Instructions
For the following questions answer them individually

Question 1

How many distinct scalene triangles with integral sides are possible whose perimeter is less than 15 units?

A 5

B 4

C 6

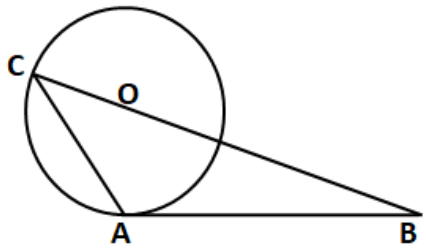
D 7

Answer: C

Explanation:
The only scalene triangles with perimeter less than 15 with integral sides are (2,3,4); (2,4,5); (2,5,6); (3,4,5); (3,4,6) and (3,5,6). So, the total number of triangles possible is 6

Question 2

AB is tangent to a circle of radius 27 cm as shown in the diagram below where O is the centre of the circle. If AB = 36 cm and BC passes through centre of the circle then find out the area of triangle ABC?



A 742.40 sq.cm

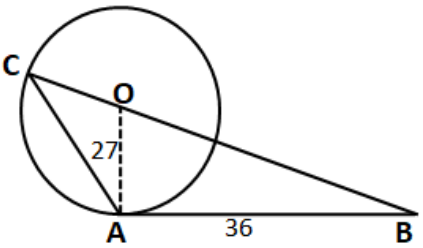
B 834 sq. cm

C 777.60 sq. cm

D None of the above

Answer: C

Explanation:



Since AB is a tangent to the circle, $\angle$OAB = 90°

Hence in right-angled triangle OAB, $OB^2 = OA^2 + AB^2$

$\Rightarrow OB^2 = 27^2 + 36^2$

$\Rightarrow OB^2 = 729 + 1296 = 2025$

$\Rightarrow OB = 45$cm.

Therefore, BC = BO + OC = 45 + 27 = 72 cm ... (1)

Also $\sin OBA = \frac{OA}{OB} = \frac{27}{45} = \frac{3}{5}$ ... (2)

We can see that area of triangle ABC = $\frac{1}{2}$*AB*BC*sinABC = $\frac{1}{2} * 36 * 72 * \frac{3}{5}$ = 777.60 sq.cm

Hence, option C is the correct answer.

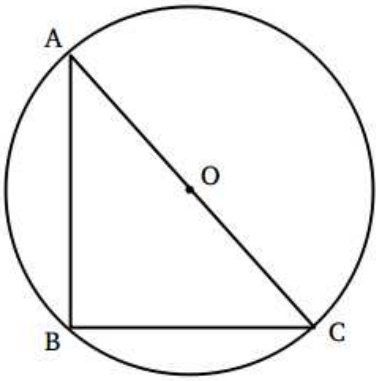
Question 3

A triangle with two of its sides as 20 cm and 99 cm is inscribed in a circle such that the area of a triangle is maximum possible. What is the diameter of that circle (in cm)?

Answer:101

Explanation:

We can write area of a triangle as $\frac{1}{2}absin\theta$ where a and b are two sides of the triangle and θ is the included angle.
As the maximum value of $sin\theta$ is 1 at θ = 90, the triangle should be right angled for maximum area. Also, for a right-angled triangle, circumradius is $\frac{1}{2}$ * hypotenuse.



So, for the given triangle hypotenuse = $\sqrt{20^2 + 99^2}$ = 101 cm
Thus, circumradius = $\frac{101}{2}$ cm = 50.5 cm
Diameter = 101 cm
Hence, 101 is the correct answer.

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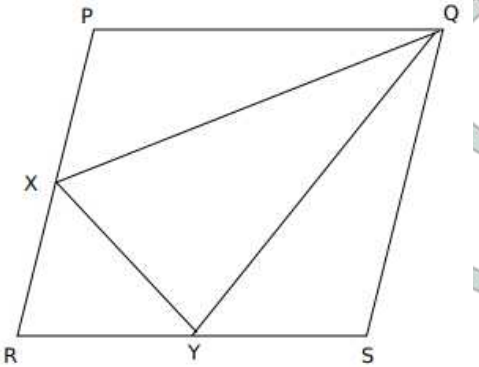
Question 4

