केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)
परीक्षार्थी प्रवेश–पत्र के अनुसार भरे

विषय Subject : BIOLOGY

विषय कोड Subject Code : 044

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : 21/03/2016

उत्तर देने का माध्यम
Medium of answering the paper : ENGLISH

प्रश्न पत्र के ऊपर लिखे कोड को दर्शाएं : Write code No. as written on the top of the question paper :	Code Number: 57/2	Set Number: ① ● ③ ④

अतिरिक्त उत्तर–पुस्तिका (ओं) की संख्या
No . of supplementary answer -book(s) used : NIL

विकलांग व्यक्ति : हाँ / नहीं
Person with Disabilities : Yes / No : NO

किसी शारीरिक अक्षमता से प्रभावित हो तो संबंधित वर्ग में ✓ का निशान लगाएँ।
If physically challenged, tick the category

B	D	H	S	C	A

B = दृष्टिहीन, D = मूक व बधिर, H = शारीरिक रूप से विकलांग, S = स्पास्टिक
C = डिस्लेक्सिक, A = ऑटिस्टिक
B = Visually Impaired, D = Hearing Impaired, H = Physically Challenged
S = Spastic, C = Dyslexic, A = Autistic

क्या लेखन – लिपिक उपलब्ध करवाया गया : हाँ / नहीं
Whether writer provided : Yes / No

यदि दृष्टिहीन है तो उपयोग में लाए गये सॉफ्टवेयर का नाम :
If Visually challenged, name of software used :

*एक खाने में एक अक्षर लिखें। नाम के प्रत्येक भाग के बीच एक खाना रिक्त छोड़ दें। यदि परीक्षार्थी का नाम 24 अक्षरों से अधिक है, तो केवल नाम के प्रथम 24 अक्षर ही लिखें।
Each letter be written in one box and one box be left blank between each part of the name. In case Candidate's Name exceeds 24 letters, write first 24 letters.

कार्यालय उपयोग के लिए
Space for office use

2727875
044/01419

SECTION - A

(1) Homo habilis probably did not eat meat, while Homo erectus probably ate meat.

(2) The advantages are →
(i) CNG is more efficient in burning than petrol/diesel
(ii) It is cheaper.
(iii) It cannot be adulterated or siphoned off by theieves.

(3) A male honeybee is formed parthenogenetically i.e directly from haploid ovum without fertilization, so its haploid.
(For honeybees 2n=32)

(4) The objectives are →
(i) to check the validity of GM Research.
(ii) to check the safety of introduction of GM products to the public.

(5) 'Genetic Mother' is a super ovulator in MOET i.e it produces 6-8 eggs per cycle rather than the normal 1 egg per cycle. FSH like hormones are given to genetic mother cow in order to induce the super ovulation.

SECTION B

(6) Aminoacylation of tRNA refers to the process in which the tRNA gets charged with its specific amino acid with the help of enzyme 'Aminoacyl tRNA synthetase'

→ Aminoacylation is important as when two such charged tRNA's are brought closer, formation of peptide bond between the amino acids becomes energetically favourable.

(7) CFC's are ozone depleting substances in the stratosphere. ½
CFC's are responsible for producing chlorine atoms in the ½
stratosphere, which act as catalysts to deplete ozone into
oxygen. This results in depletion of ozone layer in the ½
stratosphere. Thus higher the CFC concentration, lower is
the thickness of Ozone layer. ½

(8) Multicarpellary gynoecium may be apocarpous or syncarpous.
- If the gynoecium (PISTILS) are fused together they are syncarpous ½
  eg. Papaver somniferum
- If the gynoecium (PISTILS) are free and seperate in a flower, they ½
  are apocarpous gynoecium
  eg. Michelia

(9) The advantages of large scale cultivation of Spirulina are -

- Spirulina is a Single Cell Protein (SCP). Due to its high rate of reproduction, a small amount of SCP can generate an enormous amount of biomass in a short time interval. This biomass is rich in proteins, vitamins, minerals and healthier fats and thus can serve as alternate food source for humans and fodder for animals.
- This reduces the pressure on traditional agriculture. This also reduces environmental pollution as Spirulina can grow on wastes of factories.

(16) Nucleopolyhedrovirus is a genus of baculoviruses -

They are good biocontrol agents as -

- They are extremely species specific, narrow spectrum bio control agents
- They dont have any harmful effects on mammals, plants, birds and even on non-target insects
- They are especially useful in IPM (Integrated Pest management) programme.
- They are useful when an ecologically sensitive area is being treated.

SECTION - C

(11) (a) 'Y' → Yeast 'B' → Bacteria

YAC and BAC were used as vectors in Human genome Project

Yeast and Bacteria were used as hosts in HGP.

(b) → Less than 2% of Human genome codes for proteins.

→ Less than 50% of the genes have their functions known.

(c) 'SNP's → Single Nucleotide Polymorphisms.

They are variations in a single base pair, which have been observed at about 10.4 million locations in the Human genome by the scientists.

(12)

DIVERGENT EVOLUTION

→ Occurs when a number of different species arise from a same common ancestor

→ Homologous organs (same origin, different function), provides evidence for divergent evolution

→ occurs when different selection pressures act on different populations of same species, resulting in different adaptations and finally a new species

→ eg. marsupials of australia.

~~forest~~ and placental mammals of the world.

Marsupials (eg. koala, bandicoot) evolved from the same ancestral stock.

CONVERGENT EVOLUTION

→ Occurs when more than one adaptive radiation occurs in an isolated geographical area.

→ Analogous organs (same function, different origin) provide evidence for convergent evolution.

→ occurs when same set of selection pressures act on genealogically unrelated species, so that they form same adaptation towards environment

→ ~~for~~ eg. Convergent evolution has resulted marsupials resembling corresponding to placental mammals

like flying phalanger - flying squirrel

Marsupial mole - Mole

(13) (a) The characteristics of an ideal contraceptive are —

- should be user friendly
- should be effective with least or no side effects
- should be reversible
- should not interfere in any way with the sexual drive of the user.

