GATE 2016

Mechanical Engineering

▶ **General Aptitude (Question with Solution Set-1, 2 & 3)**

SET-1

1. Which of the following is **CORRECT** with respect to grammar and usage? Mount Everest is _____.

A. The highest peak in the world.

B. highest peak in the world

C. one of highest peak in the world

D. one of the highest peak in the world

Ans. A

Sol. The sentence is stating the highest peak in the world. Since it is a specific thing, we need to use the definite article 'the' before it. Also, the sentence is using the superlative degree and so we say 'the highest peak in the world' making option 1 the correct answer. There cannot be many highest peaks in the world and so options 3 and 4 are incorrect.

2. The policeman asked the victim of a theft, "What did you_____?"

A. Loose   B. Lose

C. Loss   D. Louse

Ans. B

Sol. The context of the sentence is asking a person who has been deprived of something because of a theft. The word to be used to fill the blank is 'lose' which means to be deprived of something. 'Loose' means something that is not fitted. 'Louse' is the singular form of the word 'lice' that is a parasite that lives in the skin of mammals and birds. 'Loss' is a noun that means the process of losing someone or something. Eg: He suffered tremendous loss in his business.

3. Despite the new medicine's _____ in treating diabetes, it is not _____ widely.

A. effectiveness --- prescribed

B. availability --- used

C. prescription --- available

D. acceptance --- proscribed

Ans. A

Sol. The sentence is looking for a contrast as it is joined by the conjunction 'despite'. The best pair of words that can fit the context of the sentence is 'effectiveness… prescribed'. Though the medicine is 'effective' in treating diabetes, it is not being 'prescribed' widely. A new medicine cannot have a 'prescription' or 'availability' for treating a disease. 'Proscribed' means forbidden by law. In case we use 'acceptance…proscribed' the sentence will not make any sense because it will mean that though the medicine is accepted widely, it is not forbidden by law.

4. In a huge pile of apples and oranges, both ripe and unripe mixed together, 15% are unripe fruits. Of the unripe fruits, 45% are apples. Of the ripe ones, 66% are oranges. If the pile contains a total of 5692000 fruits, how many of them are apples?

A. 2029198   B. 2789080

C. 2467482   D. 3577422

Ans. A

Sol. Let T = total no of fruits = 5692000

R = Ripe fruits

U = Unripe fruits

A = Apple

O = Oranges

Given U = 15% of T : $\frac{15}{100} \times 5692000$

= 853800

R = T − U = 4838200

A(U) = 45% of U: $\frac{45}{100} \times 853800 = 384210$

A(R) = (100 − 66)% of R: $\frac{34}{100} \times 4838200$

= 1644988

∴ A(U) + A(R) = 2029198

5. Michael lives 10 km away from where I live. Ahmed lives 5 km away and Susan lives 7 km away from where I live. Arun is farther away than Ahmed but closer than Susan from where I live. From the information provided here, what is one possible distance (in km) at which I live from Arun's place?

A. 3.00　　　　　　B. 6.02

C. 4.99　　　　　　D. 7.01

Ans. B

Sol. In question it is given that Ahmed is 5 km away and Susan is 7 km away from where I live. Further it is given that Arun is farther away than Ahmed from where I live and not as far as Susan. That means Arun must be living at distance more than 5 km but less than 7 km from my house which is according to given options can be 6.02 km.

Note: Information about Michal is unnecessary and just given to confuse.

From given data, the following diagram is possible
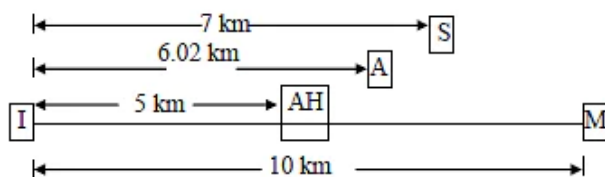
I = I live

AH = Ahmed lives

M = Michael lives

S = Susan lives

A = Arun lives

6. A person moving through a tuberculosis prone zone has a 50% probability of becoming infected. However, only 30% of infected people develop the disease. What percentage of people moving through a tuberculosis prone zone remains infected but does not show symptoms of disease?

