Instructions
For the following questions answer them individually

Question 1
If $12x^2 - ax + 7 = ax^2 + 9x + 3$ has only one (repeated) solution, then the positive integral solution of $a$ is:

A 2
B 4
C 3
D 5

Answer: C

Explanation:
Given, $12x^2 - ax + 7 = ax^2 + 9x + 3$
$(a - 12)x^2 + (a + 9)x - 4 = 0$
If $ax^2 + bx + c = 0$ has equal roots, then $b^2 = 4ac$
$(a + 9)^2 = 4(a - 12)(-4)$
$a^2 + 18 + 18a = 192 - 16a$
$a^2 + 34a - 111 = 0$
On solving above equation, we get $a = 3$ and $a = -37$.
Here, The positive integral solution will be 3.

Question 2
If $a + \frac{1}{a} = 1$, find the value of $a^3 + \frac{1}{a^3}$

A 2
B -2
C 0
D 1.5

Answer: B

Explanation:
Given, $a + \frac{1}{a} = 1$
Cubing on both sides we get,
$a^3 + \frac{1}{a^3} + 3(a + \frac{1}{a}) = 1$
$a^3 + \frac{1}{a^3} = -2$ (as we know $a + \frac{1}{a} = 1$)
Hence, option B is the correct answer.

Question 3
A root of equation $ax^2 + bx + c = 0$ (where $a$, $b$ and $c$ are rational numbers) is $5 + 3\sqrt{3}$. What is the value of $(a^2 + b^2 + c^2)$?

A $\frac{35a}{3}$
B $\frac{37a}{3}$
C $\frac{-105a}{11}$

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Answer: C

Explanation:
\[ ax^2 + bx + c = 0 \] has 5 + 3\sqrt{3} and so the other root is 5 - 3\sqrt{3} since these roots occur in pairs.

Sum of the roots = 5 + 3\sqrt{3} + 5 - 3\sqrt{3} = 10
Product of the roots = (5 + 3\sqrt{3})(5 - 3\sqrt{3}) = -2

Sum of the roots = -b/a
Product of the roots = c/a
-b/a = 10
b = -10a
-c/a = -2

\[ c = 2a \]

\[
(a + b + c) = (a^2 + b + c) \\
(\alpha + \beta + 3) = (\alpha^3 + \beta^3 + 3\alpha\beta(\alpha + \beta)) = 1 \\
(\alpha^2 + \beta^3 + 3\alpha\beta) = 1 \\
(\alpha^3 + \beta^3) = 2 \\
(\alpha^3\beta^3) = 1 \\
\]

Sum of the roots = -2
Product = 1
Required equation is \[ x^2 + 2x + 1 = 0 \]

Question 4
If \( \alpha \) and \( \beta \) are the roots of equation \( x^2 - x + 1 = 0 \), then which equation will have roots \( \alpha^3 \) and \( \beta^3 \)?

A \[ x^2 + 2x + 1 = 0 \]
B \[ x^2 - 2x - 1 = 0 \]
C \[ x^2 + 3x - 1 = 0 \]
D \[ x^2 - 3x + 1 = 0 \]

Answer: A

Explanation:
\[ x^2 - x + 1 = 0 \]
\[ \alpha\beta = 1 \]
\[ \alpha + \beta = 1 \]
Cubing on both sides
\[ \alpha^3 + \beta^3 + 3\alpha\beta(\alpha + \beta) = 1 \]
\[ \alpha^3 + \beta^3 + 3 = 1 \]
\[ \alpha^3 + \beta^3 = 2 \]
\[ \alpha^3\beta^3 = 1 \]
Sum of the roots = -2
Product = 1
Required equation is \[ x^2 + 2x + 1 = 0 \]

Question 5
If \( a(x + y) = b(x - y) = 2ab \), then the value of \( 2(x^2 + y^2) \) is

A \[ \frac{-105}{13} \]

Answer: C

Explanation:
\[ x^2 + y^2 = \]
Answer: D

Explanation:
Given : \( a(x + y) = b(x - y) = 2ab \)

=> \( a(x + y) = 2ab \)

=> \( (x + y) = 2b \)

Squaring both sides,

=> \( (x + y) = (2b)^2 \)