(b) Copper Releasing IUD's (eg. CuT, Cu7, Multiload 375) supress sperm motility

(14) (a) It is due to the memory of the immune system. When chickenpox virus first infects an individual, a slow and less effective primary response against the pathogen. In the process B and T memory cells are formed. So when the pathogen comes again, the memory cells recognise quickly the pathogen and a highly intensified

secondary (anamnestic) response is produced, which ~~over~~ overwhelms the pathogen due to massive production of antibodies. Thus, once a person gets infected with chickenpox, it is highly unlikely that he will suffer from it again.

→ The memory generated by natural infection is due to Natural Acquired Active Immunity

(b) Interferons are a class of glycoproteins which are secreted by virus infected cells.
They play a role in cytokine barrier of innate immunity and protect unaffected cells from further viral infection.

(15) (a) The two limitations of traditional breeding techniques were →

(i) They were slow and took a long time to produce even a small number of progeny plants.

(ii) Sometimes, all the desirable characters did not combine together in the progeny and also some unwanted characters came alongwith the useful characters in the progeny.

(b) The advantages of micropropogation are –

(i) It can produce a large number of progeny plants within a short time interval.

(ii) All the progeny plants will be genetically identical to the parent plant (somaclones) and thus have all the beneficial characters of the parent plant.

(iii) Can be used to obtain disease free plants from virus infected ones.

(c) Micropropogation has been commercially adopted in propogating plants like maize and banana.

→ Micropropagation is also used to culture somatic hybrids (eg. pomato) in order to produe plants from them.

(16)

PRIMARY SUCESSION	SECONDARY SUCESSION
• Takes place in those areas where living organisms never existed in the history.	• Takes place in those areas which somehow lost all the living organisms which existed there
• Is much slower and takes thousands of years, as soil has to be formed by natural processes, before living organisms can colonise and soil formation takes a long time.	• Since, some soil or sediment is already present, it is faster as compared to primary sucession.
• eg. newly exposed habitats like newly cooled lava, bare rock, newly formed pond etc	• eg. burned down forests, flooded lands etc.

(17) The beneficial roles of predators are →

(i) Predation acts as conduits of energy transfer across trophic levels in an ecosystem

(ii) Predators help to keep prey populations under control eg. prickly pear cactus caused havoc in Australia due to absence of its natural predators, by spreading into millions of hectares of rangeland. It was finally brought under control after a cactus feeding moth (predator) was introduced

(iii) Predators help to maintain species diversity in a community by reducing the intensity of interspecific competition among prey species

eg. more than 10 species of invertebrates became extinct within an year when a predator (Pisaster) was experimentally removed.

(18) Enzyme Replacement Therapy refers to a method in which a functional Adenosine Deaminase (ADA) enzyme is introduced in the lymphocytes of the patient in order to compensate for the absence of ADA in the patient.

Its disadvantages are –

→ Enzyme Replacement Therapy is not completely curative.

→ Since lymphocytes have a fixed life span, a patient will ~~suffer~~ require periodic infusions of ADA enzyme into the cells which will increase the cost of treatment.

(19) (a) Organic farmers control pests by using biocontrol methods which rely on natural predation and parasitism rather than chemicals.

Examples of biocontrol methods are –

→ Ladybird beetle and dragonfly can be used for getting rid of aphids and mosquitoes respectively.

→ Using Bacillus thuringgenesis (Bt) spores and spraying them over vulnerable plants to control caterpillars.

→ Baculoviruses are used as arthropod (insects specially) control agents.

(b) Organic farmers's biocontrol method believes that complete eradication of pests is not only impossible but also undesirable. Instead pests can be managed at suitable levels by using complex system of checks and balances. While conventional pest control methods believes in using chemicals in completely eradicating both harmful and beneficial organisms, which is detrimental to the environment.

(20) (a) Since DNA is a hydrophilic molecule, it cannot pass through cell membranes directly. So the cells must be made 'competent' to be able to pickup recombinant DNA.
Calcium ions (Ca^{+2}) help in increasing cell membrane permeability and thus helps the cells to pick up recombinant DNA easily (i.e makes them competant) 1

(b) 'Biolistics' or 'gene gun' is a method of vectorless gene transfer. It uses microparticles of gold and tungsten coated with DNA and then bombarded with high velocity on plant cells in order to transform them. Thus it has an important role in biotechnology. 1

(21) (a) Selectable markers in pBR322 are —

(i) amp^R (ii) tet^R

Selectable markers play an important role in a way that enables us to seperate (select) transformants from non transformants and recombinants from non recombinant organisms.

(b) The use of β-galactosidase gene as a selectable marker makes the job of selection easy as transformants and recombinants can be seperated on a single plating. The Recombinants dont give any colour, while non recombinants provide blue colour in presence of chromogenic substrate.

But while using amp^R and tet^R, two platings are required, one for selecting transformants and other for selecting recombinants which is a cumbersome procedure.

(22) A Test cross is a cross made between an F_1 or F_2 dominant phenotypl plant and a recessive phenotype parent In order to know the genotype of the dominant phenotyped plant.

→ There are two cases possible if a plant has dominant phenotype →
(i) It is heterozygous (say Tt):

In this case of Test cross

Tt x tt

	T	t
t	Tt	tt
t	Tt	tt

50% dominant and 50% recessive

→ If the Result of the test cross is 1:1, then it is concluded that the dominant plant is heterozygous.

(ii) It is pure homozygous (say TT):

In this case of test cross, all the offspring obtained, will have dominant phenotype.

SECTION - D

23 (a) It is because of the female prejudice in India that the female partner is often blamed for the couple being childless. They believe that females have problem and only they are responsible for the birth / no birth of a child.

→ The values which should be promoted are →

(i) promoting education about the contribution of male and female partners in birth of a child.

(ii) spreading awareness about the fallacy of the myths and to promote awareness about the reasons of infertility and their cures.