A. 15　　　　　　B. 33

C. 35　　　　　　D. 37

Ans. C

Sol. Percentage probability of being infected = PA. = 50%

Percentage probability of infected person developing disease is having system, = PB. = 30%

∴ Percentage probability of infected person not showing symptoms = P($\bar{B}$) = 70%

∴ Percentage probability of person moving though a TB prone zone remaining infected but not showing symptoms

= PA. P($\bar{B}$) = $\frac{50}{100} \times \frac{70}{100} = 35\%$

7. In a world filled with uncertainty, he was glad to have many good friends. He had always assisted them in times of need and was confident that they would reciprocate. However, the events of the last week proved him wrong. Which of the following inference(s) is/are logically valid and can be inferred from the above passage?

(i) His friends were always asking him to help them.

(ii) He felt that when in need of help, his friends would let him down.

(iii) He was sure that his friends would help him when in need.

(iv) His friends did not help him last week.

A. (i) and (ii)   B. (iii) and (iv)

C. (iii) only   D. (iv) only

Ans. B

Sol. The paragraph states that the subject was very confident about his good friends helping him in his times of need because he had always helped them before in their time. Thus, inference iii follows. Since the events of the last week proved him wrong, this means that his confidence was broken and his friends had not helped him. Thus, inference iv also follows.

8. Leela is older than her cousin Pavithra. Pavithra's brother Shiva is older than Leela. When Pavithra and Shiva are visiting Leela, all three like to play chess. Pavithra wins more often than Leela does. Which one of the following statements must be TRUE based on the above?

A. When Shiva plays chess with Leela and Pavithra, he often loses.

B. Leela is the oldest of the three.

C. Shiva is a better chess player than Pavithra.

D. Pavithra is the youngest of the three.

Ans. D

Sol. According to given information the points we got are

A- Shiva is brother of Pavithra

B- Shiva and Pavithra are cousins of Leela

C- According to their ages Shiva > Leela > Pavithra

D- They all like to play chess

E- Pavithra wins more often than Leela but information about winning cases of Shiva is not given.

So from the given options statement which is clearly true is that Pavithra is the youngest of all.

9. If $q^{-a} = \dfrac{1}{r}$, $r^{-b} = \dfrac{1}{s}$ and $S^{-c} = \dfrac{1}{q}$, then the value of abc is

A. $(rqs)^{-1}$ B. 0

C. 1   D. r + q + s

Ans. C

Sol. $q^{-a} = \dfrac{1}{r}$, $r^{-b} = \dfrac{1}{s}$ and $S^{-c} = \dfrac{1}{q}$

$\therefore q^a = r$; $r^b = s$ and $s^c = q$

taking log

$\therefore a*\log q = \log r \ldots \ldots (1)$

And $b \log r = \log s \ldots \ldots (2)$

And $c \log s = \log q \ldots \ldots (3)$

Multiplying equations 1,2 and 3

$abc (\log q)(\log r)(\log s) = (\log r)(\log s)(\log q)$

$\therefore abc = 1$

10. P, Q, R and S are working on a project. Q can finish the task in 25 days, working alone for 12 hours a day. R can finish the task in 50 days, working alone for 12 hours per day. Q worked 12 hours a day but took sick leave in the beginning for two days. R worked 18 hours a day on all days. What is the ratio of work done by Q and R after 7 days from the start of the project?

A. 10:11   B. 11:10

C. 20:21   D. 21:20

Ans. C

Sol. Given Q can finish the task in 25 days by working 12 hours a day.