=> \( x^2 + y^2 + 2xy = 4b^2 \)\[i\]

Similarly, \( (x - y) = 2a \)

Squaring both sides,

=> \( (x - y) = (2a)^2 \)

=> \( x^2 + y^2 - 2xy = 4a^2 \)\[ii\]

Adding equations \(i\) and \(ii\), we get :

=> \( 2x^2 + 2y^2 = 4a^2 + 4b^2 \)

=> \( 2(x^2 + y^2) = 4(a^2 + b^2) \)

=> Ans - (D)

Question 6
If \((x - 2)\) and \((x + 3)\) are the factors of the equation \(x^2 + k_1x + k_2 = 0\), then what are the values of \(k_1\) and \(k_2\) ?

A  \( k_1 = 6, k_2 = -1 \)

B  \( k_1 = 1, k_2 = -6 \)

C  \( k_1 = 1, k_2 = 6 \)

D  \( k_1 = -6, k_2 = 1 \)

Answer: B

Explanation:
Equation : \( f(x) = x^2 + k_1x + k_2 = 0 \)

If \((x - 2)\) and \((x + 3)\) are factors of above equation, then \(x = 2, -3\) will satisfy above equation.

=> \( f(2) = (2)^2 + k_1(2) + k_2 = 0 \)

=> \( 2k_1 + k_2 = -4 \)\[i\]

Similarly, \( f(-3) = (-3)^2 + k_1(-3) + k_2 = 0 \)

=> \( -3k_1 + k_2 = -9 \)\[ii\]

Subtracting equation \(ii\) from \(i\), we get :

=> \( 5k_1 = -4 + 9 = 5 \)
Question 7

Two students appeared for an examination. One of them secured 9 marks more than the other and his marks were 56% of the sum of their marks. The marks obtained by them are

A 40 and 31
B 72 and 63
C 42 and 33
D 68 and 59

Answer: C

Explanation:
Let marks scored by 1st student = \( x \)

=> Marks scored by another student = \( x + 9 \)

According to question, => \( x + 9 = \frac{56}{100} \times (x + x + 9) \)

=> \( x + 9 = \frac{14}{25} \times (2x + 9) \)

=> \( 25x + 225 = 28x + 126 \)

=> \( 3x = 225 - 126 \Rightarrow 99 \)

=> \( x = \frac{99}{3} = 33 \)

∴ Marks scored by other student = 33 + 9 = 42

=> Ans - (C)

Question 8

If the average of \( x \) and \( \frac{1}{x} \) be 1, then the value of \( x^{10} + \frac{1}{x^{10}} \) is

A -2
B 2
C 0
D 1

Answer: B

Explanation:
here it is given that

\( x + \frac{1}{x} = 2 \)

and it is possible only when \( x = 1 \)

and hence we will put \( x = 1 \) in \( x^{10} + \frac{1}{x^{10}} = 1 + 1 = 2 \)
Question 9

If \( x = (0.08)^2 \), \( y = \frac{1}{(0.08)^2} \) and \( z = (1 - 0.08)^2 - 1 \), then out of the following, the true relation is

A y < x and x = z
B x < y and x = z
C y < z < x
D z < x < y

Answer: D

Explanation:
Given that \( x = (0.08)^2 \), \( y = \frac{1}{(0.08)^2} \) and \( z = (1 - 0.08)^2 - 1 \)
\( x = (0.08)^2 = 0.0064 \)
\( y = \frac{1}{(0.08)^2} = 12.5 \times 12.5 = 156.25 \)
\( z = (1 - 0.08)^2 - 1 = a \) negative number
hence we can say that
\( z < x < y \)

Question 10

\( \frac{p}{a+b+c} = 1 \) and \( \frac{a}{p+q+r} = 0 \) where \( p,q,r \) and \( a,b,c \) are non-zero then the value of \( \frac{p^2}{a^2} + \frac{q^3}{b^2} + \frac{r^2}{c^2} \) is

