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## IITH UGEE 2021 Question Paper PDF

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# UGEE 2021 MEMORY BASED PAPER

## UGEE 2021 Paper Pattern

PAPER	No. of Que	Time	Marking	Total Marks	Negative Marking
UGEE 2021	100	3 hr		150	
SUPR	50	1 hr	+1	50	-0
REAP	50	2 hr	+2	100	-0.5

TIME : 3 HRS

TOTAL MARKS : 150

**Q-1)** How many points are possible in the 3D plane that satisfy the given three statements?

- $x=2$
- $xi + yj + zk = 5$
- $y = mz + c$ , where  $m$  and  $c$  are constants

- 0
- 1
- 2
- 3
- None of the above

**Q-2)** A line is passing through two points in the x-y plane whose coordinates are given as (1,2) and (2,1). Find the angle of inclination the line makes with the positive direction of the x axis?

- $\frac{\pi}{4}$
- $\frac{3\pi}{4}$
- $\frac{7\pi}{4}$
- $\frac{9\pi}{4}$

e) None of the above

**Q-3)**  $\lim_{x \rightarrow \infty} \frac{x^2 + x - 1}{x^2 - 2x + 3}$  is equal to which of the following?

- 0
- $+\infty$
- $-\infty$
- 1

e) none of the above

**Q-4)** Which of the following given functions is not a one-one function? (where 'n' belongs to natural numbers 'N').

- $f(x) = (\sqrt{n}) (\sqrt{n})$
- $f(x) = n-1$
- $f(x) = 2^n$
- $f(x) = n^2$  where  $n$  is positive
- $f(x) = n-3$ , if 'n' is odd  
 $f(x) = 0$ , if 'n' is even

**Q-5)** If 'q' is a charge of magnitude  $10^{-6}$  C, which is placed at the origin (0,0), respectively. Find the potential difference between the points (3,0) and  $(\sqrt{3}, \sqrt{3})$  within the x-y plane due to the charge.

- 6
- 4.5
- 4
- 9
- None of the above

**Q-6)** A bag contains 17 balls of 4 different colours. There exists minimum of 2 balls of a particular colour in the bag. Bag contains maximum number of green balls and the number of balls of any two colours aren't the same. If we randomly pick 11 balls from the bag such that there should be at least two balls of the same colour and the remaining balls of another colour. Then the probability of having at least one green ball among those 11 balls picked from the bag is?

- 12
- 11



c) 10

d) 9

e) 8

**Q-7)** If in an isobaric process, no heat is supplied to the system then find the correct options regarding the process?

a)  $w = -p\Delta v$ ,  $\Delta U = nC_v dt$

b)  $w = -p\Delta v$ ,  $\Delta U = Q - p\Delta v$

c)  $w = p\Delta v$ ,  $\Delta U = 0$

d) Data Insufficient

e) None of the above

**Q-8)** Which of the following quantum numbers are possible?  $(n, l, m, s)$

a) 3, 4, 3,  $-1/2$

b) 3, 3, 2,  $+1/2$

c) 1, 0, 1,  $-1/2$

d) 3, 1, 0,  $+1/2$

e) None of the above

**Q-9)**  $f(x) = x^2$  for  $0 \leq x \leq 1$ ,

$f(x) = 1/x$  for  $x < 0$

$f(x) = 0$  for  $x > 1$

Then, which of the following is correct regarding  $f(x)$ ?

a)  $f(x)$  is differentiable at 0 and 1

b)  $f(x)$  is not differentiable at 0 and 1

c)  $f(x)$  is differentiable at 0 but not differentiable at 1

d)  $f(x)$  is not differentiable at 0 but differentiable at 1

e) Data Insufficient

**Q-10)** In a harmonic oscillator, in order to double the harmonic frequency, what should be the change in mass attached to the spring?

a) Mass should be reduced by 4 times

b) Mass should be reduced by 2 times

c) Mass should be reduced by 8 times

d) Mass should be reduced by 16 times

e) Mass should be reduced by 32 times

**Q-11)** A rectangular loop is placed in the magnetic field  $B = i - j$  and the four corners of the rectangular loop have the following coordinates: A = (5, 0, 0), B = (0, 5, 10), C = (5, 0, 10), D = (0, 0, 10). Then, find the total flux through the rectangular loop? (Where all lengths have been given in SI unit)

a) 25 Wb

b) 50 Wb

c)  $20\sqrt{2}$  Wb

d)  $10\sqrt{2}$  Wb

e) None of the above

**Q-12)** Calculate the mean free path for oxygen molecules at a temperature of  $27^\circ\text{C}$  and pressure  $1.01 \times 10^5$  Pa. Assume the molecular diameter as 0.3 nm and the gas are ideal. ( $K = 1.38 \times 10^{-23}$ ).

a) 102 nm

b) 104 nm

c) 98 nm

d) 106 nm

e) None of the above

**Q-13)** 2kg of water at  $80^\circ\text{C}$  is mixed with 8 kg water at  $20^\circ\text{C}$ . Half of the resultant solution is mixed with 15 kg water at  $36^\circ\text{C}$  and the other half is mixed with 15 kg water at  $24^\circ\text{C}$  and finally all the proportions are mixed together. Find the resultant temperature.

a) 50

b) 32

c) 38

d) 28

e) 30.5

**Q-14)**  $\Delta H < 0$ ,  $S < 0$  where H and S stand for enthalpy and entropy respectively, then will the reaction be spontaneous?

a.) spontaneous at low temperature

b) will never be spontaneous

c) spontaneous at high temperature

d) spontaneous at sufficiently low temperature

e) Data Insufficient

**Q-15)** A coin is tossed 5 times. Consider head and tail to be written in binary notation as 1 and 0 respectively. Find the probability of having binary 101.

a) 4/2187

b) 8/4374

c) 11/2187

d) 13/2187

e) 11/32

**Q-16)** A curve is given by the equation  $x = e^\theta \sin \theta$  and  $y = e^\theta \cos \theta$ . Find the length of the curve between  $\theta = 0$  and  $\theta = \pi/2$ ?

a) 25

b) 20

c) 15

d) 12

e) None of the above

**Q-17)** The equation of the line through the point (0,1,2) and perpendicular to the line  $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{-2}$  is:-

a)  $\frac{x}{3} = \frac{y-1}{4} = \frac{z-2}{-3}$

b)  $\frac{x}{-3} = \frac{y-1}{4} = \frac{z-2}{3}$

c)  $\frac{x}{3} = \frac{y-1}{-4} = \frac{z-2}{3}$

d)  $\frac{x}{3} = \frac{y-1}{4} = \frac{z-2}{3}$

e) None of the above

**Q-18)** If  $dy/dx = a(x/y)$  for  $x, y$  belonging to the set of real numbers. Then the given equation represents a hyperbola for which of the following conditions?

a) Any positive real value of  $a$

b) Any negative real value of  $a$

c) For  $a=0$

d) For all real values of  $a$

e) None of the above

**Q-20)** If two vectors along the edges of a parallelopiped are  $4i-j+7k$  and  $3i+2j+5k$  respectively then the expression of the third vector for which the volume of the parallelepiped is 0 will be?

a)  $i+9j+k$

b)  $5j+6k$

c)  $7k$

d)  $2i+3j+4k$

e) None of the above

**Q-22)** If the two vectors along the edges of the parallelopiped are  $16i+16j+8k$  and  $3i-4j+8k$ . if Area of parallelogram is given by  $A$ , then find the value of  $A/6$ ?

a)  $8\sqrt{2}$

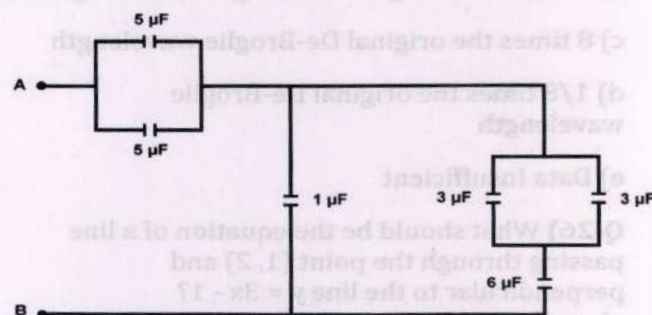
b)  $4\sqrt{2}$

c)  $3\sqrt{2}$

d)  $2\sqrt{2}$

e)  $\sqrt{1360}$

**Q-23)** Find the equivalent capacitance of the circuit.



a) 20/17

b) 1/3

c) 4/17

d) 20/7

e) None of the above



**Q-24)** CO, CN, NF, NO, N<sub>2</sub>. Which of the above species will stabilise?

i) after losing an e<sup>-</sup>?

- a) CN
- b) CO
- c) NF
- d) NO
- e) N<sub>2</sub>

ii) after gaining an e<sup>-</sup>?

- a) CN
- b) CO
- c) NF
- d) NO
- e) N<sub>2</sub>

**Q-25)** If the new kinetic energy is 16 times the original one, then find the new De-Broglie wavelength.

- a) 1/4 times the original De-Broglie wavelength
- b) 4 times the original De-Broglie wavelength
- c) 8 times the original De-Broglie wavelength
- d) 1/8 times the original De-Broglie wavelength
- e) Data Insufficient

**Q-26)** What should be the equation of a line passing through the point (1, 2) and perpendicular to the line y = 3x - 1?