So, Q's rate of doing work per hour = $1/(25 \times 12) = 1/300$

Q has worked for 5 days (12 hours a day) so the work done by Q in that time = $5 \times 12 \times 1/300$

$= 1/5$

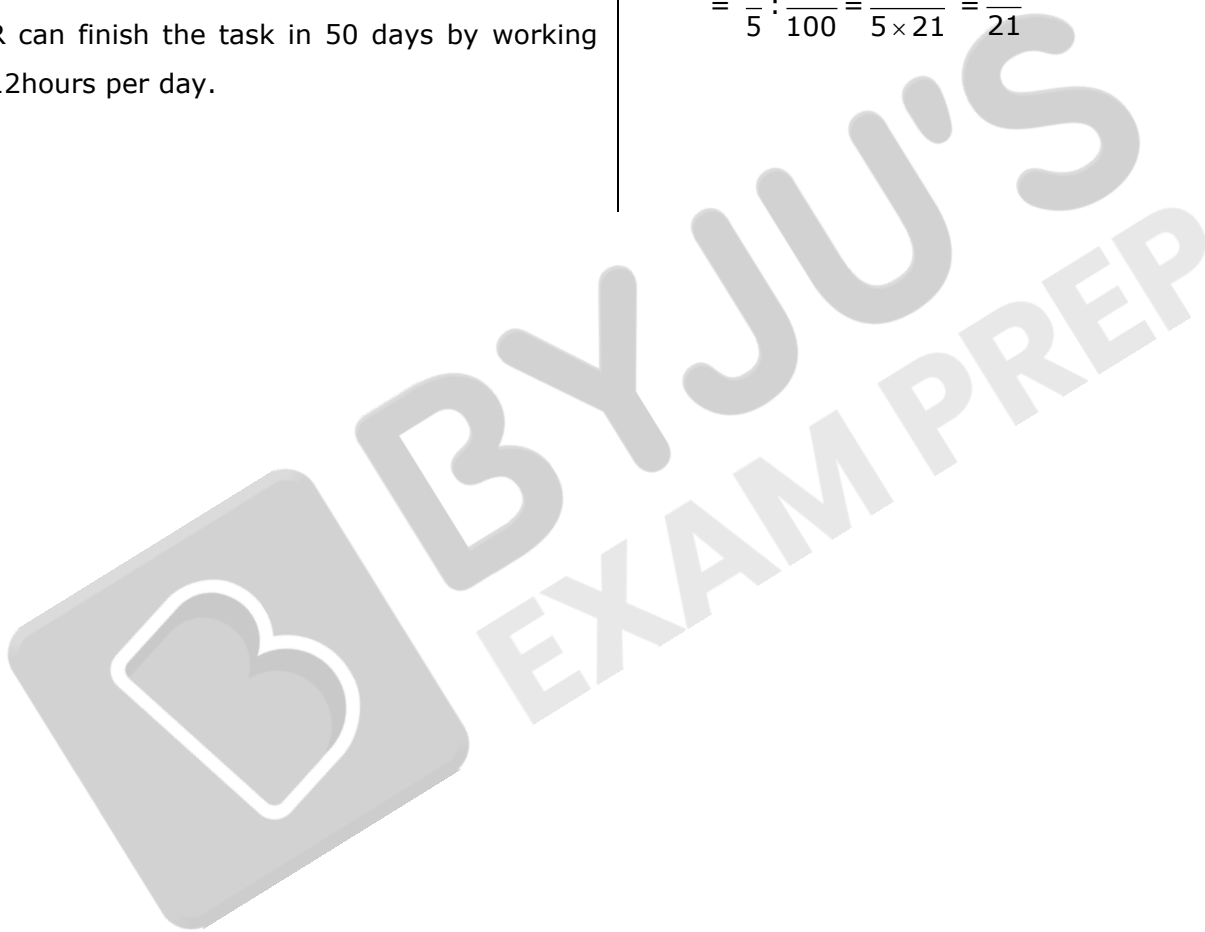R can finish the task in 50 days by working 12hours per day.