(b) The reasons which are responsible for infertility may be physical, hereditary, diseases or even psychological.

(c) Artificial Insemination (AI) in which semen from husband or donor is artificially introduced into the vagina of female. This can help when problem lies with male partner.

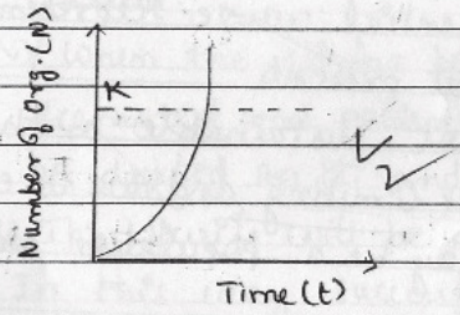
SECTION - E

(24) (a) The two growth models for population growth are —

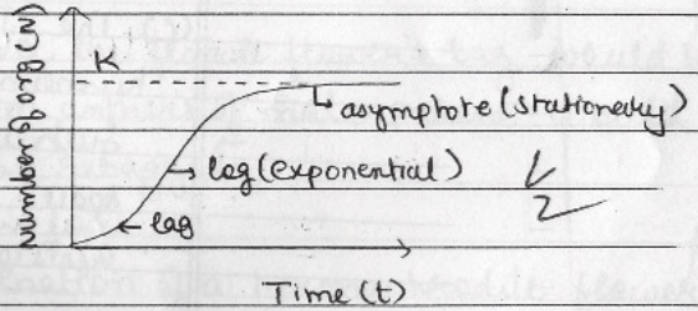
(i) Exponential growth ½ (ii) Verhulst Pearl Logistic growth ½

$\frac{dN}{dt} = rN$ [r = Intrinsic Rate of Natural Increase]

$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$ [K = Carrying capacity]



J shape growth curve



Sigmoid / S-shape growth curve

(b) The basis of difference in shapes of the curves is due to Resources.

→ In exponential curve (Resources = food + space) are unlimited, so the population grows exponentially. ½

→ In logistic growth after a short phase of exponential growth, Resources begin to get depleted and thus population Reaches an equilibrium near the carrying capacity of the habitat. ½

(c) The J shaped exponential curve represents the growth of human population at present. 1

→ Such a growth is not sustainable as the Resources (food + space) will soon get limiting and due to environmental resistance there may be a population crash crash. 1

(25) (a) The steps that would be followed in cross pollination of a hermaphrodite flower would be →

(i) The plants which will serve as male and female parent will be selected

(ii) The anthers of the flowers of the female parent will be removed before dehiscence, in order to prevent self pollination. This step is known as emasculation. 1

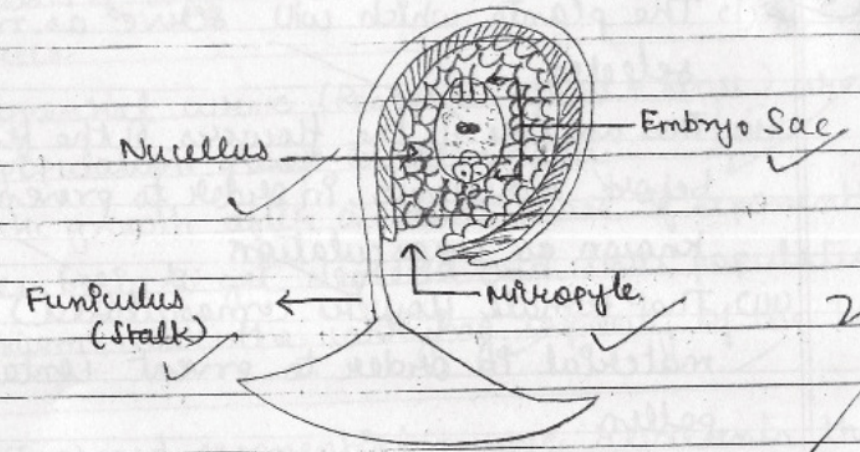
(iii) The female flowers (emasculated) will be then bagged by a suitable material in order to prvent contamination of stigma by unwanted pollen.

(iv) When the stigma becomes receptive, the female flower's bag would be removed and pollen collected from anthers of male parent would be dusted on Pt and the flower be rebagged. 1

(v) The fruits will be allowed to develop.

In this way successful cross pollination of a hermaphrodite flower would be accomplished.

(b)



DIAGRAMATIC VIEW OF A MEGASPORANGIUM OF ANGIOSPERMS

26 (a) Fredrick Griffith in 1928 performed a series of experiments on Streptococcus pneumoniae in order to find.
Streptococcus pneumoniae exists in 2 strains → Smooth & Rough ½
Smooth strains have a layer of shiny mucilagineous coat, which provides them with infectious nature.
Rough strains cannot manufacture the smooth polysaccharide coat due to which they dont cause infections.

Griffiths experiment was as follows —

(i) S-Strain bacteria —Injected into Mice→ Mice died of pneumonia ½

(ii) R-Strain bacteria —Injected into mice→ Mice survived ½

(iii) Heat killed S Strain Bacteria —Injected into mice→ Mice survived ½

(iv) Heat killed S strain bacteria + live R bacteria $\xrightarrow{\text{Injected into mice}}$ Mice died of pneumonia + living S bacteria were recovered from mice.

→ The significance of the Results obtained was that there was some 'Transforming Principle' which had transformed R strain into S strain infectious form bacteria, due to which the mice died of pneumonia

→ Much later, when the role of DNA was established, Griffins exp. showed the stable nature of DNA i.e high temperature did not destroy at least some of the properties of the genetic material

(b) Avery, MacLeod, McCarty were responsible to find out the chemical nature of this 'Transforming Principle' They did so in 2 ways —

→ They isolated biomolecules (DNA, RNA, Proteins) from ~~heat killed~~ S-Strain bacteria and found out that only DNA could transform R strain bacteria.