- a) x+3y+7 = 0
- b) x+3y-7 = 0
- c) x+3y = 0
- d) x-3y = 0
- e) None of the above

**Q-27)** f(x)=cx<sup>2/3</sup>. If Rolle's theorem is applicable on f(x) in the interval [0,2]. Find C.

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4

**Q-28)** Evaluate  $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}}$

- a)  $\frac{\pi}{2}$
- b)  $\frac{\pi}{4}$
- c)  $\frac{\pi}{6}$
- d)  $\frac{\pi}{8}$

e) None of the above

**Q-29)** Find  $\int_0^1 \frac{x}{x^2+4x+3}$

- a)  $1\sqrt{2}$
- b)  $2\sqrt{2}$
- c)  $3\sqrt{2}$
- d) 4
- e) None of the above

**Q-30)** A Carnot engine working in the range of 400K to 800K gives an output power of 1200J. What is the power input?

- a) 300J
- b) 400J
- c) 500J
- d) 2400J
- e) 2800J

**Q-31)** Evaluate  $\lim_{x \rightarrow \infty} \frac{x^2-x-2}{x^2-4x+4} = ?$

- a) 0
- b) 1
- c) -1
- d) -∞

e) None of the above

**Q-32)** Two identical blocks of the same metal having the same mass are maintained at temperatures T<sub>1</sub> and T<sub>2</sub> respectively. They are brought in contact with each other and allowed to attain thermal equilibrium at constant pressure. The change in entropy, ΔS, for this process is:

- a)  $C_p \ln \left[ \frac{(T_1+T_2)^2}{4T_1T_2} \right]$
- b)  $C_p \ln \left[ \frac{(T_1+T_2)^2}{T_1T_2} \right]$

- c)  $C_p \ln \left[ \frac{(T_1+T_2)^4}{4T_1T_2} \right]$   
 d)  $C_p \ln \left[ \frac{(T_1+T_2)}{4T_1T_2} \right]$   
 e) None of the these

**Q-33)** Let P be any point on the curve  $x^{2/3} + y^{2/3} = a^{2/3}$ . Then, what would be the length of the segment of the tangent between the coordinate axes?

- a) a  
 b) 2a  
 c) 3a  
 d) 4a  
 e) 5a

**Q-34)**  $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ . Find the determinant value of  $(A^2 + I)(A + I)^{-1}$ ?

- a) 5  
 b) 6  
 c) 1  
 d) 9  
 e) None of the above

**Q-35)**  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O} \xrightarrow{\text{A}} \text{H}_3\text{BO}_3 \xrightarrow{\text{B}} \text{B}_2\text{O}_3$ . Find the reagents A and B respectively.

- a) A = HCl + heat, B = Heat  
 b) A = Heat, B = Heat  
 c) A = HCl, B = Heat  
 d) A = HCl + water, B = Heat  
 e) None of the above

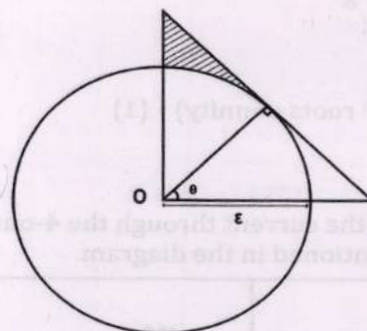
**Q-36)** Evaluate  $\lim_{x \rightarrow 0} \left( \frac{1+ax}{1-bx} \right)^{\frac{1}{x}}$ ?

- a)  $e^{a-b}$   
 b) 1  
 c) e  
 d)  $b - a$   
 e)  $e^{a+b}$

**Q-37)** Which of the following statements is correct regarding  $\text{N}_2^-$  &  $\text{N}_2^+$  ions?

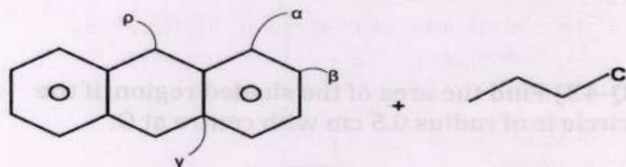
- a) Both have the same bond order  
 b) Both have the same bond length  
 c) Both are paramagnetic  
 d) Both are diamagnetic  
 e) Both have different Bond length

**Q-38)** Find the area of the shaded region if the radius of the circle is 1 cm.



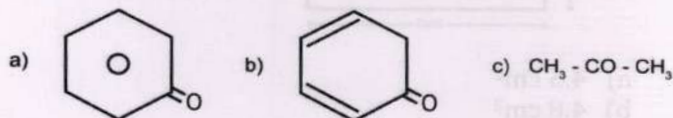
- a)  $1 \text{ cm}^2$   
 b)  $2 \text{ cm}^2$   
 c)  $4 \text{ cm}^2$   
 d)  $8 \text{ cm}^2$   
 e) None of the above

**Q-39)** Find the position on the Benzene derivative, where propane will get attached.



- a)  $\alpha$   
 b)  $\beta$   
 c)  $\gamma$   
 d)  $\delta$   
 e) Propane will not get attached

**Q-40)** Which of the following has the maximum enol content?



d)  $\text{CH}_3 - \text{CO} - \text{CH}_3 - \text{CO} - \text{CH}_3$

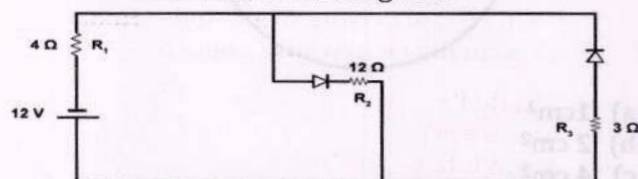
- a) A  
 b) B  
 c) C  
 d) D  
 e) None of the above



**Q-41)** Find the set S from the following options which contain the root of the polynomial  $1 + x + x^2 + x^3 + \dots + x^n$

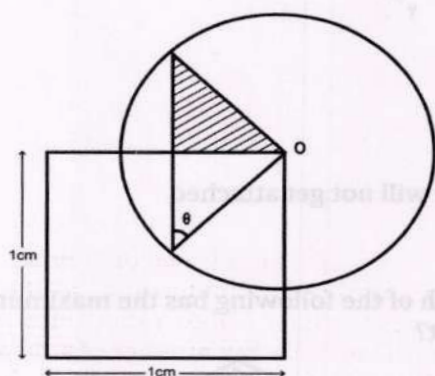
- a)  $\{0\}$
- b)  $\{0, 1, -1\}$
- c)  $\{0, n+1^{\text{th}} \text{ roots of unity}\} - \{1\}$
- d)  $\{0, 1\}$
- e) None

**Q-42)** Find the current through the 4-ohm resistor mentioned in the diagram.



- a) 12/7
- b) 2/7
- c) 3/7
- d) 4/7
- e) None of the above

**Q-43)** Find the area of the shaded region, if the circle is of radius 0.5 cm with centre at O.



- a)  $4.5 \text{ cm}^2$
- b)  $4.8 \text{ cm}^2$
- c)  $5.6 \text{ cm}^2$
- d)  $6.8 \text{ cm}^2$
- e) None of the above

**Q-44)** Two persons A and B mark three balls independently with number 1, 2 and 3 respectively. What is the probability that at least one of the balls is marked by the same number by both A and B?

- a)  $2/3$
- b)  $1/3$
- c)  $2/5$
- d)  $5/3$
- e) None of the above

**Q-45)** Eight ants are present at the eight corners of the cube. Each ant starts to move towards its adjacent corner. Find the probability such that no two ants collide with each other?

- a)  $4/2187$
- b)  $2/2187$
- c)  $8/729$
- d)  $9/4374$
- e)  $8/2187$

**Q-46)** If the reaction  $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$ ,  $\Delta H^\circ = -x \text{ kJ/mol}$ ,  $\Delta S^\circ = (-x + 72) \text{ kJ/mol}$ . Then what is the condition for the reaction to be spontaneous?

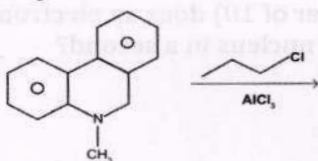
- a) Low temperature will be favourable for a spontaneous reaction
- b) High temperature will be favourable for a spontaneous reaction
- c) Low pressure will be favourable for a spontaneous reaction
- d) High Pressure will be favourable for a spontaneous reaction
- e) None of the above

**Q-47)** A resistor develops 500J of heat energy in 20 seconds when 1.5A current is passed through it. Now if the current is increased from 1.5 A to 3 A, what will be the heat energy developed in 20 seconds?

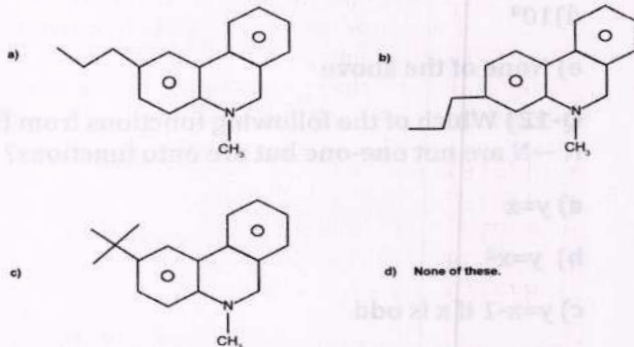
- a) 2000 J
- b) 3000J
- c) 300 J
- d) 4000 J
- e) None of the above

Q-48)

a)



What would be the major product in this reaction?



## REAP SECTION

(1-2) A factory produces two types of products X and Y. The price of the two products in the market are 7 and 4 Rupees respectively. There are two machine A and B. X requires 3 hours of both machines A and B, Y requires 2 hours of A and 1 hour of B. A and B can be used for 12 and 8 hours per day, respectively. Let the number of units of X that should be produced be  $\alpha$  and the number of units of Y that should be produced be  $\beta$ . Given that the owner needs to maximize his profit.