So, R's rate of doing work per hour = $1/(50 \times 12) = 1/600$

R has worked for 7 days (18 hours a day) so the work done by R in that time = $7 \times 18 \times 1/600 = 21/100$

So required ratio = work done by Q/work done by R

∴ Ratio of work done by Q to work done by R

$= \dfrac{1}{5} : \dfrac{21}{100} = \dfrac{100}{5 \times 21} = \dfrac{20}{21}$

SET-2

1. The volume of a sphere of diameter 1 unit is _____ than the volume of a cube of side 1 unit.

A. least   B. less

C. lesser   D. low

Ans. B

Sol. 'Less' is option because the sentence should be in comparative degree.

Either there would be lesser or less than. "Lesser than" is a grammatical error

2. The unruly crowd demanded that the accused be _____ without trial.

A. hanged   B. hanging

C. hankering   D. hung

Ans. A

Sol. 'hanged' means death by hanging.

'hung' is used only with things and not with people.

'hankering' means fond of something rare things.

From the given options 'hanged' is the only suitable word to make the sentence meaningful.

3. Choose the statement(s) where the underlined word is used correctly:

(i) A prone is a dried plum.

(ii) He was lying prone on the floor.

(iii) People who eat a lot of fat are prone to heart disease.

A. (i) and (iii) only   B. (iii) only

C. (i) and (ii) only   D. (ii) and (iii) only

Ans. D

Sol. Prune (dry fruit) is a dried plum not ' prone '. So, statement (I) is incorrect.

'Prone to' means the chance of suffering from a disease. So, statement (ii) is correct.

'lying prone ' means lying down flat (face down). So, statement (iii) is correct.

Hence option D is the right answer.

4. Fact: If it rains, then the field is wet.

Read the following statements:

(i) It rains   (ii) The field is not wet

(iii) The field is wet   (iv) It did not rain

Which one of the options given below is NOT logically possible, based on the given fact?

A. If (iii), then (iv)   B. If (i), then (iii)

C. If (i), then (ii)   D. If (ii), then (iv)

Ans. C

Sol. Option A, the field may be wet, but that does not mean there is rain. So this is logically possible.

Option B, if it rains, then the field is wet follows the given statement.

Option D, if the field is not wet then it did not rain, which can be inferred from the statement.

Option C is logically not possible; if it rains, then the field must be wet. Thus option C is the required answer.

5. A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in m^2 is_____.

A. 1.43   B. 2.06

C. 2.68   D. 2.88

Ans. B

Sol.
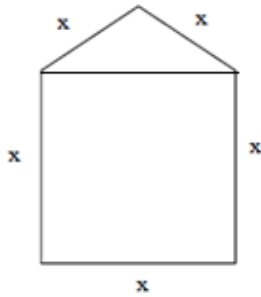
3x + 2x = 6

5x = 6

X = 6/5

Area of square $= \dfrac{6}{5} \times \dfrac{6}{5} = \dfrac{36}{25}$

Area of square triangle

$= \dfrac{\sqrt{3}}{4} \ell^2 = \dfrac{\sqrt{3}}{4} \times \dfrac{6}{5} \times \dfrac{6}{5} = \dfrac{\sqrt{3}}{4} \cdot \dfrac{36}{25}$

$\left(1 + \dfrac{\sqrt{3}}{4}\right) \times \dfrac{36}{25} = 2.06$

6. Students taking an exam are divided into two groups, P and Q such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group P was 105, while that of group Q was 85. The standard deviation of group P was 25, while that of group Q was 5. Assuming that the marks were distributed on a normal distribution, which of the following statements will have the highest probability of being TRUE?

