{\imath} - \hat{j} - \hat{k}$. Then vector $\vec{b}$ *satisfying* $\vec{a} \times \vec{b} + \vec{c} = \vec{0}$ *and* $\vec{a} . \vec{b} = 3$ *is*

(a) $2\hat{\imath} - \hat{j} + 2\hat{k}$
(b) $\hat{\imath} - \hat{j} - 2\hat{k}$
(c) $\hat{\imath} + \hat{j} - 2\hat{k}$
(d) $-\hat{\imath} + \hat{j} - 2\hat{k}$

Sol. (d)

$\vec{c} = \vec{b} \times \vec{a}$

$\Rightarrow \vec{b} \cdot \vec{c} = 0$

$\Rightarrow \left(b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k}\right) \cdot \left(\hat{i} - \hat{j} - \hat{k}\right) = 0$

$b_1 - b_2 - b_3 = 0$

and $\vec{a} \cdot \vec{b} = 3$

$\Rightarrow b_2 = b_3 = 3$

$b_1 = b_2 + b_3 = 3 + 2b_3$

$\vec{b} = (3 + 2b_3)\hat{i} + (3 + b_3)\hat{j} + b_3 \hat{k}$