PQRS is a parallelogram, X and Y are the midpoints of the sides PR and RS respectively. If the area of the △QYS is 60 ,The area of the triangle △QXY is



A 60

B 120

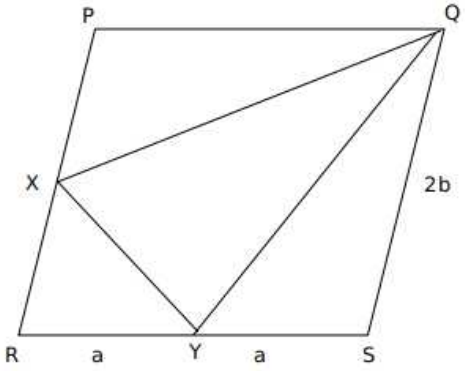
C 90

D Cannot be determined

Answer: C

Explanation:

Let the length and breadth of the parallelogram be 2a, 2b and the angle between them be θ



Given the area of the △QYS = 60

$\frac{1}{2} * a * 2b * \sin\theta$ =60

a*b*$\sin\theta$=60

Area of △XYQ = Area of the parallelogram - (Area of △ PQX + Area of △ RXY + Area of △ QYS)

Area of the parallelogram PQRS = 2a*2b*$\sin\theta$

= 4*60 =240

Area of △ PQX = $\frac{1}{2} * 2a * b * \sin(180 - \theta)$

=60

Area of △ RXY = $\frac{1}{2} * a * b * \sin(180 - \theta)$

=30

Area of △XYQ=240-60-60-30

=90

Hence C is the correct answer.

Alternate approach

If we consider **h** to be the height of the parallelogram.

Area of the parallelogram PQRS = 2a*h = 4*60 =240

Height of the △ RXY will be equal to **h/2**. (Perpendicular dropped from the mid-point.)

Area of △ RXY = $\frac{1}{2} * a * h/2$ = 30

Area of △ PQX = $\frac{1}{2} * 2a * h$ = 60

Area of △XYQ=240-60-60-30 =90

Question 5

A point on the circumference of a semicircle is joined with the endpoints of the diameter of the semicircle. It is found that the sides of the triangle so formed are in an arithmetic progression. If it is known that the length of the sides of the triangle are integers, which of the following can be the perimeter of the semicircle? (Take $\pi = \frac{22}{7}$)

A 120 units

B 140 units

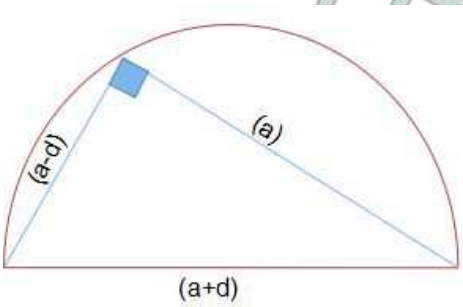
C 160 units

D 180 units

Answer: D

Explanation:
It has been given that a point on the circumference of the circle is joined with the end points of the semicircle. Therefore, the triangle so formed should be a right-angled triangle (Since the angle subtended by the diameter of the circle on the circumference is 90°.

It has been given that the sides of the triangle are in an arithmetic progression. Let us assume the sides to be $a-d, a,$ and $a+d$ units. $a+d$ must be the length of the hypotenuse of the triangle.



Applying Pythagoras theorem, we get,
$(a+d)^2 = a^2 + (a-d)^2$
$a^2 + d^2 + 2ad = a^2 + a^2 + d^2 - 2ad$
$4ad = a^2$
$4d = a$

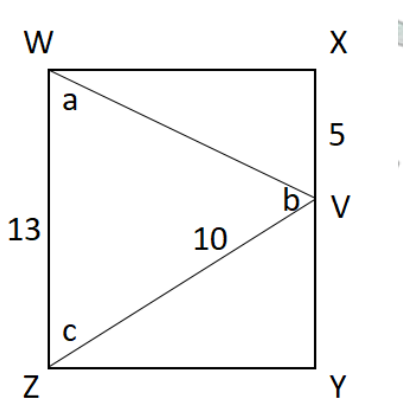
Therefore, the 3 sides of the triangle will be of the form $3d, 4d$ and $5d$.
$5d$ is the diameter of the semicircle.
=> Radius of the semicircle = $2.5d$

Perimeter of the semicircle = $\pi * r + 2r$
$= \frac{22}{7} * r + 2r$
$= r * \frac{36}{7}$
$= 2.5d * \frac{36}{7}$
Perimeter of the semicircle = $\frac{90*d}{7}$ units.