A. No student in group Q scored less marks than any student in group P.

B. No student in group P scored less marks than any student in group Q.

C. Most students of group Q scored marks in a narrower range than students in group P.

D. The median of the marks of group P is 100

Ans. C

Sol. Group 'P'

Mean (μ) = 105

Standard deviation (σ_1) = 25
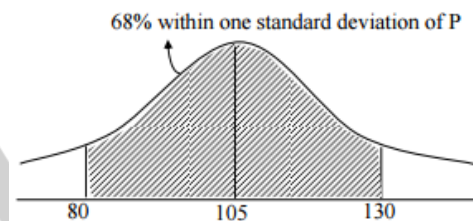
Pr ($\mu - \sigma \le \mu + \sigma$) ≃ 0.6827

∴ 68% within one standard deviation

$\mu_1 - \sigma_1 = 105 - 25 = 80$

$\mu_1 - \sigma_1 = 105 + 25 = 130$

∴ range = 80 to 130

Distribution of P:

Group Q

Mean (μ_2) = 85

Standard deviation (σ_2) = 5
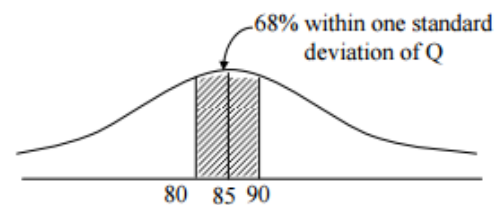
Pr ($\mu - \sigma \le x \le \mu + \sigma$) ≃ 0.6827

∴ 68% within one standard deviation

$\mu_2 - \sigma_2 = 85 - 5 = 80$

$\mu_2 + \sigma_2 = 85 + 5 = 80$

∴ Range of Q in one standard deviation is 80 to 90

Distribution of 'Q'

68% within one standard deviation of Q is narrower.

∴ 68% within one standard deviation of Q means most students of group Q.

∴ Most students of group 'Q' score marks in a narrower range than students in group 'P'

7. A smart city integrates all modes of transport, uses clean energy and promotes sustainable use of resources. It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state.

Which of the following can be logically inferred from the above paragraph?

i. All smart cities encourage the formation of surveillance states.

ii. Surveillance is an integral part of a smart city.

iii. Sustainability and surveillance go hand in hand in a smart city.

iv. There is a perception that smart cities promote surveillance.

A. (i) and (iv) only   B. (ii) and (iii) only

C. (iv) only   D. (i) only

Ans. C

Sol. Critics argue that the use of technology to ensure the safety and security of the city will lead to a surveillance state, making a perception that a smart city promotes Surveillance, which makes a statement (iv) correct. Hence, option C is the right answer. There is no mention that smart cities encourage surveillance states, and Surveillance is an integral part of it. This makes a statement (i) and (ii) incorrect. So all other options are wrong.
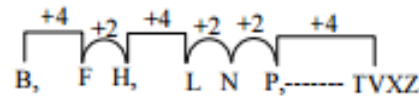
8. Find the missing sequence in the letter series.

B, FH, LNP, _ _ _ _.

A. SUWY   B. TUVW

C. TVXZ   D. TWXZ

Ans. C

Sol. The following letter series is in the order of even letters series

There is a pattern of +4 difference between each term and the letter of each component is increase by one letter with difference of +2.

9. The binary operation □ is defined as a □ b = ab + (a + b), where a and b are any two real numbers. The value of the identity element of this operation, defined as the number x such that a □ x = a, for any a, is _____.

A. 0   B. 1

C. 2   D. 10

Ans. A

Sol. a □ b = ab + (a + b)
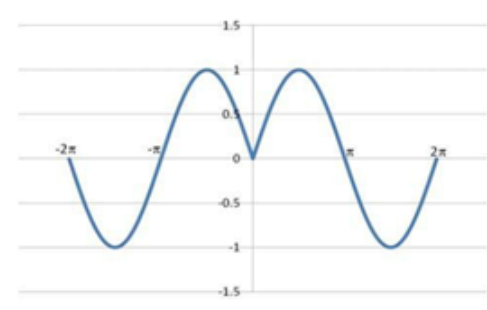
Given that a □ x = a

ax + (a + x) = a

ax + x=0

x(1 + a)=0

So, x = 0 for any value of a.