→ They also found out that treatment with RNAse's and proteases did not inhibit transformation, while treatment with DNAase did inhibit transformation.
They hence concluded that the chemical nature of Transforming Principle was DNA.

04407107

Ans 29. Let x and y be the decision variables where,

x represents the packets of Screw A and

y represents the packets of Screw B.

$Z = 70x + 100y$ {to be maximised}

Subject to constraints,

$4x + 6y \leq 240$

$6x + 3y \leq 240$

$x \geq 0, \quad y \geq 0$ (non-negative constraints)

Converting above inequalities into equalities,

$4x + 6y = 240$

$\Rightarrow 2x + 3y = 120$

x	0	60
y	40	0

$6x + 3y = 240$

$\Rightarrow 2x + y = 80$

x	0	40
y	80	0

$x = 0$ and $y = 0$ (non negative constraints)

Consider a test point (0,0)

$2x + 3y \leq 120$

$0 + 0 \leq 120$

$0 < 120$

which is true

$2x + y \leq 80$

$0 + 0 \leq 80$

$0 < 80$

which is true

Corner points	$Z = 70x + 100y$
O (0,0)	$Z = 0 + 0 = 0$
A (0,40)	$Z = 0 + 100(40) = 4000$ → maximum value
B (30,20)	$Z = 70(30) + 100(20) = 3800$
C (40,0)	$Z = 70(40) + 100(0) = 2400$

The factory owner must produce 0 packets of Screw A and 40 packets of Screw B to maximise his profit.

His maximum profit = 4000 paise or Rs 40

Graph ⇒

Corner points	$Z = 70x + 100y$
O (0,0)	$Z = 0 + 0 = 0$
A (0,40)	$Z = 70(0) + 100(40) = 4000$
B (30,20)	$Z = 70(30) + 100(20) = 4100$ → maximum value
C (40,0)	$Z = 70(40) + 100(0) = 2800$

The factory owner must produce 30 packets of Screw A and 20 packets of Screw B to maximise his profit.

His maximum profit = 4100 paise or Rs 41

Ans 28. (6)

Equation of line in cartesian form :-

$$\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{2} = \lambda$$

$\Rightarrow x = 3\lambda + 2$

$y = 4\lambda - 1 \quad \Rightarrow P(3\lambda+2, 4\lambda-1, 2\lambda+2)$

$z = 2\lambda + 2$

Equation of plane in cartesian form :-

$$x - y + z = 5.$$

The line and plane intersect so the point of line must satisfy the equation of the plane.

$$x - y + z = 5$$

$$\Rightarrow (3\lambda+2) - (4\lambda-1) + (2\lambda+2) = 5$$

$$3\lambda + 2 - 4\lambda + 1 + 2\lambda + 2 = 5$$

$$\lambda + 5 = 5$$

$$\boxed{\lambda = 0}$$

So, the required point $P(3(0)+2, 4(0)-1, 2(0)+2)$

$= P(2, -1, 2)$

Distance of the point Q(−1, −5, −10) from P(2, −1, 2)

$$d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

$$d = \sqrt{(2+1)^2 + (-1+5)^2 + (2+10)^2}$$

$$d = \sqrt{9+16+144}$$

$$d = \sqrt{169}$$

$$d = 13 \text{ units} \quad \text{Ans}$$

2 ✓

18

Ans 27:

(6)

$$\int_0^{\pi/4} \frac{\sin x + \cos x \, dx}{16 + 9\sin 2x}$$

Put $\sin x - \cos x = t$

$$(\cos x + \sin x)\, dx = dt$$

Also $(\sin x - \cos x)^2 = t^2$

$$\sin^2 x + \cos^2 x - 2\sin x \cos x = t^2$$

$$1 - \sin 2x = t^2$$

$$\sin 2x = 1 - t^2$$

1 ✓

limits, when, $x = 0$, $t = -1$

$x = \pi/4$, $t = 0$

1/2 ✓

$$\int_{-1}^{0} \frac{dt}{16 + 9(1-t^2)}$$

$$= \int_{-1}^{0} \frac{dt}{16+9-9t^2}$$

$$= \int_{-1}^{0} \frac{dt}{25-9t^2}$$

$$= \int_{-1}^{0} \frac{dt}{-9(t^2-25/9)}$$

$$= -\frac{1}{9} \int_{-1}^{0} \frac{dt}{t^2-(5/3)^2}$$

$$= -\frac{1}{9}\left[\frac{1}{2\times\frac{5}{3}} \log\left|\frac{t-5/3}{t+5/3}\right|\right]_{-1}^{0}$$

$$= -\frac{1}{9}\left[\frac{3}{10} \log\left|\frac{3t-5}{3t+5}\right|\right]_{-1}^{0}$$

$$= -\frac{1}{9_3} \times \frac{3}{10}\left[\log\left|\frac{3(0)-5}{3(0)+5}\right| - \log\left|\frac{3(-1)-5}{3(-1)+5}\right|\right]$$

$$= -\frac{1}{30}\left[\log\left|\frac{-5}{5}\right| - \log\left|\frac{-8}{2}\right|\right]$$

$$= -\frac{1}{30}\left[\log|-1| - \log|-4|\right] = -\frac{1}{30}\left[\log\left|\frac{-1}{-4}\right|\right] = -\frac{1}{30}\log\left(\frac{1}{4}\right)$$

or $\frac{1}{15}\log 2$ Ans

2

1½

Ans 26°

6

Circle,

$x^2 + y^2 = 32$ —— (i)

centre (0,0)

radius = $4\sqrt{2}$ cm.

line, $y = x$ —— (ii)

On solving (i) and (ii) eq.