We know that 'd' has to be an integer. Therefore, the perimeter has to be a multiple of 90/7. Only option D satisfies this condition and hence, option D is the right answer.

Question 6

In the rectangle WXYZ given below WZ = 13 cm, VX = 5 cm and ZV = 10 cm. a,b and c represent the measure of angle ZWV, WVZ and VZW respectively. Which of the following options accurately shows the relation between a, b and c.



A a>b>c

B b>a>c

C b>c>a

D Cannot be determined

Answer: B

Explanation:
XY = 13 cm = XV+VY = 5+VY Thus, VY = 8 cm
Thus, ZY = $\sqrt{10^2 - 8^2}$ = 6 cm
Thus, WV = $\sqrt{5^2 + 6^2} = \sqrt{61} \approx 8cm$
Thus, WZ>ZV>WV.
Thus, b>a>c
Hence, option B is the correct answer

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Question 7

In an isosceles triangle ABC with AB=AC, AD and AE trisects BC such that BD = DE = EC. IF angle DAE is equal to angle ABC and the area of triangle ABC is equal to $\frac{27\sqrt{7}}{4}$, then find AC.

A 3

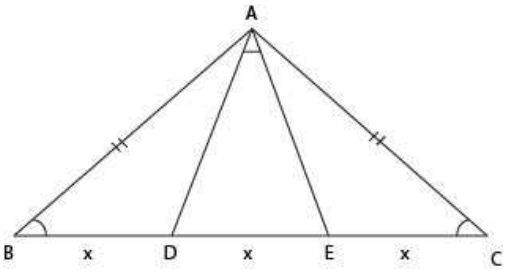
B 8

C 9

D 6

Answer: D

Explanation:



Since AB = AC

Angle B = Angle C

Let BD = DE = EC = x

BD = EC = x, AB = AC and Angle B = Angle C

Triangle ABD is congruent to triangle ACE

AD = AE

Angle ADE = Angle AED ---- (1)

Now Angle ADE = Angle B + Angle BAD as angle ADE is the exterior angle of BAE. --- (2)

It is given that angle DAE = angle ABC. Hence, replacing angle B with angle DAE in eqn(2), we get

angle ADE = angle DAE + angle BAD

From (1), we can replace angle ADE with angle AED.

Angle AED = Angle DAE + Angle BAD

Angle AED = Angle BAE

Hence, AB = BE = 2x

=> AB = AC = 2x

BC = 3x

Hence, height of triangle ABC = h = $\sqrt{(2x)^2 - (3x/2)^2}$ = √7x/2

Area of triangle = $\frac{27\sqrt{7}}{4}$

1/2 * 3x * √7x/2= $\frac{27\sqrt{7}}{4}$

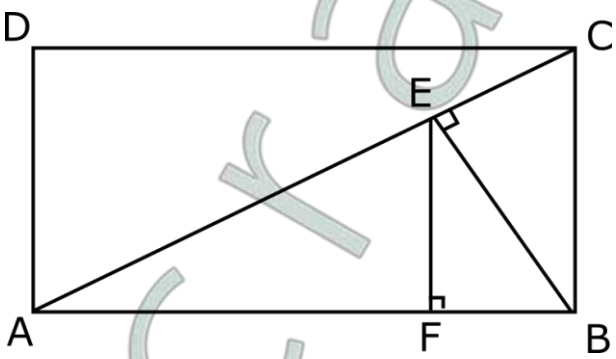
x^2 = 9 => x=3

2x = 6

AB = AC = 6

Question 8

ABCD is a rectangle as shown in the figure. AB = 8 cm and BC = 6 cm. BE is the perpendicular drawn from B to the diagonal AC. EF is the perpendicular drawn from E to AB. What is the length of BF?