A -1
B 0
C 1
D 2

Answer: C

Explanation:
Given \( \frac{p}{a+b+c} = 1 \)
Squaring on both sides gives, \( \left( \frac{p}{a+b+c} \right)^2 = 1^2 \)
\( \frac{p^2}{a+b+c} = \frac{a}{p+q+r} = 0 \)
Also given that \( p + q + r = 0 \)
Solving this, we get \( aq + bpr + cpq = 0 \)
Divide this with \( abc \) on both sides, we get \( \frac{aq}{abc} + \frac{bpr}{abc} + \frac{cpq}{abc} = 0 \)
i.e. \( \frac{aq}{bc} + \frac{bpr}{ac} + \frac{cpq}{ab} = 0 \) . Substituting this in \( \text{equ(1)} \)
We get, \( \frac{p^2}{a^2} + \frac{q^2}{b^2} + \frac{r^2}{c^2} = 1 \)

Question 11

If \( a^2 - 4a - 1 = 0 \), then value of \( a^2 + \frac{1}{a^2} + 3a - \frac{3}{a} \) is

A 25
B 26
Answer: B

Explanation:
it is given that \( a^2 + 4a - 1 = 0 \)
from this we can say \( a - \frac{1}{a} = 4 \)
we need to find \( a^2 + a^2 + 3a - \frac{3}{a} \)
\[
\begin{align*}
a^2 + a^2 &= (a - \frac{1}{a})^2 + 2 \\
a^2 + a^2 + 3a &= (a - \frac{1}{a})^2 + 2 + (3 \times 4) \\
&= 30
\end{align*}
\]

Question 12
If \( \frac{a}{1-a} + \frac{b}{1-b} + \frac{c}{1-c} = 1 \) the the value of \( \frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} \)

A 1
B 3
C 4
D 0

Answer: C

Explanation:
Expression : \( \frac{a}{1-a} + \frac{b}{1-b} + \frac{c}{1-c} = 1 \)
Let’s put each term equal to each other
\[
\begin{align*}
=> 3 \frac{a}{1-a} &= 1 \\
=> 3a &= 1 - a \\
=> a &= \frac{1}{4} = b = c
\end{align*}
\]
To find : \( \frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} \)
\[
= \frac{1}{1-\frac{1}{4}} + \frac{1}{1-\frac{1}{4}} + \frac{1}{1-\frac{1}{4}} \\
= 3 \times \frac{4}{3} = 4
\]

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Question 13
If \( 7 + 4x > 3 + 3x \) and \( 3x - 2 < 5 - x \), then \( x \) can take which of the following values?

A 2
B 3
C 1
D -5

Answer: C
Explanation:
Expression 1: $7 + 4x > 3 + 3x$
$\Rightarrow 4x - 3x > 3 - 7$
$\Rightarrow x > -4$  \hspace{1cm} (i)

Expression 2: $3x - 2 < 5 - x$
$\Rightarrow 3x + x < 5 + 2$
$\Rightarrow 4x < 7$
$\Rightarrow x < \frac{7}{4}$  \hspace{1cm} (ii)

Combining inequalities (i) and (ii), we get: $-4 < x < \frac{7}{4}$

Thus, $x$ can take values = -3, -2, -1, 0, 1
$\Rightarrow$ Ans - (C)

Question 14
Product of three consecutive odd numbers is 1287. What is the largest of the three numbers?

A 9
B 11
C 13
D 17

Answer: C

Explanation:
Let the three consecutive odd numbers be $(x-2), (x), (x+2)$
$\Rightarrow$ Product = $(x-2)(x)(x+2) = 1287$
$\Rightarrow x(x^2 - 4) = 11 \times 117$
$\Rightarrow x = 11$ and $x^2 - 4 = 117$
$\therefore$ Largest of the three numbers = $11 + 2 = 13$
$\Rightarrow$ Ans - (C)

Question 15
If $x + y + z = 0$, then what is the value of $\frac{3y^2 + x^2 + z^2}{2y^2 - xz}$?

A 2
B 1
C $\frac{3}{2}$
D $\frac{5}{3}$

Answer: A

Explanation:
Solution 1:
As the answer is independent of variables and so we can assume values for $x, y$ and $z$ and solve
let $x=1, y=-1, z=0$ therefore $x+y+z=1-1+0=0$
We know \(x+y+z=0\)
we can see that for \(k=2\)
we get \(x+z+y=0\)
Therefore value of \(k=2\)
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