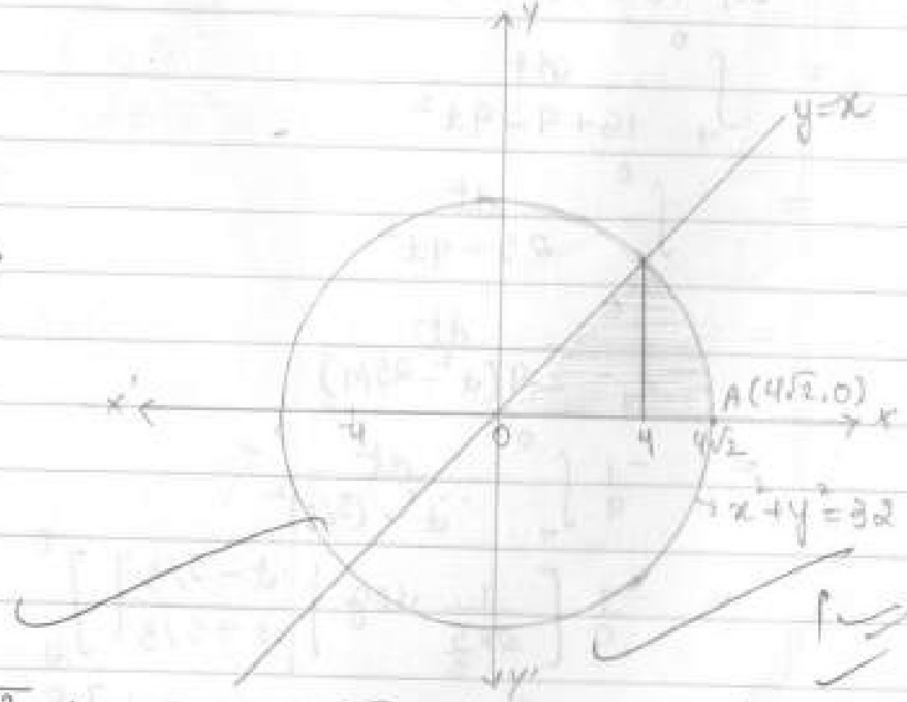
$x^2 + x^2 = 32$

$2x^2 = 32$

$x^2 = 16$

$x = \pm 4$

$y = \pm 4$



Required Area :-

$$\int_0^4 x\,dx + \int_4^{4\sqrt{2}} \sqrt{32-x^2}\,dx$$

$$= \left(\frac{x^2}{2}\right)_0^4 + \left(\frac{x}{2}\sqrt{32-x^2} + \frac{32}{2}\sin^{-1}\frac{x}{4\sqrt{2}}\right)_4^{4\sqrt{2}}$$

$$= \left(\frac{x^2}{2}\right)_0^4 + \left(\frac{x}{2}\sqrt{32-x^2} + 16\sin^{-1}\frac{x}{4\sqrt{2}}\right)_4^{4\sqrt{2}}$$

$$= \left(\frac{16}{2} - \frac{0}{2}\right) + \left(\frac{4\sqrt{2}}{2}\sqrt{32-32} + 16\sin^{-1}\frac{4\sqrt{2}}{4\sqrt{2}} - \left[\frac{4}{2}\sqrt{32-16} + 16\sin^{-1}\frac{4}{4\sqrt{2}}\right]\right)$$

$$= (8-0) + (0 + 16\sin^{-1}(1) - 2\sqrt{16} - 16\sin^{-1}\frac{1}{\sqrt{2}})$$

$$= 8 + (16 \times \pi/2 - 2\times 4 - 16\times \pi/4)$$

$$= 8 + 8\pi - 8 - 4\pi$$

$$= 4\pi \text{ units ans}$$

Ans 25. (6)

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 7 \\ -2 & -4 & -5 \end{bmatrix}$$

By elementary row transformation

$$A = IA$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 7 \\ -2 & -4 & -5 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$$

$R_2 \to R_2 - 2R_1$

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 1 \\ -2 & -4 & -5 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$$

$R_3 \to R_3 + 2R_1$

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix} A$$

$R_1 \to R_1 - 2R_2$

$$\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 5 & -2 & 0 \\ -2 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix} A$$

$R_1 \to R_1 - R_3$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -2 & -1 \\ -2 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix} A$$

$R_2 \to R_2 - R_3$

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

$$I = A^{-1} A$$

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

Que 24° (6)

To Show: R is an equivalence relation

Solution.

For Reflexive :-

(a, a) : $a, a \in A$

$a R a \quad \forall \; a \in A$

$|a - a|$ is divisible by 4

0 is divisible by 4

which is true

$\Rightarrow$ R is a reflexive relation.

For Symmetric relation :-

Let $(a,b) \in R \ \forall \ a,b \in A$

$a \ R \ b \ \forall \ a,b \in A$

$|a-b|$ is divisible by 4

$\Rightarrow$ $|b-a|$ is divisible by 4

$\Rightarrow$ $b \ R \ a \ \forall \ b,a \in A$

$\Rightarrow$ $(b,a) \in R$

$\Rightarrow$ R is an symmetric relation since $(a,b) \in R$ also $(b,a) \in R$

For transitive relation :-

Let $(a,b) \in R$ and $(b,c) \in R \ \forall \ a,b,c \in A$

$a \ R \ b$ and $b \ R \ c \ \forall \ a,b,c \in A$

$|a-b|$ is divisible by 4 and $|b-c|$ is divisible by 4

$|a-b| = 4\lambda$ — (i)

$|b-c| = 4u$ — (ii)

(i) + (ii)

$|a-b+b-c| = 4(\lambda+u)$

$|a-c| = 4(\lambda+u)$

$\Rightarrow$ $a \ R \ c \ \forall \ a,c \in A$

$\Rightarrow \quad (a, c) \in R$

$\Rightarrow$ R is an transitive relation since $(a,b) \in R$, $(b,c) \in R$ and also $(a,c) \in R$

Hence R is reflexive, symmetric and transitive so it is a Equivalence relation.

The set of all elements related to A are:-

$R = \{(1,5), (5,1), (1,9), (9,1), (1,1)\}$.

Equivalence class $[2] = \{2, 6, 10\}$

Ans 23. Let X denote the larger of the two numbers.