10. Which of the following curves represents the $Y = \ln\left(\left|e^{\left|\sin(|x|)\right|}\right|\right)$ for |x| < 2π ?
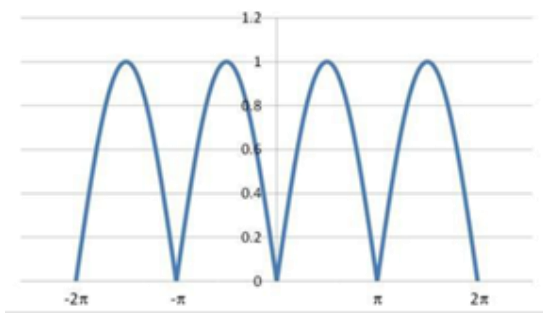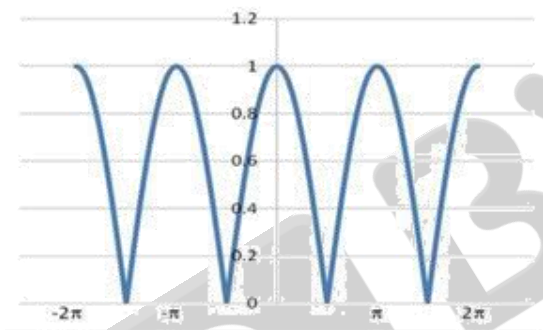
A.

B.
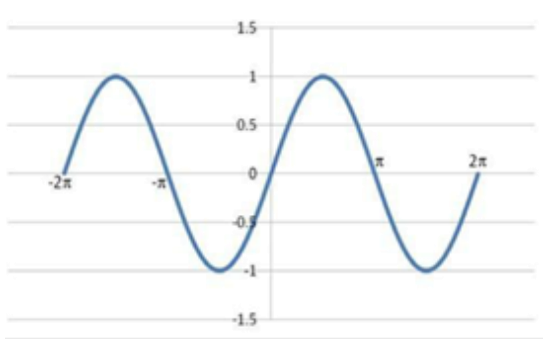
C.

D.

Ans. C

Sol. $Y = \ln\left(\left|e^{|\sin(|x|)|}\right|\right)$

$= \ln\left(\left|e^{|\sin(|x|)|}\right|\right) = |\sin(|x|)|$

Now for drawing the graph follow these steps

1) Draw sin x graph on paper

2) Take reflection about x – axis, you will get graph of sin (|x|)

3) Now, take a reflection again but this time about y–axis, you will get the graph of $|\sin(|x|)|$

⇒ Option C is correct.

1. Based on the given statements, select the appropriate option with respect to grammar and usage. Statements

i. The height of Mr. X is 6 feet.

ii. The height of Mr. Y is 5 feet.

A. Mr. X is longer than Mr. y.

B. Mr. X is more elongated than Mr. Y.

C. Mr. X is taller than Mr. Y.

D. Mr. X is lengthier than Mr. Y.

Ans. C

Sol. For height reference, tall word is used.

2. The students _____ the teacher on teacher's day for twenty years of dedicated teaching.

A. Facilitated   B. Felicitated

C. Fantasized   D. Facillitated

Ans. B

Sol. The student **felicitated** the teacher on teacher's day for twenty years of dedicated teaching.

Facilitated: make something possible and easier.

Felicitated: an expression of good wishes; congratulation.

Fantasized: to imagine something that you would like to happen

Facillitated: there is no such word in English dictionary.

From the given options felicitated is the most suitable word.

3. After India's cricket world cup victory in 1983, Shrotria who was paying both tennis and cricket till then, decided to concentrate only on cricket. And the <u>rest is history.</u>

What does the underlined phrase mean in this context?

A. History will rest in peace

B. Rest is recorded in history books

C. Rest is well known

D. Rest is archaic

Ans. C

Sol. "rest is history" is an idiomatic expression that means 'rest is well known'

4. Given (9 inches)$^{1/2}$ = (0.25 yards)$^{1/2}$, which one of the following statements is **TRUE**?

A. 3 inches = 0.5 yards

B. 9 inches = 1.5 yards

C. 9 inches = 0.25 yards

D. 81 inches = 0.0625 yards

Ans. C

Sol. Given (9 inches)$^{1/2}$ = (0.25 yards)$^{1/2}$

Taking square on both sides

9 inches = 0.25 yards

So, C is a right answer.