A 3.24 cm

B 1.96 cm

C 2.56 cm

D 2.88 cm

Answer: D

Explanation:

By Pythagoras theorem $AC = \sqrt{AB^2 + BC^2} = \sqrt{8^2 + 6^2} = 10$ cm

Triangle BEC is similar to triangle ABC. So we get,

$\frac{BE}{AB} = \frac{BC}{AC}$

=> $\frac{BE}{8} = \frac{6}{10}$

=> $BE = 4.8$ cm

Triangle BFE is similar to triangle BEA. So we get,

$\frac{BF}{BE} = \frac{BE}{AB}$

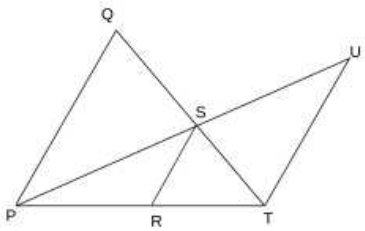
=> $BF = \frac{BE^2}{AB}$

=> $BF = \frac{4.8^2}{8}$

=> $BF = 2.88$ cm

Question 9

In the figure given below PQ II RS II TU. If PQ:TU=3:2, then what is the value of SR:TU?



A 3:5

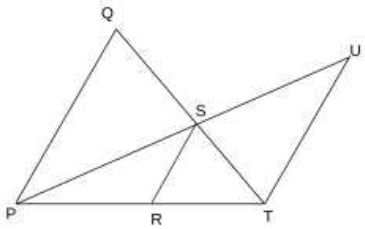
B 2:5

C 3:4

D 2:3

Answer: A

Explanation:



PQ:TU=3:2

PQ=3y

TU=2y

If SR = x

△ PUT is similar △ PSR then PR/PT=x/2y

Similarly, △ PQT is similar △ RST then RT/PT=x/3y

RT=PT-PR

∴(PT-PR)/PT= x/3y

1-PR/PT=x/3y

1-x/2y=x/3y

x=6y/5

thus SR/TU= 6y/(5*2y)=3/5

Question 10

In triangle ABC, two points P and Q are on AB and BC respectively such that AP:BP=1:4 and BQ:CQ=2:3. The ratio of areas of triangle BPQ and the quadrilateral PQCA is

A $\frac{8}{25}$

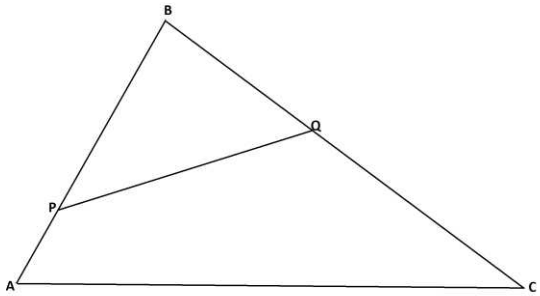
B $\frac{17}{25}$

C $\frac{9}{17}$

D $\frac{8}{17}$

Answer: D

Explanation:



We have AP:PB=1:4 and BQ:CQ=2:3

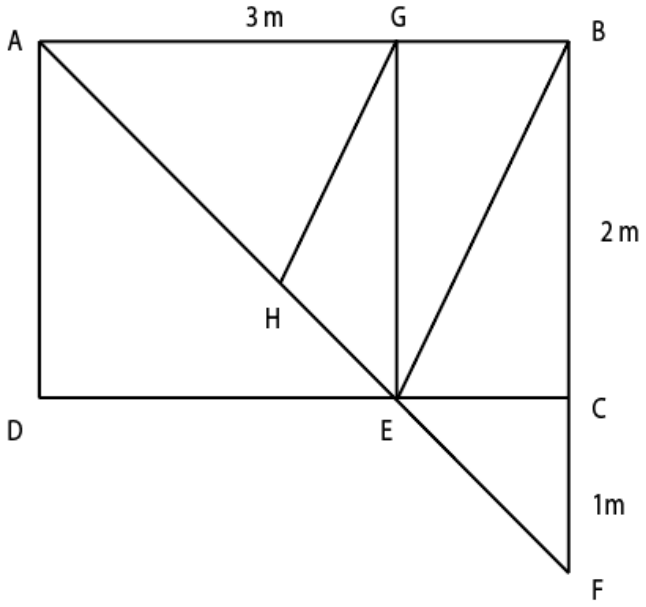
Now the area of ABC= $\frac{1}{2}BA * BCsin\theta$ = x (Assume)

Similarly, area of BPQ= $\frac{1}{2}BP * BQsin\theta = \frac{1}{2}(\frac{4}{5}BA) * (\frac{2}{5}BC)sin\theta = \frac{8}{25}x$

Now, $\frac{areaBPQ}{areaPQCA} = \frac{areaBPQ}{areaABC-areaBPQ} = \frac{\frac{8}{25}x}{x-\frac{8}{25}x} = \frac{8}{17}$

Question 11

In the given figure ABCD is a rectangle. AB is 3m and BC is 2m. It is given that CF is 1m. AF intersects CD at E and it is known that BE is parallel to HG. GE is perpendicular to AB. Find the length of HG (in m).