$X = 2, 3, 4, 5$

(4)

$$P(X=2) = \frac{2}{20} = \frac{1}{10}$$

$$P(X=3) = \frac{4}{20} = \frac{2}{10}$$

$$P(X=4) = \frac{6}{20} = \frac{3}{10}$$

$$P(X=5) = \frac{8}{20} = \frac{4}{10}$$

Probability Distribution :-

x	2	3	4	5
P(x)	1/10	2/10	3/10	4/10

Mean

$$E(x) = \Sigma P_i x_i$$

$$\Sigma P_i x_i = 2\times\frac{1}{10} + 3\times\frac{2}{10} + 4\times\frac{3}{10} + 5\times\frac{4}{10}$$

$$\Sigma P_i x_i = \frac{2}{10} + \frac{6}{10} + \frac{12}{10} + \frac{20}{10} = \frac{40}{10} = \boxed{4} \text{ ans}$$

$\frac{1}{2} + \frac{1}{2}$ ✓

Variance

$$\Sigma P_i (x_i^2) - (\Sigma P_i x_i)^2$$

$$\sigma = \left(4\times\frac{1}{10} + 9\times\frac{2}{10} + 16\times\frac{3}{10} + 25\times\frac{4}{10}\right) - (16)$$

$$= \left(\frac{4}{10} + \frac{18}{10} + \frac{48}{10} + \frac{100}{10}\right) - (16)$$

$$= \left(\frac{170}{10}\right) - 16$$

$$= 17 - 16 = \boxed{1} \text{ ans}$$

$\frac{1}{2} + 1$ ✓

Standard deviation $\sqrt{1} = 1$ ans

Qn 22 Let E_1 = "Event that the girl throws 3, 4, 5 or 6"

E_2 = "Event that the girl throws 1, 2"

and A = "Event that the girl gets exactly one tail"

(4)

$$P(E_1) = \frac{4}{6} = \frac{2}{3}, \quad P(E_2) = \frac{2}{6} = \frac{1}{3}$$

$$P(A/E_1) = \frac{1}{2}, \quad P(A/E_2) = 3/8$$

Now, $$P(E_1/A) = \frac{P(E_1) \cdot P(A/E_1)}{P(E_1) \cdot P(A/E_1) + P(E_2) \cdot P(A/E_2)}$$

$$P(E_1/A) = \frac{\frac{2}{3} \times \frac{1}{2}}{\frac{2}{3} \times \frac{1}{2} + \frac{1}{3} \times \frac{3}{8}}$$

$$P(E_1/A) = \frac{\frac{2}{6}}{\frac{2}{6} + \frac{1}{8}} = \frac{\frac{1}{3}}{\frac{1}{3} + \frac{1}{8}} = \frac{\frac{1}{3}}{\frac{8+3}{24}}$$

$$P(E_1/A) = \frac{1}{3} \times \frac{24}{11} = \boxed{\frac{8}{11}}$$ Ans.

Qn 21:

(A)

$\vec{r} = (4\hat{i} - \hat{j}) + \lambda(\hat{i} + 2\hat{j} - 3\hat{k})$

$\vec{a_1} = 4\hat{i} - \hat{j} + 0\hat{k}$

$\vec{b_1} = \hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{r} = (\hat{i} - \hat{j} + 2\hat{k}) + \mu(2\hat{i} + 4\hat{j} - 5\hat{k})$

$\vec{a_2} = \hat{i} - \hat{j} + 2\hat{k}$

$\vec{b_2} = 2\hat{i} + 4\hat{j} - 5\hat{k}$

Shortest distance $= \left| \dfrac{(\vec{a_2} - \vec{a_1}) \cdot (\vec{b_1} \times \vec{b_2})}{|\vec{b_1} \times \vec{b_2}|} \right|$

Now,

$\vec{a_2} - \vec{a_1} = (\hat{i} - \hat{j} + 2\hat{k}) - (4\hat{i} - \hat{j} + 0\hat{k})$

$= -3\hat{i} + 0\hat{j} + 2\hat{k}$

$= -3\hat{i} + 2\hat{k}$

$\vec{b_1} \times \vec{b_2} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -3 \\ 2 & 4 & -5 \end{vmatrix}$

$\vec{b_1} \times \vec{b_2} = \hat{i}(-10+12) - \hat{j}(-5+6) + \hat{k}(4-4)$

$\vec{b_1} \times \vec{b_2} = 2\hat{i} - \hat{j} + 0\hat{k}$

$|\vec{b_1} \times \vec{b_2}| = \sqrt{4+1+0} = \sqrt{5}$.

Now,

$$d = \left| \frac{(-3\hat{i}+0\hat{j}+2\hat{k}) \cdot (2\hat{i}-\hat{j}+0\hat{k})}{\sqrt{4+1+0}} \right|$$

$$d = \left| \frac{-3\times 2 + 0\times -1 + 2\times 0}{\sqrt{5}} \right|$$

$$d = \left| \frac{-6+0+0}{\sqrt{5}} \right|$$

$$\boxed{d = \frac{6}{\sqrt{5}} \text{ units}}$$ Ans

Ans 20. Let $\vec{d}$ be $x\hat{i}+y\hat{j}+z\hat{k}$

(4)

Now, $\vec{d} \perp \vec{c}$

$(x\hat{i}+y\hat{j}+z\hat{k}) \cdot (3\hat{i}+\hat{j}-\hat{k}) = 0$

$3x + y - z = 0$ ——— (i)

Also, $\vec{d} \perp \vec{b}$

$(x\hat{i}+y\hat{j}+z\hat{k}) \cdot (\hat{i}-4\hat{j}+5\hat{k}) = 0$

$x - 4y + 5z = 0$ ——— (ii)

Also, $\vec{d} \cdot \vec{a} = 21$

$(x\hat{i} + y\hat{j} + z\hat{k}) \cdot (4\hat{i} + 5\hat{j} - \hat{k}) = 21$

$4x + 5y - z = 21$ ——— (iii)

Solving (i) and (iii) equation

$3x + y - z = 0$

$-4x + 5y - z = 21$

$-x - 4y = -21$

$\Rightarrow x + 4y = 21$ ——— (iv)

Multiply (i) by 5 and add to (ii) eq,

$15x + 05y - 5z = 0$

$+x - 4y + 8z = 0$

$16x + y = 0$ ——— (v)

Solving (iv) and (v) eq.