Option A is incorrect because multiple values of +ve and -ve values would be there.

5. S. M. E and F are working in shifts in a team to finish a project. M works with twice the efficiency of others but for half as many days as E worked. S and M have 6 hour shifts in a day, whereas E and F have 12 hours shifts. What is the ratio of contribution of M to contribution of E in the project?

A. 1:1   B. 1:2

C. 1:4   D. 2:1

Ans. B

Sol. Given that

M works with twice the efficiency of others but for half as many days as E worked

let the efficiency of E be y and worked for D days

then the efficiency of M= 2y (twice as E)

M worked for no of days = D/2 days (half as many days as E worked)

Also given that, S and M have 6 hour shifts in a day, whereas E and F have 12 hours shifts

Total work = Efficiency x no of days x working hr in shift

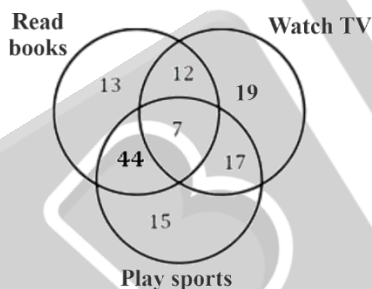Work done by M= 2y x D/2 x 6 = 6Dy

Work done by E= y x D x 12 = 12Dy

Ratio of contribution of M : E in work

= 6Dy : 12Dy = 6 : 12 =1:2

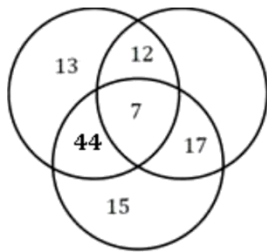**6.** The Venn diagram shows the preference of the student population for leisure activities.

From the data given, the number of students who like to read books or play sports is_____.

A. 44   B. 51

C. 79   D. 108

Ans. D

Sol.

The number of students who like to read books or play sports has been shown so we need to count every student who is associated with reading books or playing sports

= 13 + 12 + 44 + 7 + 15 + 17

= 108

7. Social science disciplines were in existence in an amorphous from until the colonial period when they were institutionalized. In varying degrees, they were intended to further the colonial interest. In the time of globalization and the economic rise of postcolonial countries like India, conventional ways of knowledge production have become obsolete. Which of the following can be logically inferred from the above statements?

i. Social science disciplines have become obsolete.

ii. Social science disciplines had a pre-colonial origin.

iii. Social science disciplines always promote colonialism.

iv. Social science must maintain disciplinary boundaries.

A. (ii) only   B. (i) and (iii) only

C. (ii) and (iv) only   D. (iii) and (iv) only

Ans. A

Sol. There is no mention that Social Science **always** promotes colonialism and must maintain disciplinary boundaries. Only mention that they were intended to advance colonial interests, not continually and necessarily, making statements (iii) and (iv) wrong. Therefore, options B, C and D are incorrect.

"existence in an amorphous form until the colonial period" means Social science has existed in various forms since the colonial period, indicating its pre-colonial origin, makes a statement (ii) is right. Therefore, option A is the correct option.

8. Two and a quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1:30. What is the actual current time shown by the clock?