1. What is the value of  $\alpha$ ? \_\_\_\_\_.
2. What is the value of  $\beta$ ? \_\_\_\_\_.

Q-3) A factory produces a product which has a market value of Rupees 110. The production cost follows the function of  $x$  as  $f(x) = x^2 + 60x$ , where  $x$  is the number of units produced. Factories can produce a maximum of 30 units per day. How many units should be produced to maximize the profit?

- a) 20  
b) 30

c) 25

d) 27

e) None of the above

Q-4) A Sheriff is finding the Robin Hood in the neighbourhood of 3 houses. Mr. RED says he is in his House, Mrs. GREEN says he is not in her house, Mr. WHITE says Mr. RED is lying. If Mr. RED is lying then Mr. GREEN is also lying and if either of Mr. RED and Mr. GREEN is lying then Mr. WHITE is also lying. Then Robin Hood would actually be in whose house?

- a) Mr. Red's  
b) Mr. Green's  
c) Mr. White's  
d) Not in the neighbourhood  
e) Data Insufficient

Q-5) A person has taken a loan of 5 lakhs from a bank at an interest rate of 5%. He wants to invest the money in 2 companies A and B, where A gives him 12% interest rate, while B gives him 8% interest rate but B is more stable than A. How much should he invest in A to get a profit of 25,000 with minimum risk?

- a) 2 lakh  
b) 3 lakh  
c) 2.3 lakh  
d) 2.5 lakh  
e) 2.75 lakh

Q-6) There is a particular breed of animals which is affected with a unique disease. If it is brought near and kept within a shed with remaining 20 animals, the number of animals affected due to the disease is equal to product of number of animals before being affected and number of animals that got affected respectively. Find a relationship for number of animals being affected (as a function of time  $t$ ) after time " $t$ ".

- a)  $y = 20(1 + ae^{-bt})$   
b)  $y = 20/ae^{-bt}$   
c)  $y = 20/1 + ae^{-bt}$   
d)  $y = 20(1 - ae^{-bt})$   
e) None of the above



**Q-7)** A Professor says that an instrument has 3 nozzles. One nozzle inputs nitrogen, another one gives out cold nitrogen, another one gives out hot nitrogen. Is the above-mentioned setup thermodynamically possible? If yes, then which of the following options correctly states the reason:

**Q-8)** Find the missing term in the series

20, 86, 27, 72, 48, \_\_\_\_, 83

a) 60

b) 64

c) 66

d) 72

e) 44

**Q-9)** Find the missing term in the series:

3, 8, 15, 26, \_\_\_\_, 80, 147

a) 45

b) 38

c) 54

d) 68

e) None of the above

**Q-10)** There are 3 friends Ari, Biju and Charu. They go to three different colleges namely 'A', 'B' and 'C'. A college can provide courses in Electronics, Computer Science or Mechanical Engineering. No two of the friends can have the same course. Ari can't study in 'A' and Biju can't study in 'B'. The friend studying in 'B' is doing electronics. Friend in 'A' cannot do Computer Science. Biju is not doing Mechanical Engineering. Where is C and what is she doing?

a) At A, doing Mechanical

b) At A, doing Electronics

c) At B, doing Mechanical

d) At C, doing Computer science

e) At C, doing Electronics

**Q-11)** In a hydrogen atom, approximately, how many times (in order of 10) does an electron revolve around the nucleus in a second?

a) 1

b) 1000

c)  $10^{17}$

d)  $10^9$

e) None of the above

**Q-12)** Which of the following functions from  $N \rightarrow N$  are not one-one but are onto functions?

a)  $y=x$

b)  $y=x^2$

c)  $y=x-1$  if  $x$  is odd

$y=x+1$ , if  $x$  is even

d)  $y = [\sqrt{x}]$ , where  $[.]$  is the greatest integer less than or equal to  $\text{root}(x)$

e) None of the above

**(Q13- 14)** In some code the word EXAM is written as OVSG and TEST is written as ZOAZ then, answer the following three questions:

**13.** The word ANSWER is written in that code as: \_\_\_\_\_

**14.** SFAWOB Which two letters are coded the same as itself? \_\_\_\_ & \_\_\_\_

**15.** The code JSDSF symbolises which word? \_\_\_\_\_

**Q-16)** If two men took one card each (i.e., both of them together took 2 cards) from a deck of 52 cards. After they took the cards and saw it, they replaced and reshuffled the cards. Then, the two repeated the same process again. Find the probability of getting a different card the second time which is not the same as the first time for each individual?

a)  $5/12$

b)  $1/2$

c)  $3/4$



d)  $2/3$

e) None of the above

**Q-17)** If the spin magnetic quantum number  $m = +1/2, -1/2$  and  $0$ , then what are the atomic numbers of the first three noble gases?

- a) 3, 15, 27
- b) 4, 16, 27
- c) 3, 15, 36
- d) 4, 15, 27
- e) None of the above

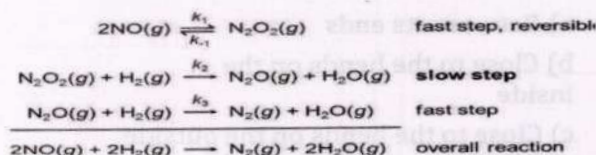
**Q-18)** If the length of two equal arcs of a circle is  $L$  such that  $\pi r \leq L \leq 3\pi r$ . If the angle between the lines joining the midpoint of curve and the centre of the circle is  $\theta$ . Then find the probability that the union of two arcs form a complete circle?

- a)  $L/2\pi R$
- b)  $L/\pi R$
- c)  $1 - L/\pi R$
- d)  $L/2\pi R - 1$
- e)  $\pi R^2/L$

**Q-19)** Which energy level of single ionised carbon atom has the same energy as that of the ground state energy of a hydrogen atom?

- a) 2
- b) 3
- c) 4
- d) No such energy level
- e) None of the above

**Q-20)** A Chemical reaction takes place through different steps out of which some are slow and some are fast. Which of the following options are correct?



- a) Rate of reaction is proportional to  $K_1[\text{NO}]^2$
- b)  $\text{rate} = K [\text{N}_2\text{O}_2] [\text{H}_2]$

c) rate of reaction depends only on the fast steps of the reaction

d) all of the above

e) Data Insufficient

**Q-21)** Things made by metals are stronger than rocks. The following theories have been proposed to justify the statement. Which of them is most appropriate?

- a) bonds in metals are stronger than in stones
- b) atoms in metals are stronger than atoms in rocks
- c) in metals the atoms are closely packed and the force is exerted by the surrounding atoms so it will be stronger than stone
- d) the creator wants the metals to be strong
- e) None of the above

**Q-22)** In a college there are "m" students and "n" courses and 'P' is a matrix of order  $m \times n$  respectively and  $P_{ij}$  represents that student 'i' takes course 'j' in the college. Then what does the expression,  $(P^T \times P)_{kl}$  represent? (Where  $T$ =transpose and  $kl$  is same as  $ij$  in  $P_{ij}$ )

- a) 'k' is the student whereas 'l' is not the student in the college
- b) 'k' and 'l' are the courses in the college
- c) either 'k' or 'l' are the students of the college
- d) 'l' is a student of the college and 'k' is a course in the college
- e) 'l' is a course in the college whereas 'k' is not the student of the college

**Q-23)** There are three people A, B and C playing cricket. Among them there is a captain, a wicket keeper and an all-rounder. If A is not the wicket keeper, B is not an all-rounder and then C is an all-rounder, given that only one of the statements is correct. Then which of the following options is correct?

- a) A-captain, B-wicket keeper, C-allrounder
- b) A-captain, B-allrounder, C-Wicket Keeper



- c) A-allrounder, B-wicket Keeper, C-allrounder  
d) A-wicket keeper, B-captain, C-allrounder  
e) Data Insufficient

**Q-24)** Find  $P(X>1)$  for  $P[x=k] = e^{-\alpha} \left(\frac{\alpha^k}{k!}\right)$  where  $P(x)$  stands for the probability of event  $x$ ?

- a) 0.5  
b) 0.3  
c) 0.2  
d) 0.1  
e) None of the above

**Q-25)** In the acidic form, an acid-base indicator with ( $K_{in}$  of  $3 \times 10^5$ ) can be in red and blue colour in their different states. By how much must the pH change, in order to change the indicator from 90% of one colour to the other colour?

- a) 10  
b) 1.92  
c) 8  
d) 6  
e) 5

**Q-26)** A rectangular wall has to be painted from  $x=0$  to  $x=100$ . Height( $h$ ) of the wall as the function of  $x$  is given as  $x=ae^{-bx}$  and  $h$  is given in terms of  $x$ . Painting per unit of wall costs 20 Rupees. Find the area covered with a budget of 1 lakh Rupees?

- a)  $10ae^{-ab}$   
b)  $20ae^{-ab}$   
c)  $25ae^{-ab}$   
d)  $45ae^{-ab}$   
e) None of the above

**(27-28)** Two atoms are brought close to each other from infinity and at first, they attract each other till  $r = r_0$  with a force proportional to  $r^m$  and after coming closer they start

repelling each other with a force proportional to  $r^n$ . Answer the questions which follow.

**27.** What should be the relation between  $m$  and  $n$ ?

- a)  $m=n$   
b)  $m>n$   
c)  $m<n$   
d)  $m = 2n$   
e) None of the above

**28.** What should be the nature of charges?

- a) One atom is positively charged whereas the other one is negatively charged  
b) Both the atoms are positively charged  
c) Both the atoms are negatively charged  
d) Data Insufficient  
e) None of the above

**Q-29)** When two atoms A and B, initially at  $r \gg r_0$ , come closer to each other till  $r=r_0$ , where  $r_0$  is the equilibrium position of the internuclear distance where the attractive force is equal to repulsive force. Then, at the equilibrium position the potential energy will be?