$x + 4y = 21$

$-64x + y = 0$

$-63x = 21$

$x = \frac{-21}{63} = -\frac{7}{21} = -\frac{1}{3}$

Putting value of x in eq. (iv).

$$x + 4y = 21$$

$$\frac{-1}{3} + 4y = 21$$

$$4y = 21 + \frac{1}{3}$$

$$4y = \frac{63+1}{3}$$

$$4y = \frac{64}{3}$$

$$y = \frac{64}{12} = \frac{32}{6} = \frac{16}{3}$$

Also, $3x + y - z = 0$

$$3\left(\frac{-1}{3}\right) + \frac{16}{3} = z$$

$$-1 + \frac{16}{3} = z$$

$$\frac{-3+16}{3} = z \quad , \quad z = \frac{13}{3}$$

Therefore, $\boxed{\vec{x} = \frac{-1}{3}\hat{i} + \frac{16}{3}\hat{j} + \frac{13}{3}\hat{k}}$ Ans

$$= \frac{1}{3}(-\hat{i} + 16\hat{j} + 13\hat{k}) \text{ Ans.}$$

2½

1½

1

Ans 19.

$$\frac{dy}{dx} + 2y \tan x = \sin x$$

On comparing the above equation with the standard linear equation

$$\frac{dy}{dx} + Py = Q$$

we get, $P = 2\tan x$, $Q = \sin x$

Therefore, $I.F. = e^{\int P\,dx}$

$$I.F. = e^{2\int \tan x\,dx}$$

$$= e^{2[\log(\sec x)]}$$

$$= e^{\log(\sec x)^2} = \sec^2 x$$

Now,

$$y \cdot I.F. = \int Q \times I.F.\,dx.$$

$$y \cdot \sec^2 x = \int \sin x \times \sec^2 x\,dx$$

$$y \cdot \sec^2 x = \int \sin x \times \frac{1}{\cos^2 x}\,dx$$

$$y \cdot \sec^2 x = \int \tan x \cdot \sec x\,dx$$

Put $\sec x = t$

$(\sec x \tan x)\,dx = dt$

$y \cdot \sec^2 x = \int t \, dt$

$y \cdot \sec^2 x = t + C$

$y \cdot \sec^2 x = \sec x + C$

Now when $y = 0$, $x = \pi/3$.

$0 = \sec \frac{\pi}{3} + C \quad , \quad 0 = +2 + C$

$C = -2$

Therefore,

Solution $\Rightarrow$ $y \cdot \sec^2 x = \sec x - 2$.

or $y = \frac{1}{\sec x} - \frac{2}{\sec^2 x}$

or $y = \sec x^{-1} - 2(\sec^2 x)^{-1}$ Ans.

+ 1½

½

+

Ans 18.

(4) ✓

$$\int \frac{2\cos x}{(1-\sin x)(1+\sin^2 x)}\,dx$$

Put $\sin x = t$

$\cos x\,dx = dt$

$$2\int \frac{dt}{(1-t)(1+t^2)}$$

Now by partial fraction,

$$\frac{1}{(1-t)(1+t^2)} = \frac{A}{1-t} + \frac{Bt+C}{1+t^2}$$

$$1 = A(1+t^2) + (Bt+C)(1-t)$$

$$1 = A + At^2 + Bt - Bt^2 + C - Ct$$

$A + C = 1$ — i)

$A - B = 0$ — ii)

$B - C = 0$ — iii)

i) + iii)

$A + C + B - C = 1$

$A + B = 1$ — iv)

$A - B = 0$ — ii)