A $\frac{2\sqrt{5}}{3}$

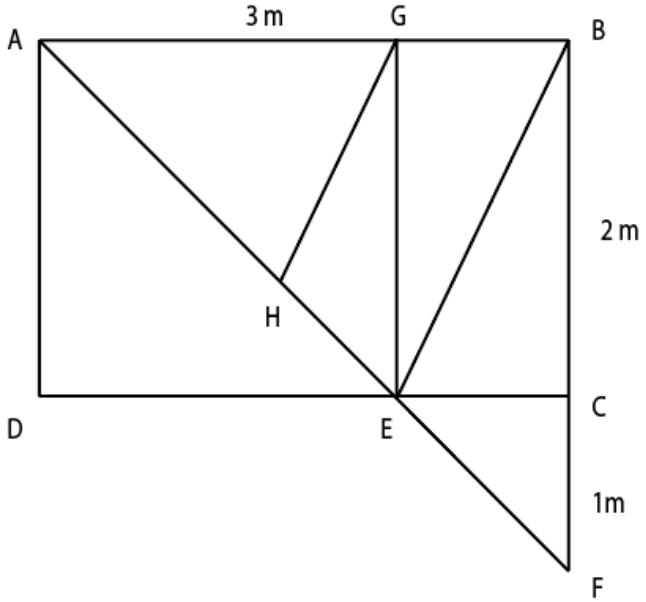
B $\sqrt{2}$

C $\frac{4\sqrt{5}}{3}$

D $\frac{2\sqrt{5}}{5}$

Answer: A

Explanation:



In the figure given above,

In △ABF, AB is parallel to EC.

EC/AB=CF/BF

EC/3 = 1/3

$\therefore$ EC= 1m

Then according to the figure, GB=1m.

Length of side BE=$\sqrt{GB^2+GE^2}$ = $\sqrt{2^2+1^2}$

=$\sqrt{5}$

$\triangle AHG \sim \triangle AEB$ (Since HG||BE)

Thus AG/AB=HG/BE.

2/3=HG/$\sqrt{5}$

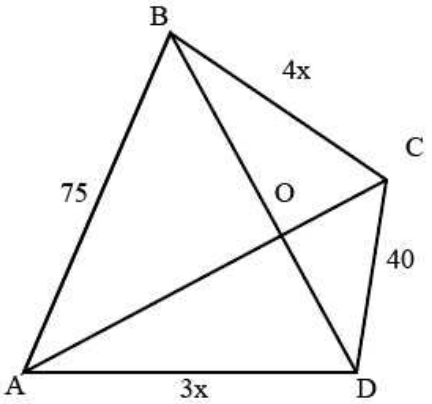
HG=2$\sqrt{5}$/3

Question 12

ABCD is a quadrilateral such that its diagonals are perpendicular to each other. If AB=75 and CD = 40. If AD:BC= 3:4, then the sum of the lengths of AD and BC is

Answer:119

Explanation:



Assume the diagonals intersect at O. Now $OA^2+OB^2+OC^2+OD^2 = OA^2+OD^2+OB^2+OC^2$
Hence $AB^2+CD^2=AD^2+BC^2$....(1)

$75^2+40^2=(3x)^2+(4x)^2$ (Consider AD=3x and BC=4x)
=> $7225 = 25x^2$

=> $x^2=289$

=> x=17

AD+BC=3x+4x=7x=7*17=119

Question 13

In a triangle PQR, PA divides the QR in the ratio of 3:2. The angular bisectors of ∠PAQ and ∠PAR intersect PQ and PR at B and C, respectively. If PB:BQ =2:1, then the ratio PC:CR is

A 2:1

B 1:2

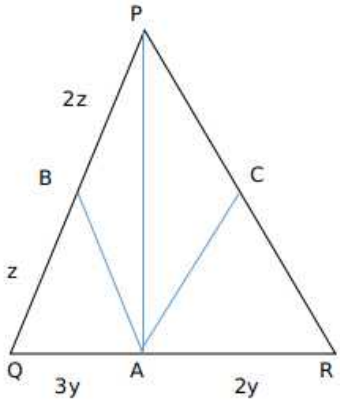
C 3:4

D 3:1

Answer: D

Explanation:

Let's try to represent the information on a diagram.