- a) Minimum  
b) Maximum  
c) Remains Constant  
d) None of the Above  
e) Data Insufficient

**Q-30)** The strength of the magnetic field of a horseshoe magnet is maximum at which of the following positions?

- a) Between its ends  
b) Close to the bends on the inside  
c) Close to the bends on the outside  
d) Along the sides of the magnet  
e) Everywhere the strength is the same

**Q-31)** The wings of Boeing 787 plane are slightly raised from the horizontal level. There are four forces acting on the aeroplane which include the drag force, lift force, buoyant force and the gravitational force. One of these forces might be the reason behind the tilt in the wings of the plane. Which of the following options gives the best explanation for this?

- a) to reduce the drag force
- b) to provide more thrust force
- c) it is just a random idea of the company to make planes like this
- d) All of the above
- e) Lift Force

**Q-32)** There are 5 holes on a wall and a total of 17 pigeons have to be kept in them. Which of the following options(choices) are correct and can be the best suitable arrangement?

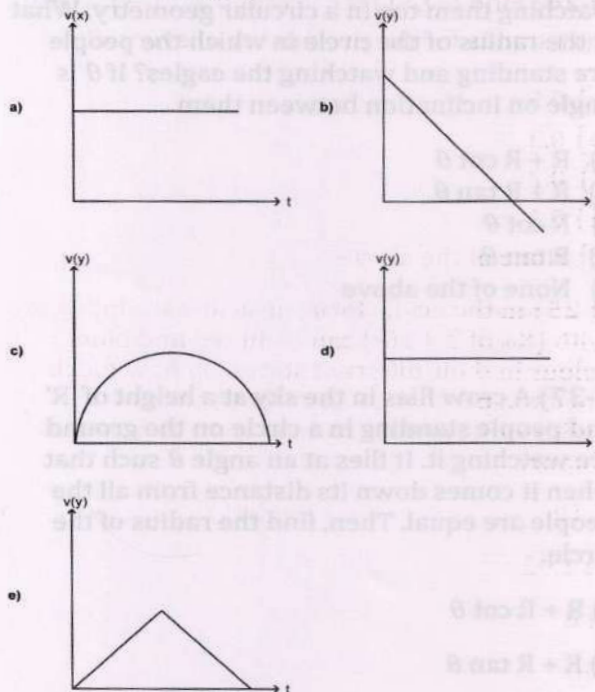
- a) Every filled/occupied hole has a minimum of 3 pigeons
- b) Every filled /occupied hole has at least 2 pigeons but not more than 4 pigeons
- c) Every filled/occupied hole has not less than 2 pigeons
- d) All of the above
- e) The filled/occupied holes have not less than 4 pigeons

**Q-33)** Find the missing term in the following series.

20, 86, 27, 72, 48, \_\_, 83

- a) 56
- b) 46
- d) 44
- e) 68
- f) None of the above

**Q-34)** A body is projected at some angle  $\theta$  with the positive direction of the x axis. Find the variation of velocity along the x axis as  $V(x)$  and velocity variation along the y axis as  $V(y)$  with respect to time, respectively, from the following given graphs?



- a) A & D
- b) B & C
- c) C & D
- d) D & E
- e) A & B

**Q-35) Statement 1** - Cow dung is the divine source of life. It gives birth to flies.

**Statement 2** - The flies lay eggs in the cow dung. The conditions present in the dung are favourable for their growth.

Which of the following most accurately allows one to come to a certain conclusion in the light of the above statements?

- a) Read a book regarding traditional belief on Cow dung.
- b) Perform a religious ritual around the Cow dung.
- c) Derive a mathematical equation on the number of flies coming out of the cow dung.
- d) Visit a scientist and ask him about this.



- e) Visit the cow dung regularly and count the number of flies around it.

**Q-36)** A group of eagles are moving in a circle of radius  $R$  at a height  $R$  from the surface of the Earth. Also, a group of men are standing and watching them too in a circular geometry. What is the radius of the circle in which the people are standing and watching the eagles? If  $\theta$  is angle on inclination between them

- a)  $R + R \cot \theta$
- b)  $R + R \tan \theta$
- c)  $R \cot \theta$
- d)  $R \tan \theta$
- e) None of the above

**Q-37)** A crow flies in the sky at a height of ' $R$ ' and people standing in a circle on the ground are watching it. It flies at an angle  $\theta$  such that when it comes down its distance from all the people are equal. Then, find the radius of the circle.

- a)  $R + R \cot \theta$
- b)  $R + R \tan \theta$
- c)  $R \cot \theta$
- d)  $R \tan \theta$
- e) None of the above

**Q-38)** When a hydrogen gas containing balloon is released from rest, it goes upward. But when a solid ball is released, it goes downward. What could be the best possible explanation for this phenomenon?

- a) Hydrogen containing balloon rolls and topples in the air while the solid ball doesn't
- b) Density of the material of the ball is more than the density of the material of the balloon
- c) Net force on the balloon is in the upward direction whereas on the solid ball it is in the downward direction
- d) This fact is not true
- e) None of the above is suitable

**Q-39)** It is a well-known fact that the growth in living beings stop after a certain age. What could be the best possible explanation for the above-mentioned phenomenon?

- a) In old age people don't eat food properly and therefore don't get sufficient nutrition for further growth
- b) The body is built naturally such that release of growth hormones and chemicals decrease after a certain age
- c) Old age people's mind is involved in other necessary activities and therefore it stops releasing growth hormone
- d) Old age people lose control over their mind
- e) None of the above is a suitable option

**Q-40)** **Statement 1** - Cu has larger size than K

**Statement 2** - Although both have outer similar electronic configuration as  $4s^1$  but Cu has fully filled 3d orbital which is not available in the case of K

- a) Both the statements are correct
- b) Both the statements are incorrect
- c) Statement 1 is correct but statement 2 is incorrect
- d) Statement 2 is correct whereas Statement 1 is incorrect
- e) None of the above

**Q-41.)** The value of  $M$  is given as unity. Take the value of  $i$  as 2 for the given question. Two vectors are represented as :

$$X = mi + (M-i)j + (2m-1)k$$

$$Y = i + 2(m-1)j + (M-i)k$$

$Z$  represents the magnitude of  $(X \times Y)$ . When the value of  $Z$  is divided by  $(M/m)$  {as given in the diagram below} then, the result comes out to be unity.

Find the value of  $m$  using the above information.

m	(M - i)	(2m - 1)
i	2(m - 1)	M - i

$$\left(\frac{M}{m}\right)$$

**Q42.)** Read the passage given below and answer the questions that follow.

A group of people went on a safari with a guide. The guide told the tourists that they can take the tour of the whole park along the roads but they must avoid the wild monkeys as they may harm them. He also told them that on every turn, where the roads divide into two/ three directions, there are sign boards placed with some message and exactly one of the signboards contains the wrong message. Tourists need to identify the correct path with the help of the signboards only, which of the following would be a safer route?

- i)
- ii)
- iii)

Three subparts of the question were present with different statements and the answer could be found out by using the simple method of contradiction.

[43 - 49] There are two columns given below. Column-1: contains Persian Words/Statements

Column-2: contains their respective English translations (meaning). Based on the given column

Answer the questions which follow.

Persian	English
• Xaridam	→ I Bought
• Xaridi	→ You (Singular) Bought
• Xarid	→ He Bought
• Naxaridam	→ I did not Buy
• Namixaridand	→ They were not Buying
• Naxaridim	→ We did not Buy
• Mixarid	→ (he) Was Buying
• Mixaridid	→ You (plural) were Buying

Also, "Xaridan" means "To Buy" and "Chesidan" means "to taste"

#### Questions:

43. The Suffix in Persian for I is \_\_\_\_\_.

44. The Suffix in Persian for They is \_\_\_\_\_.

45. Translate into Persian "You (Plural) were not Buying" \_\_\_\_\_.

46. Translate into Persian "You (Singular) did not taste" \_\_\_\_\_.

47. Translate into Persian "You (Plural) were not tasting" \_\_\_\_\_.

48. Translate into Persian "We were tasting" \_\_\_\_\_.

49. Translate into Persian "I did not taste" \_\_\_\_\_.



# IIITPREP UGEE 2021 PAPER ANSWER KEY

## Answers of UGEE 2021 SUPR

1	C	11	A	21	-	31	B	41	C
2	B	12	A	22	E	32	A	42	A
3	D	13	E	23	D	33	A	43	E
4	E	14	A	24	D, A	34	C	44	A
5	E	15	E	25	A	35	D	45	B
6	-	16	Faulty question	26	B	36	E	46	A
7	C	17	B	27	A	37	A	47	A
8	D	18	A	28	B	38	E	48	A
9	B	19	-	29	E	39	A		
10	A	20	E	30	E	40	B		

## Answers of UGEE 2021 REAP

1	1	11	C	21	C	31	E	41	Self
2	4	12	B	22	B	32	B	42	-
3	C	13	SFAWOB	23	B	33	D	43	Am
4	D	14	W & J	24	E	34	E	44	And
5	D	15	Japan	25	B	35	C	45	Namixaridid
6	-	16	-	26	Sol	36	Insufficient data	46	Nachesidi
7	-	17	C	27	A	37	-	47	Namicesidid
8	E	18		28	E	38	C	48	Michesidim
9	A	19	A	29	A	39	B	49	Nachesidam
10	A	20	A	30	A	40	D		

1) Correct Answer → (C) 2

Given:  $x = 2$  and  $y = mz + c$

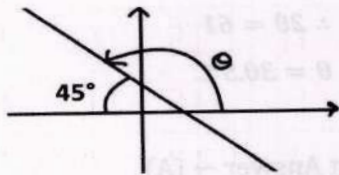
$$\therefore |2i + (mz + c)j + zk| = 5$$

$$2^2 + (mz + c)^2 + z^2 = 5^2$$

The above quadratic would yield two unique values of "z" and hence "y".