A. 8:15   B. 11:15

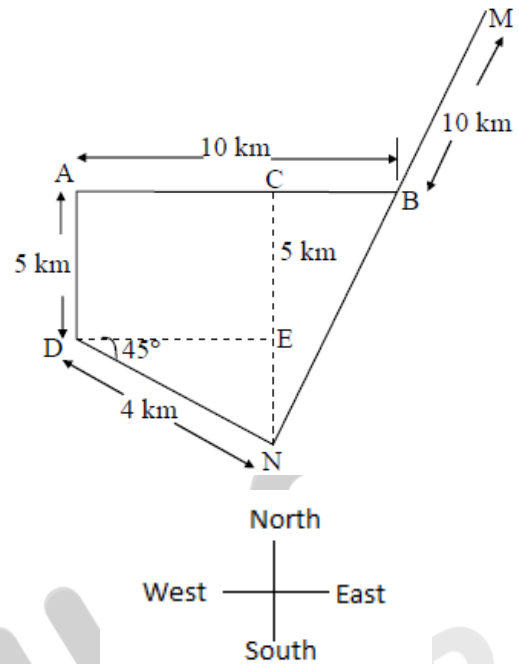C. 12:15   D. 12:45

Ans. D

Sol.
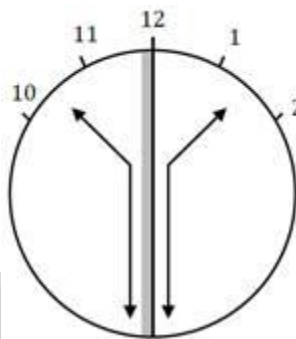
Mirror image of 1 : 30 is 10 : 30

10 : 30 was the time two and quarter hour back so time now will be 12 : 45

9. M and N start from the same location. M travels 10 km East and then 10 km North-East. N travels 5 km South and then 4 km South-East. What is the shortest distance (in km) between M and N at the end of their travel?

A. 18.60   B. 22.50

C. 20.61   D. 25.00

Ans. C

Sol.

A is the origin point

$\cos 45° = DE/DN$

$DE = \cos 45° \times 4$

$= 2.828$ km

$\sin 45° = EN/4$

$EN = \sin 45° \times 4 = 2.828$ km

$CN = NE + CE = 2.828 + 5$

$= 7.828$ km

$CB = AB - AC = 10 - 2.828$ (AC=DE)

$= 7.171$ km

$(NB)^2 = (NC)^2 + (BC)^2$

$= (7.828)^2 + (7.171)^2$

$NB = \sqrt{7.828^2 + 7.171^2} = 10.616$ km

So, distance between them = MN
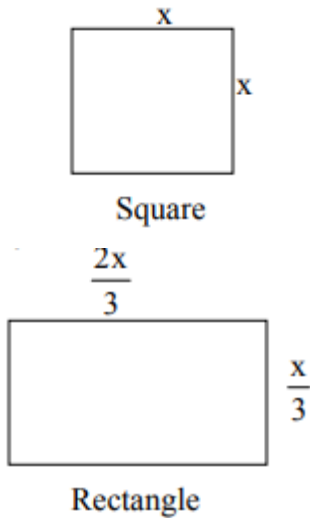
$= MB + NB$

$= 10.616 + 10 = 20.616$ km

10. A wire of length 340 mm is to be cut into two parts. One of the parts is to be made into a square and the other into a rectangle where sides are in the ratio of 1:2. What is the length of the side of the square (in mm) such that

the combined area of the square and the rectangle is a **MINIMUM**?

A. 30   B. 40

C. 120   D. 180

Ans. B

Sol. Length of the wire = 340 m

Square

Rectangle

Perimeter of rectangle $= 2\left[\dfrac{x}{3} + \dfrac{2x}{3}\right] = 2x$

Perimeter of square = 340 − 2x

Side of square $= \dfrac{340 - 2x}{4}$

Total area = Area of square + Area of rectangle

$= \left[\dfrac{340 - 2x}{4}\right]^2 + \dfrac{x}{3} \times \dfrac{2x}{3} = \left[\dfrac{340 - 2x}{4}\right]^2 + \dfrac{2x^2}{9}$

Combined area of square + rectangle = minimum

$f'(x) = 0$

$f(x) = \left[\dfrac{340 - 2x}{4}\right]^2 + \dfrac{2}{9}x^2$

$f'(x) = \dfrac{4}{9}x^2 - \dfrac{340 - 2x}{4} = 0$

$\dfrac{4}{9}x^2 = \dfrac{1}{4}[340 - 2x]$

Side of square $= \dfrac{340 - 2x}{4} = 40$ mm

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