The angular bisector AB divides PQ in the ratio of 2:1
Let PB = 2z ad BQ=z
The angular bisector divides the opposite side in the ratio of the sides containing the angle.
So AP: AQ =2:1
So AP =6y
Similarly, PC: CR = AP: AR = 6y:2y = 3:1
D is the correct answer.

Question 14

ABCD is an isosceles trapezium with angle A =45^0 and the length of one of the non-parallel sides are 10$\sqrt{2}$, and the area of ABD is 200 sq. Units. What is the sum of the lengths of the parallel sides.

A 60

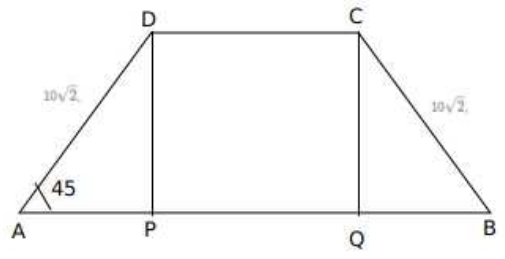
B 50

C 40

D 30

Answer: A

Explanation:
Given ABCD is an isosceles trapezium, so the length of the non-parallel sides is equal.
And area of the triangle ABD is 200 sq units.
$\frac{1}{2}$*AD*AB $sin\theta$ = 200
$\frac{1}{2}$*10$\sqrt{2}$*AB$\sin 45^0$ = 200
AB=40 units
Now let us draw a perpendicular from vertices C and D to AB,



The lengths of AP and PD should be equal, (A = 45^0)
$AP^2 + PD^2$ = 200
2 AP^2 = 200
AP = 10 units
The length of AP and BQ is same,
BQ = 10 units
CD = AB - (AP + BQ)
40-20 = 20 units

Sum of the lengths of the parallel sides = 40+20 = 60 units

Question 15

A survey was conducted in a town to gauge the popularity of 2 detergent powders viz. Sariel and Turf Excel. A total of 800 housewives participated in the survey. It was found that 544 housewives knew about Sariel whereas only 378 housewives knew about Turf Excel. What can be the number of housewives who knew about Sariel alone?

A 150

B 425

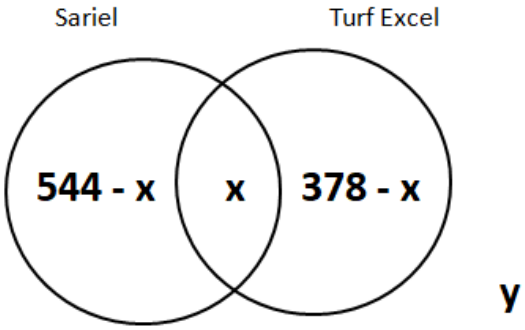
C 165

D 394

Answer: D

Explanation:

Let 'x' be the number of housewives who knew about both detergent powders. Let 'y' be the number of housewives who didn't know about any of the two brands. We can draw a Venn diagram as shown below:



y

It is given that a total of 800 housewives participated in the survey.

$\Rightarrow 544 - x + x + 378 - x + y = 800$

$\Rightarrow x = 122 + y$

We know that $y \geq 0$, therefore, we can say that $x \geq 122$ ... (1)

Also, the number of housewives who knew about Turf excel alone = $378 - x$. Therefore, $378 - x \geq 0$

$\Rightarrow x \leq 378$ ... (2)

By combining inequality (1) and (2) we can say that

$\Rightarrow 122 \leq x \leq 378$

$\Rightarrow -122 \geq -x \geq -378$

$\Rightarrow 544 - 122 \geq 544 - x \geq 544 - 378$

$\Rightarrow 166 \leq 544 - x \leq 422$

Hence, the number of housewives who knew about Sariel alone = (544 - x) ϵ [166, 422]