2) Correct Answer → (B)  $3\pi/4$

$$\text{Slope, } m = \frac{2-1}{1-2} = -1$$



$$\text{Inclination} = \theta = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$$

3) Correct Answer → (D) 1

$$\lim_{x \rightarrow \infty} \frac{x^2 + x - 1}{x^2 - 2x + 3}$$

On applying L-Hospital Rule,

$$\lim_{x \rightarrow \infty} \frac{2x+1}{2x-2} = \frac{2x+1}{2(x-1)}$$

On dividing by x and enforcing the limit

$$x \rightarrow \infty,$$

We get,

$$\lim_{x \rightarrow \infty} \frac{2+y_x}{2(1-y_x)} = \frac{2}{2} = 1$$

4) Correct Answer → (E)

In option (E)

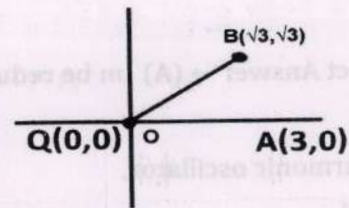
$$\text{If } n = 3 \text{ then } F(x) = 0$$

$$\text{And } n \in \text{any even number, then also } F(x) = 0$$

Therefore, it is not a one-one function.

{Remove "but an onto function" from the question}

5) Correct Answer → (E) None of the above



$$OA = 3$$

$$OB = \sqrt{6}$$

$$V_A = \frac{9 \times 10^9 \times 10^{-6}}{3} = 3 \times 10^3 \text{ V}$$

$$V_B = \frac{9 \times 10^9 \times 10^{-6}}{\sqrt{6}} = \frac{9}{\sqrt{6}} \times 10^3 \text{ V}$$

$$V_A - V_B = 10^3 \left\{ 3 - \frac{3\sqrt{6}}{2} \right\} \text{ V}$$

6) Correct Answer → In UGEE SUPR Guide  
Revise Important Section from SUPR also

7) Correct Answer → (B)

Since, Isobaric process implies  $P = \text{Constant}$

$$\text{Given, } \Delta H = Q_p = 0$$

$$\text{As, } nC_p \Delta T = 0$$

$$\text{So, } \Delta T = 0 \text{ and } \Delta U = 0 \text{ \& } \Delta W = p \Delta V$$

so, Ans (C)

8) Correct Answer → (D)  $+3, 1, 0, +1/2$

$$\text{If } n = 3, l \text{ can be } 0, 1, 2.$$

$$\text{If } l = 1, m \text{ can be } -1, 0, 1.$$

$$\text{And } s \text{ can be either } +1/2 \text{ or } -1/2.$$

9) Correct Answer → (B)

$$F'(x) = 2x \quad 0 \leq x \leq 1$$

$$F'(x) = -\frac{1}{x^2} \quad x < 0$$

$$F'(x) = 0 \quad x > 1$$

$$F'(0^+) = 0, \quad F'(0^-) = -\infty,$$

$$F'(0) = 0$$

$$F'(1^+) = 0, \quad F'(1^-) = 2,$$

$$F'(1) = 2$$



$\therefore F(x)$  is not differentiable at 0 and 1.

**10) Correct Answer  $\rightarrow$  (A)**  $m$  be reduced by 4 times.

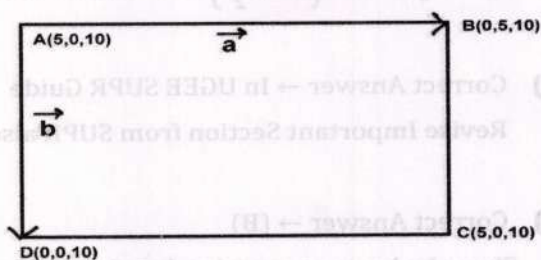
In a harmonic oscillator,

$$\delta \propto \frac{1}{\sqrt{m}}$$

If  $F \rightarrow 2F$

Then  $m \rightarrow m/4$

**11) Correct Answer  $\rightarrow$  (A)**



$$\text{Area} = \vec{a} \times \vec{b} = (-5\hat{i} + 5\hat{j} + 10\hat{k}) \times (-5\hat{i} + 10\hat{k})$$

$$25 \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 1 & 2 \\ -1 & 0 & 2 \end{vmatrix}$$

$$= 25 \times \{ \hat{i}(2-0) - \hat{j}(-2+2) + \hat{k}(0+1) \}$$

$$= 50\hat{i} + 25\hat{k}$$

$$\phi = \vec{B} \cdot \vec{A} = (\hat{i} - \hat{j}) \cdot (50\hat{i} + 50\hat{k}) = 25 \text{ Wb}$$

**12) Correct Answer  $\rightarrow$  (A)** 102nm

$$T = 300\text{K}$$

$$p = 1.01 \times 10^5 \text{ Pa}$$

$$d = 0.3\text{nm} = 0.3 \times 10^{-9}\text{m}$$

$$\lambda = \frac{1}{M_0^2 \sqrt{2N^*}}, \quad N^* = \frac{N}{V} = \frac{P}{KT}$$

$$\lambda = \frac{KT}{M_0^2 \sqrt{2P}} =$$

$$\frac{(1.38 \times 10^{-23})(300) \times 10^9}{(3.14)(0.3 \times 10^{-9})^2 (1.414)(1.01 \times 10^5)} \text{ nm}$$

$$\therefore \lambda = 102 \text{ nm}$$

**13) Correct Answer  $\rightarrow$  (E)** 30.5°C

$$\text{i) } 2 \times c \times (80 - \theta) = 8 \times c \times (\theta - 20) \Rightarrow \theta_1 = 32^\circ\text{C}$$

$$\text{ii) } 5 \times c \times (\theta - 32) = 15 \times c \times (36 - \theta) \Rightarrow \theta_2 = 35^\circ\text{C}$$

$$\text{iii) } 5 \times c \times (32 - \theta) = 15 \times c \times (\theta - 24) \Rightarrow \theta_3 = 26^\circ\text{C}$$

$$\text{iv) } 20 \times c \times (35 - \theta) = 20 \times c \times (\theta - 26)$$

$$\therefore 2\theta = 61$$

$$\theta = 30.5^\circ\text{C}$$

**14) Correct Answer  $\rightarrow$  (A)**

$$\Delta G = \Delta H - T \Delta S$$

For a spontaneous reaction,

$$\Delta G < 0$$

$$\Delta H - T \Delta S < 0$$

Given:  $\Delta H < 0$  and  $\Delta S < 0$

$$\therefore \Delta H - T \Delta S > 0$$

$$\Delta H > T \Delta S$$

$$T < \left| \frac{\Delta H}{\Delta S} \right|$$

It will be spontaneous at low temperature.

**15) Correct Answer  $\rightarrow$  (E)**  $\frac{11}{32}$

The cases can be as follows:

(10100), (10111), (10101), (10110), (01010),

(11011), (01011), (11010), (00101), (11101),

(01101)

$$P = \left( \frac{1}{2} \right)^5 \times 11 = \frac{11}{32}$$

**16) Correct Answer  $\rightarrow$  {FAULTY QUESTION}**

### Revise Complete Graph Question from

#### SUPR Section Book

$$x = e^{\theta} \sin(\sin \theta)$$

$$y = e^{\theta} \cos(\cos \theta)$$

$$\frac{dx}{d\theta} = e^{\theta} \sin(\sin \theta) + e^{\theta} \cos(\sin \theta) \cos \theta$$

$$\frac{dy}{d\theta} = e^{\theta} \cos(\cos \theta) + e^{\theta} \sin(\cos \theta) \sin \theta$$

$$\therefore \frac{dy}{dx} = \frac{\cos(\cos \theta) + \sin(\cos \theta) \cdot \sin \theta}{\sin(\sin \theta) + \cos(\sin \theta) \cos \theta}$$

$$l = \int_0^{N_2} \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

17) Correct Answer → (B)

Let a point on line be P:  $(2\lambda + 1, 3\lambda - 1, 1 - 2\lambda)$

Let  $(0, 1, 2)$  be A &  $A_p$  Perpendicular Line

$$\therefore [(2\lambda + 1)\hat{i} + (3\lambda - 2)\hat{j} + (-2\lambda - 1)\hat{k}] \cdot (2\hat{i} + 3\hat{j} - 2\hat{k}) = 6$$

$$\therefore 4\lambda + 2 + 9\lambda - 6 + 4\lambda + 2 = 0 \text{ so, } \lambda = 2/17$$

$$\therefore \text{Equation of Line} \Rightarrow \frac{x-0}{-3} = \frac{y-1}{4} = \frac{z-2}{3}$$

18) Correct Answer → (A)

$$\int y dy = \int ax dx$$

$$\frac{y^2}{2} = \frac{ax^2}{2} + c$$

$$y^2 - ax^2 = c$$

This will represent a hyperbola for any positive real value of "a".

19)

20) Correct Answer → (E) None of the above.

STP i.e., the scalar triple product of the three vectors should be zero.