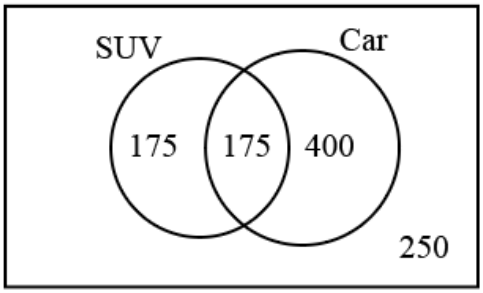
We can see that only 394 lies in that range. Therefore, option D is the correct answer.

Question 16

In a township of 1000 families, some families have an SUV and some families have a car. Some families have both the vehicles and some families have no vehicle. It is known that 350 families own an SUV. Out of those who own an SUV, 50% own a car too. If it is known that 75% of the families of the township owns at least one vehicle, how many families own at most one vehicle?.

Answer:825

Explanation:
No. of families who owns an SUV = 350
No. of families who owns both SUV and car = 50% of 350 = 175
It is given that 75% of the families own at least one vehicle.
So, 250 families do not own any vehicle.
No. of families who own a car and not an SUV = 750 - 350 = 400
So, no of families who own at most one vehicle
= 250 + (350 - 175) + (750 - 350) = 825
Hence, 825 is the correct answer.



Question 17

In a CAT prep institute, all the students are interested in at least one of the following series: GOT, FRIENDS, Big Bang Theory. It was found that the percentage of students who like the shows are 55,86,69 respectively. Let x be the percentage of students who are interested in all the three series. Find the ratio of the maximum to the minimum value of x.

A 11

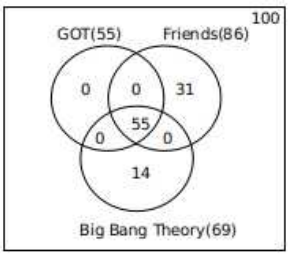
B 6

C 5.5

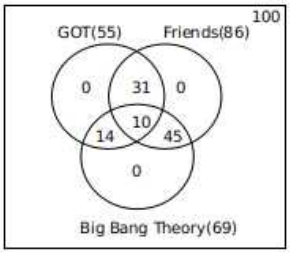
D 4

Answer: C

Explanation:
Let A be the percentage of students who like only one show
B be the percentage of students who like two shows
C be the percentage of students who like all the three shows
A+B+C=100 ----------(1)
A+2B+3C=55+86+69
A+2B+3C=210 ----------(2)
B+2C=110
Since we have to maximize C, if B=0 C=55 A=45 which satisfies both the equations
The maximum value of C=55



Let us try to find the minimum value of C
Eq (2) - 2*Eq (1), we get C-A=10
Minimum value of C is 10 when A=0 then B=90
A=0, B=90, C=10 satisfies both the equations.
Hence the minimum value of C is 10



The ratio of Maximum to Minimum=5.5
Hence C is the correct answer.

Question 18

Two sets P and Q contain elements such that p ϵ P and q ϵ Q. p is a 4 digit number in decimal system which has at least 3 trailing zeroes when converted into base 6 and q is a four digit perfect square. How many elements does the set P U Q contain?

A 79

B 99

C 108

D 110

Answer: C

Explanation:
The 4 digit number should be divided by 6^3 = 216 in order to get at least 3 trailing zeroes.

First 4 digit number divided by 216 = 1080

Last 4 digit number divided by 216 = 9936

9936=1080+216(n-1)

=>n=42

Total elements in Q = 4 digit squares = {32^2 to 99^2} = = 99-32+1 = 68

No of elements in P intersection Q = 2 , because 4 digit square divisible by 6^3 will also be divisible by 6^4=1296. Hence it can come in P as 36*36= 1296 and 72*72= 5184 .

Total number of elements in PUQ = 68+42-2 = 108

Question 19

In a residential school, every student has to play at least one out of three sports namely hockey, badminton and cricket. Out of 100 students, 81 play hockey, 75 play cricket and 71 play badminton then the maximum number of students who play exactly two games can be

A 71

B 77

C 73

D 75

Answer: C

Explanation:
Consider the number of students who play exactly 1 sport = x, the number of students who play exactly 2 sports = y and the number of students who play exactly 3 sports = z

x+y+z=100

2x+2y+2z=200....(1)

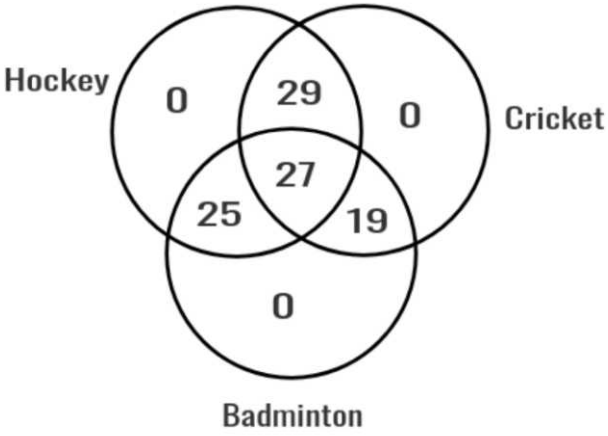
x+2y+3z=227.....(2)

Subtracting (1) from (2), we get z-x=27

The minimum value of x can be 0. Hence z=27 and y=73 (from (1))

The number of students who play exactly 2 sports = 73

The Venn diagram for the case when x=0, y=73 and z=27 is as follows:



Question 20

In a class, each student likes at least one of the five activities, namely Playing, Singing, Drawing, Dancing, Reading. 80% of the students like playing, 70% of the students like singing, 90% of the students like Drawing, 80% of the students like dancing and 90% like reading. What is the maximum percentage of the students who like exactly four of the five activities?

Answer:90

Explanation:
Let I be the percentage of students who like exactly one activity
II be the percentage of students who like exactly two activities.
III be the percentage of students who like exactly three activities.
IV be the percentage of students who like exactly four activities.
V be the percentage of students who like all the five activities.
I+II+III+IV+V=100
I+2II+3III+4IV+5V=410
We have to maximize the percentage of students who like exactly four activities.
Let us consider I, II, III be 0
IV+V=100
4IV+5V=410
On solving both the equations, we get
V=10, IV=90
90 is the correct answer.

Question 21

If A = {2,4,5}, How many natural numbers less than 101 are not divisible by any of the numbers in the set A?

Answer:40

Explanation:
Here, all the numbers that are divisible by 4 are divisible 2.(Hence, we do not need to find the numbers that are not divisible by 4)
Hence, we need to find the numbers that are divisible 2, 5 and both 2 and 5.
The number of natural numbers divisible by 2 = 50(all the even numbers from 1 to 100)

The number of natural numbers that are divisible by 5 = 20 (from 5*1 to 5*20).
Numbers that are divisible by both 5 and 2 are divisible by 10.
Hence, there are 10 numbers that are divisible by both.
N(2 U 5) = N(2)+N(5) - N(2 and 5)
N(2 U 5) = 50+20 - 10 = 60
Number of numbers that are not divisible by both 2 and 5 = 100-60 = 40

Alternate Solution

Since 2 is a factor of 4, the crux of the question is to find how many number less than 100 are not divisible by either 2 or 5

Since 100 is divisible by both 2 and 5

No of numbers not divisible by 2 = $100 \times \frac{1}{2} = 50$

No of numbers not divisible by 2 and not divisble by 5 = $100 \times \frac{1}{2} \times \frac{4}{5} = 40$

Question 22

A and B are two series as follows.
A={1, 4, 7, 10,.....181}
B={22, 45, 68, ...482}
The value of the product of the number of terms in set A and Set B is

A 1281

B 1280

C 1200

D 1820

Answer: A

Explanation:
Set A= {1, 4, 7, 10 .....181}
Here the first term = 1
Common difference =3
181=1+(n-1)3
n=61
Set B = {22, 45, 68, ...482}
First term = 22
Common difference = 23
482=22+(n-1)23
n=21
The product of the number of terms in set A and B = 61*21=1281
A is the correct answer.

Question 23

Among the first year students of IIM Calicut, 100 students do not like DC comics and 134 students do not like Marvel comics. If the difference between the students who like both and the number of students who like none is 24, how many students like only one out of the two comics?

A 200

B 198

C 186

D Cannot be determined