Let the third vector be,

$$x\hat{i} + y\hat{j} + z\hat{k}$$

$$\begin{vmatrix} 4 & -1 & 7 \\ 3 & 2 & 5 \\ x & y & z \end{vmatrix} = 0$$

On putting different values, none of them satisfy. Thus, (E)

21)

22) Correct Answer → (E)  $\sqrt{1360}$

$$\vec{A} = 8(2\hat{i} + 2\hat{j} + \hat{k})$$

$$\vec{B} = 3\hat{i} - 4\hat{j} + 8\hat{k}$$

$$\text{Area} = |\vec{A} \times \vec{B}|$$

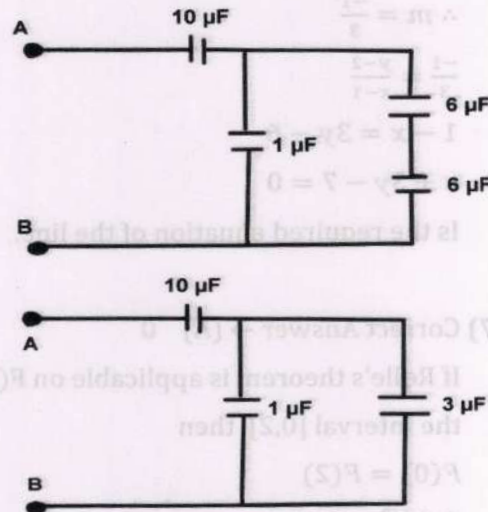
$$\therefore \text{Area} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 16 & 16 & 8 \\ 3 & -4 & 8 \end{vmatrix}$$

$$\text{Area} = \hat{i}(160) - \hat{j}(104) + \hat{k}(-112) = A$$

$$\text{Required area} = A/6 = \sqrt{1360}$$

23) Correct Answer → (D)

20/7



$$= C_{eq} = \frac{10 \times 4}{14} = 20/7 \mu F$$

24) Correct Answer → i) (D) ii) (A)

Bond order: -

CO(3), CN (2.5), NF (2), NO (2.5), N<sub>2</sub>(3)



- i) After losing an  $e^-$ , NO will stabilize as bond order will increase from 2.5  $\rightarrow$  3.
- ii) After gaining an  $e^-$ , CN will stabilize as bond order will increase from 2.5  $\rightarrow$  3

25) Correct Answer  $\rightarrow$  (A)  $1/4$  times

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mKE}}$$

$$\therefore \lambda \propto \frac{1}{\sqrt{KE}}$$

$$KE \rightarrow 16 KE$$

$$\lambda \rightarrow \lambda/4$$

26) Correct Answer  $\rightarrow$  (B)  $x + 3y - 7$

$$y = 3x - 1, \quad \text{Slope} = 3$$

For the given line, let the slope = m

$$m \cdot 3 = -1$$

$$\therefore m = \frac{-1}{3}$$

$$\frac{-1}{3} = \frac{y-2}{x-1}$$

$$1 - x = 3y - 6$$

$$x + 3y - 7 = 0$$

Is the required equation of the line.

27) Correct Answer  $\rightarrow$  (A) 0

If Rolle's theorem is applicable on  $F(x)$  in the interval  $[0, 2]$ , then

$$F(0) = F(2)$$

$$C \cdot 2^{2/3} = 0$$

$$\therefore C = 0$$

28) Correct Answer  $\rightarrow$  (B)  $n/4$

$$I = \int_0^{n/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx \quad \text{----- (i)}$$

$$I = \int_0^{n/2} \frac{\sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx \quad \text{----- (ii)}$$

$$\left\{ \int_0^a \delta(x) dx = \int_0^a \delta(a-x) dx \right.$$

On adding (i) and (ii),

$$2I = \int_0^{n/2} \frac{\sqrt{\sin x} + \sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx = \int_0^{n/2} dx$$

$$2I = \frac{n}{2}$$

$$\therefore I = n/4$$

29) Correct Answer  $\rightarrow$  (E) None of the above.

$$I = \int_0^1 \frac{x}{x^2+4x+3} dx = \int_0^1 \frac{x}{x^2+3x+x+3} dx$$

$$I = \int_0^1 \frac{x+1-1}{(x+1)(x+3)} dx = \int_0^1 \frac{dx}{x+3} - \int_0^1 \frac{dx}{(x+1)(x+3)}$$

$$I = \int_0^1 \frac{dx}{x+3} - \frac{1}{2} \int_0^1 \frac{(x+3)-(x+1)}{(x+1)(x+3)} dx$$

$$I = \int_0^1 \frac{dx}{x+3} - \frac{1}{2} \int_0^1 \frac{dx}{x+1} + \frac{1}{2} \int_0^1 \frac{dx}{x+3}$$

$$I = \frac{3}{2} \int_0^1 \frac{dx}{x+3} - \frac{1}{2} \int_0^1 \frac{dx}{x+1}$$

$$I = \frac{3}{2} \ln|x+3| \Big|_0^1 - \frac{1}{2} \ln|x+1| \Big|_0^1$$

$$I = \frac{3}{2} \{\ln 4 - \ln 3\} - \frac{1}{2} \ln\{2\}$$

$$I = \frac{3}{2} \cdot 2 \cdot \ln 2 - \frac{3}{2} \ln 3 - \frac{1}{2} \ln 2$$

$$I = \frac{5}{2} \ln 2 - \frac{3}{2} \ln 3$$

30) Correct Answer  $\rightarrow$  (E) 2400 J

$$\eta = 1 - \frac{T_2}{T_1} = \frac{\text{output}}{\text{input}}$$

$$\eta = 1 - \frac{400}{800} = \frac{1}{2}$$

$$\therefore \text{Input} = 2 \times 1200 = 2400 \text{ J}$$

31) Correct Answer  $\rightarrow$  (B) 1

$$\lim_{x \rightarrow \infty} \frac{x^2-2x+x-2}{x^2-2x-2x+4} = \frac{x(x-2)+1(x-2)}{x(x-2)-2(x-2)}$$

$$\lim_{x \rightarrow \infty} \frac{(x+1)(x-2)}{(x-2)(x-2)} = \frac{x+1}{x-2}$$

$$\lim_{x \rightarrow \infty} \frac{1+\frac{1}{x}}{1-\frac{2}{x}} = 1$$

32) Correct Answer → (A)

$$mc(T_F - T_1) = mc(T_2 - T_F)$$

$$2T_F = T_1 + T_2$$

$$\therefore T_F = \frac{T_1 + T_2}{2}$$

Where " $T_F$ " is the final temperature attained.

$$\Delta S = Cp \ln \left( \frac{T_F}{T_1} \right) + cp \ln \left( \frac{T_F}{T_2} \right)$$

$$\Delta S = Cp \ln \left( \frac{T_F^2}{T_1 T_2} \right) = Cp \ln \left\{ \frac{(T_1 + T_2)^2}{4 T_1 T_2} \right\}$$

33) Correct Answer → (A)  $a$

$$x^{2/3} + y^{2/3} = a^{2/3}$$

The length of the tangent intercepted between the co-ordinate axes is " $a$ ".

{Standard result}

34) Correct Answer → (C) 1

$$A^2 = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 10 & 4 & 1 \end{bmatrix}$$

$$A^2 + I = \begin{bmatrix} 2 & 0 & 0 \\ 4 & 2 & 0 \\ 10 & 4 & 2 \end{bmatrix}, A + I = \begin{bmatrix} 2 & 0 & 0 \\ 2 & 2 & 0 \\ 3 & 2 & 2 \end{bmatrix}$$

$$(A + I)^{-1} = \frac{1}{8} \begin{bmatrix} 4 & 0 & 0 \\ 4 & 4 & 0 \\ -2 & -4 & 4 \end{bmatrix} \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 \\ -\frac{1}{4} & -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

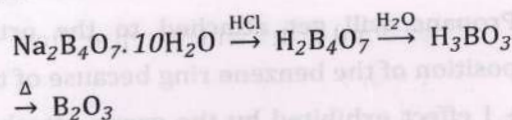
$$(A^2 + I) \cdot (A + I)^{-1} =$$

$$\begin{bmatrix} 2 & 0 & 0 \\ 4 & 2 & 0 \\ 10 & 4 & 2 \end{bmatrix} \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 \\ -\frac{1}{4} & -\frac{1}{2} & \frac{1}{2} \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

B

$$B = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 13/2 & 1 & 1 \end{bmatrix}, |B| = 1$$

35) Correct Answer → (D)



NCERT Based (p-block)

36) Correct Answer → (E)  $e^{a+b}$

$$\lim_{x \rightarrow 0} \left( \frac{1+ax}{1-bx} \right)^{\frac{1}{x}}$$

It is of the format  $1^\infty$ . (Standard case). The answer would be  $e^k$ , where

$$\lim_{x \rightarrow 0} k = \left\{ \frac{1+ax}{1-bx} - 1 \right\} \frac{1}{x}$$

$$\lim_{x \rightarrow 0} \left( \frac{x+ax-1+bx}{1-bx} \right) \frac{1}{x} = a + b$$

$$\therefore \text{Limit} = e^{a+b}$$

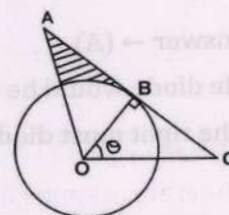
37) Correct Answer → (A)

Number of electrons:  $\text{N}_2^-$  (15) &  $\text{N}_2^+$  (13)

Bond order:  $\text{N}_2^-$  (2.5) &  $\text{N}_2^+$  (2.5)

Thus, Both the species have the same bond order.

38) Correct Answer → (E) None of the above



Due to symmetry  $\theta = 45^\circ$

So,  $OB = 1 \Rightarrow BC = 1$  and  $AB = 1$

$$OC^2 = OB^2 + BC^2$$

$$OC = \sqrt{2} \text{ cm}$$

Let Area of shaded region be, A:

$$A + \frac{\pi}{4} + A = 1$$

$$2A = 1 - \frac{\pi}{4} \quad \therefore A = \frac{1}{2} - \pi/8 \text{ cm}^2$$



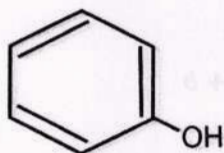
39) Correct Answer → (A)  $\propto$

Propane will get attached to the ortho position of the benzene ring because of the + I effect exhibited by the group attached b/w the two benzene rings.

40) Correct Answer → (B)



Will have the maximum enol content as the enol form of it, that is



has aromatic character.

41) Correct Answer → (C)

$$x^{n+1} = 1$$

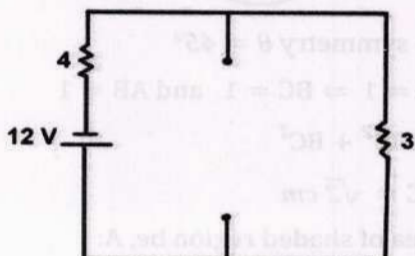
$$(x - 1)(1 + x + x^2 + x^3 + \dots + x^n)$$

↓

This derived polynomial will have all the  $(n + 1)$  roots of unity except 1.

42) Correct Answer → (A)  $12/7$

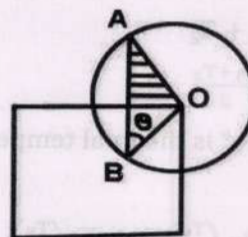
The middle diode would be reverse-biased whereas the right most diode is forward biased.



$$\therefore I = \frac{12}{(4+3)} = 12/7 \text{ A}$$

43) Correct Answer → (E) None of the above

Revise From UGEE SUPR & REAP Guide



Taking angle B as  $15^\circ$

$$\therefore \angle AOB = 180^\circ - 30^\circ = 150^\circ$$

$$\text{Area of } \triangle AOB = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{16} \text{ cm}^2$$

$$\text{Required area} = \frac{1}{8} \text{ cm}^2$$

44) Correct Answer → (A)  $2/3$

Suppose the balls were previously arranged in a specific manner.

Now, for any such case, the second person has to place the balls in such a way such that the numbering does not coincide.

For the 1<sup>st</sup> ball → It would have 2 choices of position.

For the 2<sup>nd</sup> ball → It will also have 2 choices

However, as the 1<sup>st</sup> and 2<sup>nd</sup> balls get their specific positions the place of 3<sup>rd</sup> ball gets already fixed, so it has only one choice.

Now,

$$\text{Favorable cases} = 2 * 2 * 1 = 4$$

$$\text{Total cases} = 3! = 6$$

$$\text{Probability} = \frac{4}{6} = 2/3$$

45) Correct Answer → (B)  $\frac{8}{2187}$

Each ant can move along 3 possible edges.

$$\text{Total paths} = 3^8 = 6561$$

Number of paths at which ants do not collide,

CASE 1: The ants on opposite faces rotate positions.

For each face, the ants can move in 2 directions (clockwise and counter-clockwise).

Thus, there are  $2 \times 2 = 4$  possibilities for each pair of opposite faces.

There are 3 pairs of opposite faces:

Thus, in  $4 \times 3 = 12$  ways the ants do not collide.

CASE 2: All 8 ants move in a loop.

A closed path that goes through every vertex exactly once is called a Hamiltonian cycle.

There are 6 undirected Hamiltonian cycles.

Each loop can be traversed in 2 directions, so,  $6 \times 2 = 12$  ways.

$$\text{Thus, } P = \frac{12+12}{6561} = \frac{24}{6561} = \frac{8}{2187}$$

46) Correct Answer  $\rightarrow$  (A)

$$\Delta H^\circ = -x \quad \text{and} \quad \Delta S^\circ = -x + 72$$

$$\Delta G^\circ = -x - T(-x + 72) < 0$$

$$\therefore x + T(72 - x) > 0$$

$$(72 - x)T > -x$$

$$(x - 72)T < x$$

$$T < x/(x - 72) \text{ \{low temperature\}}$$

47) Correct Answer  $\rightarrow$  (A)

2000 J

$$H = i^2 R t$$

$$\therefore R = \frac{500}{\frac{3}{2} \times \frac{3}{2} \times 20} = \frac{100}{9} \Omega$$

$$\text{Now, } H' = 3 \times 3 \times \frac{100}{9} \times 20 = 2000 \text{ J}$$

48) Correct Answer  $\rightarrow$  (A)

N is an activating group therefore substitution will take place at para position with

respect to it.



## REAP

(1-2)  $\alpha = 1$  and  $\beta = 4$

- 1) Answers  $\rightarrow$  i)  $\alpha = 1$   
ii)  $\beta = 4$

$$\text{Profit} = 7\alpha + 4\beta$$

Constraints:

$$3\alpha + 2\beta \leq 12$$

$$3\alpha + \beta \leq 8$$

On plotting,

Corner points:  $(0, 6), (\frac{8}{3}, 0), (0, 0), (\frac{4}{3}, 4)$

Profit is maximum in the case of  $(\frac{4}{3}, 4)$ .

$$\therefore \alpha = 1 \text{ and } \beta = 4$$

3) Correct answer  $\rightarrow$  C 25

$$\text{Profit} = 110x - x^3 - 60x = 50x - x^2 = y$$

$$\text{For Profit to be maximum, } \frac{dy}{dx} = 0$$

$$50 - 2x = 0 \quad \therefore x = 25$$

4) Correct Answer  $\rightarrow$  D

- i) Let, Robin Hood be in Mr. Red's House, then:

Statement of: Mr. Red  $\checkmark$

Mrs. Green  $\checkmark$

Mr. White  $\times$

In this case, Mr. white should not lie but he is lying. So, Robin Hood cannot be in Mr. Red's House.

- ii) Let, Robin Hood be in Mrs. Green's House, then:

Statement of: Mr. Red  $\times$

Mrs. Green  $\times$

Mr. White  $\checkmark$

In this case, Mr. White should also lie but he is not. So, Robin Hood cannot be in Mrs. Green's House.

- iii) Let, Robin Hood be in Mr. White's House, then:

Statement of: Mr. Red  $\times$

Mrs. Green  $\checkmark$

Mr. White  $\checkmark$

If Mr. Red is lying then Mrs. Green should also lie but this is not the case. So, Robin Hood cannot be in Mr. White's House.

Thus, Robin Hood is not in the neighborhood.

5) Correct Answer  $\rightarrow$  (D) 2.5

lakh

A

B

$$r = 12\%$$

$$8\%$$

$$p = 2x \quad 25,00,000 -$$

x

Interest he has to pay to bank is,

$$I_1 = \frac{500000 \times 5 \times 1}{100} = \text{Rs. } 25000$$

Total interest that he can earn from A & B is,

$$I_2 = \frac{x \times 12 \times 1}{100} + \frac{(500000 - x) \times 8}{100}$$

$$\therefore I_2 = \frac{4x + 4000000}{100}$$

$$\text{Now, profit} = I_2 - I_1 = 25000$$

$$\text{So, } \frac{4x + 4000000}{100} = 50000$$

$$4x = 5000000 - 4000000 = 1000000$$

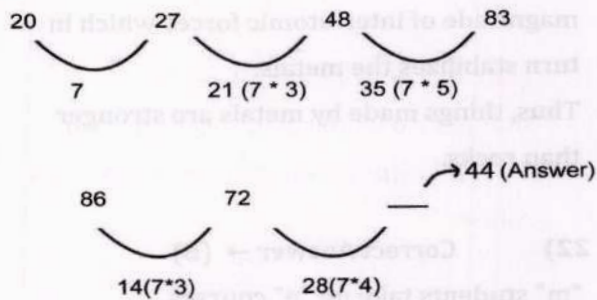
$$x = \text{Rs. } 2.5 \text{ laks.}$$

6) Revise Miscellaneous Problem from  
IIITprep UGEE REAP Guide

7)

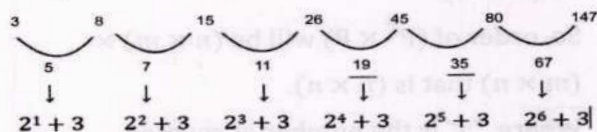
8) Correct Answer → (E) 44

The Pattern followed is:



9) Correct Answer → (A) 45

The pattern followed here is:



10) Correct Answer → (A)

Friend in "B" → Electronics

Friend in "A" → Mechanical

Friend in "C" → Computer Science

Biju cannot study in "B" and he is not doing Mechanical Engineering, that is Biju is not in "A" as well, so Biju is in "C" doing computer science Engineering.

Ari cannot study in "A" and Biju is studying in "C", so Ari has to be in "B" doing Electronics.

Thus, Charu is in "A" and she is doing Mechanical Engineering.

11) Correct Answer → (C)

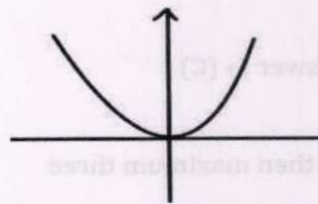
$$10^{17}$$

$$T = 1.5 \times 10^{-16} \frac{n^3}{z^2} \propto$$

$$F = \frac{1}{T} \approx 10^{17}$$

12) Correct Answer → (B)  $y = x^2$

$y = x^2$  is not a one-one function



however, it is an onto function for the range of natural numbers.

(13-15)

Before Starting Revise Complete

Coding & Decoding Chapter from UGEE  
REAP Guide

Answers → i) SFAWOB

ii) W & J

iii) Japan

Using symmetry, (About J)

ABCDE	FGHIJ	KLMNO	PQRST
1 5	6 10	11 15	16 20

1 → 19 that is A → S

Similarly, N → F

S → A and so on.

On similar notes using symmetry, (About W)

T	UVWXY	Z
20		26



So,  $T \rightarrow Z$   
 $W \rightarrow W$   
 $U \rightarrow Y$  and so on.

Thus, the letters J and W would stand the same position.

**16)** Revise Important SET II from  
 UGEE SUPR Guide

**17)** Correct Answer  $\rightarrow$  (C)  
 (3,15,36)

If  $m = +\frac{1}{2}, -\frac{1}{2}$  and 0 then maximum three electrons can be occupied in a given atomic orbital.

Now, Groups in s-block = 3.

Groups in p-block = 9

Groups in D-block = 15

Groups in F-block = 21

Therefore, the atomic numbers would be:

3, 15, 36.

**18)** Graphical Analysis Question

**19)** Correct Answer  $\rightarrow$  (A)

2

$$13.6 \frac{(2)^2}{n^2} = 13.6 \frac{(1)^2}{12}$$

$n = 2$

**20)** Correct Answer  $\rightarrow$  (A)

Rate of any chemical reaction depends upon the rate determining step that is the slowest step of the reaction.

$$r = k_2[\text{N}_2\text{O}_2][\text{H}_2]$$

$$k_1 = \frac{[\text{N}_2\text{O}_2]}{[\text{NO}]^2}$$

$$[\text{N}_2\text{O}_2] = k_1[\text{NO}]^2$$

$$\therefore r = k_1 k_2 [\text{NO}]^2 [\text{H}_2]$$

Thus, rate of reaction is proportional to  $k_1[\text{NO}]^2$ .

**21)** Correct Answer  $\rightarrow$  (C)

In case of metals, the atoms are very closely packed which leads to very high magnitude of inter-atomic forces which in turn stabilizes the metals.

Thus, things made by metals are stronger than rocks.

**22)** Correct Answer  $\rightarrow$  (B)

"m" students take up "n" courses.

$P_{ij} \rightarrow$  order  $(m \times n)$

Order of P is  $(m \times n)$  and order of  $P^T$  will be  $(n \times m)$ .

So, order of  $(P^T \times P)$  will be  $(n \times m) \times (m \times n)$  that is  $(n \times n)$ .

Where, "n" is the number of courses.

Since, it has the order  $(n \times n)$ .

Therefore,  $K = L$

So, option (B) is most appropriate answer however option (E) can also be considered.

**23)** Correct Answer  $\rightarrow$  (B)

Option (B) should be modified as A – captain, B – All-rounder, C – Wicket Keeper.

Going via the process of contradiction, consider option (B).

If A is the captain, then A's statement is correct.

If B is the all-rounder, then B's statement is incorrect.

If C is the wicket-keeper, then C's statement is incorrect.

Thus, the condition that only one of the given statements is correct is fulfilled.

Hence,

A → Captain, B → All rounder, C → Wicket keeper

24) Correct Answer → (E) None of the above

$$p(x > 1) = 1 - p(x = 0) - p(x = 1)$$

$$p(x = 0) = e^{-\alpha} \cdot \frac{\alpha^0}{0!} = e^{-\alpha}$$

$$p(x = 1) = e^{-\alpha} \cdot \frac{\alpha^1}{1!} = \alpha e^{-\alpha}$$

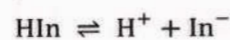
$$p(x > 1) = 1 - e^{-\alpha} - \alpha e^{-\alpha}$$

$$p(x > 1) = 1 - e^{-\alpha}(1 + \alpha)$$

25) Correct Answer → (B) 5.48

$$\text{kin} = 3 \times 10^{-5}$$

$$p^{\text{kin}} = 5 - \log 3 = 4.53$$



$$0.1x \quad 0.9x$$

$$p^{\text{H}} = p^{\text{kin}} + \log \left[ \frac{(\text{In}^-)}{(\text{HIn})} \right]$$

$$p^{\text{H}} = 4.53 + \log 9 = 5.48$$

$$p^{\text{H}} = 5.48$$

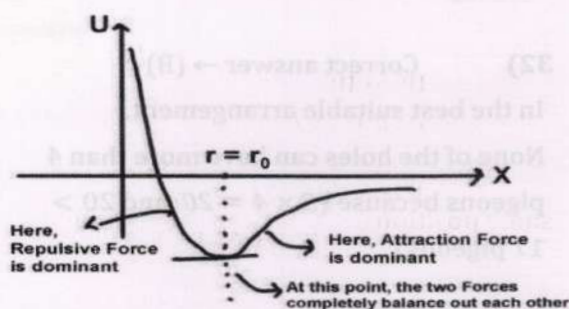
26) Revise **Important** Section from **IIITprep UGEE SUPR Guide**

27) Correct answer →

27) (A)  $m = n$

28) (E) none of the above

The potential well diagram is as follows:



Therefore,  $m = n$

Irrespective of the charge possessed by the atoms, the above phenomenon does take place.

29) Correct Answer → (A) Minimum

The equilibrium position at the internuclear distance is "stable" in nature. Thus, the potential energy would be minimum.

(It can be interpreted from the energy diagram/potential well diagram as well)

30) Correct Answer → (A)

Between its ends.

The strongest magnetic field is produced at the poles of the horse-shoe magnet. (NCERT Based)

31) Correct Answer → (E) Lift Force

The reason behind the tilt of the wings in an aero plane is to counter balance the pressure difference (given by Bernoulli's principle).

Thus, lift force is the reason behind this tilt in the wings of the Aeroplane.

\*{In the exam, lift force was present in one of the options}



32) Correct answer → (B)

In the best suitable arrangement,  
None of the holes can have more than 4  
pigeons because ( $5 \times 4 = 20$  and  $20 >$   
17 pigeons).

However, each hole should have at least 3,  
2 pigeons ( $5 \times 3 = 15$  and  $15 <$   
17 pigeons).

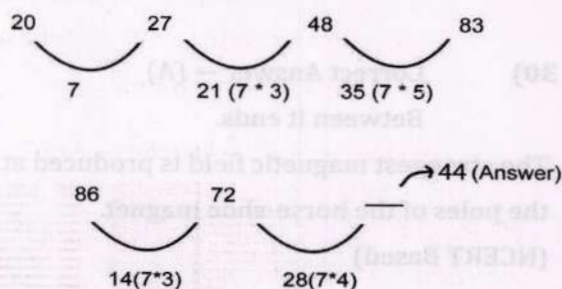
So, the best arrangement (symmetrical)  
falls out as:

(3,3,3,4,4) ← This distribution

Thus, option (B) suits the best.

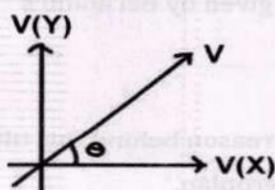
33) Correct Answer → (D) 44

The pattern followed is Difference Pattern:



34) Correct Answer → (E) (A & B)

Let initial velocity be "v",



$$v(x) = v \cos \theta$$

$$v(y) = u \sin \theta - gt$$

Correct graphs include: → (A & B)

35) Correct Answer → (C)

The most certain and logical conclusion  
would be,

Derive a mathematical equation on the  
number of flies coming out of the cow  
dung.

36) Insufficient data

37) Question needs to be modified.

38) Correct Answer → (C)

The net force on the balloon is in the  
upward direction as Buoyant Force is  
greater than that of its weight, so it moves  
in the upward direction.

However, in the case of the ball, as the net  
force is in the downward direction, it goes  
downward.

39) Correct Answer → (B)

The body is built in such a way that the  
growth hormones tend to decrease  
chemically over a specific period of time.

40) Correct Answer → (D)

Across the period, the effective nuclear  
charge increases and the overall size of the  
atom decreases. So, size of Cu < size of k.  
So, statement 1 is incorrect however  
statement is correct.

(NCERT Based)

41) Correct Answer →

$$m = 1$$

$$i = 2$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ m & -1 & 2m-1 \\ 2 & 2(m-1) & -1 \end{vmatrix}$$

$$\begin{aligned} & \hat{i}(1 - (2m-2)(2m-1)) + \hat{j}(m + 2(2m-1)) + \hat{k}(2m(m-1) + 2) \\ &= (-4m^2 + 6m - 1)\hat{i} + (5m - 2)\hat{j} + (2m^2 - 2m + 2)\hat{k} \end{aligned}$$

Now,

$$(6m - 4m^2 - 1)^2 + (5m - 2)^2 + (2m^2 - 2m + 2)^2 = \frac{1}{m^2}$$

For m, Hit & Trial first for good values if you can point out root else go with Lengthy calculation .....

42) Inadequate, For your knowledge about exam

(43-49)

### Revise Complete Linguistics Section from UGEE REAP Guide Books

Answers:

- i) Am
- ii) And
- iii) Namixaridid
- iv) Nachesidi
- v) Namicheshidid
- vi) Micheshidim
- vii) Nachesidam

Solution:

Here "xarid" and "cheshid" are the root words.  
Now,

i) Xaridam → "xarid" + "am", so the suffix for "I" is "am".

ii) Naxaridam → "na" + "xarid" + "am", so "na" implies not.  
nomixaridand → "na" + "mi" + "xarid" + "and", so "and" is the suffix for "they".

iii) mixaridid → you (plural) were buying, "mi" + "xarid" + "id". So, "you (plural) were not buying", would correspond to "na" + "mi" + "xarid" + "id" that is "namixaridid".

iv) Similarly, "na" + "cheshid" + "i" that is "nachesidi" would correspond to "you (singular) did not taste"

v) "na" + "mi" + "cheshid" + "id" = "namicheshidid" would be "you (plural) were not tasting".

vi) "we were tasting" on similar notes would translate to "mi" + "cheshid" + "im" = "micheshidim"

"na" + "cheshid" + "am" → "nachesidam"