$2A = 1$

$A = 1/2$, $B = 1/2$, $C = 1/2$

$\frac{1}{2}$ ✓ ✓

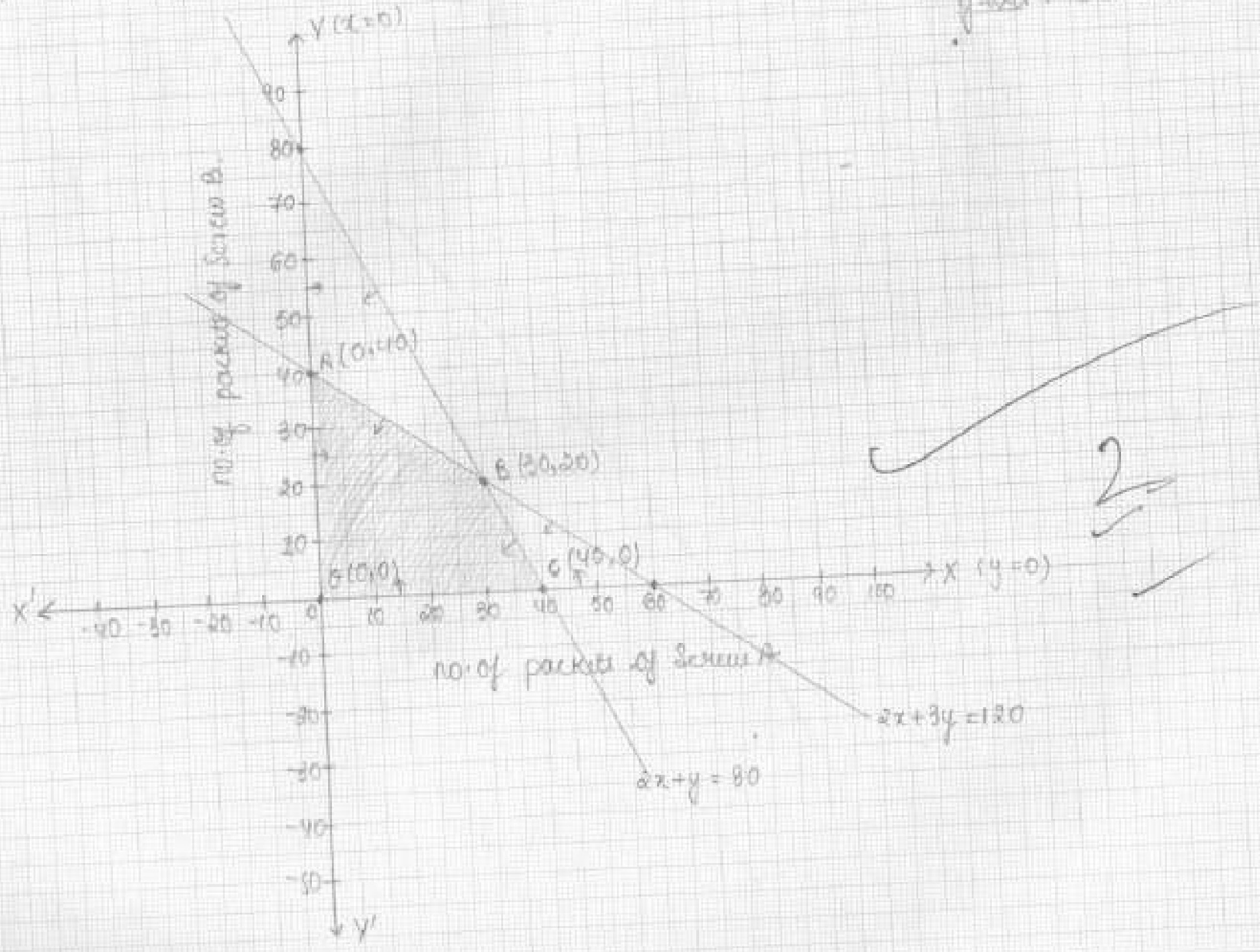
$1\frac{1}{2}$ ✓

Ans 29:

Scale

x-axis : 1 cm = 10 units

y-axis : 1 cm = 10 units



2

$$2\int \frac{1/2}{1-t} + \frac{1/2\,t + 1/2}{1+t^2}\,dt$$

$$\frac{2}{2}\times\frac{1}{2}\int \frac{dt}{1-t} + \frac{2}{2}\times\frac{1}{2}\int \frac{t+1}{t^2+1}\,dt$$

$$\int \frac{dt}{1-t} + \int \frac{t\,dt}{t^2+1} + \int \frac{dt}{t^2+1}$$

$$\int \frac{dt}{1-t} + \frac{1}{2}\int \frac{2t\,dt}{t^2+1} + \int \frac{dt}{t^2+1}$$

$$-\log(1-t) + \frac{1}{2}\log(t^2+1) + \tan^{-1}t + c. \qquad 1\tfrac{1}{2}$$

$$-\log(1-\sin x) + \frac{1}{2}\log(1+\sin^2 x) + \tan^{-1}(\sin x) + c.$$

$$\Rightarrow \frac{1}{2}\log(1+\sin^2 x) - \log(1-\sin x) + \tan^{-1}(\sin x) + c \quad \underline{\text{Ans}}.$$

$$= \log(1+\sin^2 x)^{1/2} - \log(1-\sin x) + \tan^{-1}(\sin x) + c.$$

$$= \log\left|\frac{\sqrt{1+\sin^2 x}}{1-\sin x}\right| + \tan^{-1}(\sin x) + c. \qquad \frac{1}{2}$$

Dayaswal
0412403

Ans 17°

(A)

Let, length = breadth = x

height = y

volume = $x \times x \times y$

$K = x^2 y$

$y = \frac{K}{x^2}$

According to question,

$S = x^2 + 4xy$

$S = x^2 + 4x \times \frac{K}{x^2} = x^2 + \frac{4K}{x}$

$\frac{ds}{dx} = 2x - \frac{4K}{x^2} = \frac{2x^3 - 4K}{x^2}$

Put $\frac{ds}{dx} = 0$ for critical points

$\frac{2x^3 - 4K}{x^2} = 0$

$2x^3 - 4K = 0$

$x^3 = 2K$

$x = (2K)^{1/3}$

Now, $\frac{d^2S}{dx^2} = 2 - \frac{4K(-2)}{x^3} = 2 + \frac{8K}{x^3}$

$\left(\frac{d^2S}{dx^2}\right)_{(x=(2K)^{1/3})} = 2 + \frac{8K}{2K} = 2+4 = 6$ ✓ $\frac{1}{2}$ ✓

$\frac{d^2S}{dx^2} > 0$ hence it is minimum. ✓ ∴ $\frac{1}{2}$ ✓

Now, $y = \frac{K}{x^2}$

$y = \frac{K}{(2K)^{2/3}} = \frac{K \cdot K^{-2/3}}{(2)^{2/3}} = \frac{K^{1/3}}{2^{2/3}}$

$y = f\left(\frac{K^{1/3}}{2^{2/3}}\right)$ $y = K^{1/3} \times 2^{-2/3}$

$y = 2^{-1}(2K^{1/3})$

$y = \frac{1}{2}(2K)^{1/3}$

$\boxed{y = \frac{1}{2}x}$ ✓ $\frac{1}{2}$ ✓ Hence Proved. ✓

∴

Value :- Helping in nature
Support to middle class people
cooperative & concern towards poor.

1

Q.No 16 (A)

$$f(x) = \frac{x^4}{4} - x^3 - 5x^2 + 24x + 12$$

$$f'(x) = \frac{4x^3}{4} - 3x^2 - 10x + 24$$

$$f'(x) = x^3 - 3x^2 - 10x + 24$$

$$f'(x) = (x-2)(x^2 - x - 12)$$

$$f'(x) = (x-2)(x^2 - 4x + 3x - 12)$$

$$f'(x) = (x-2)[x(x-4) + 3(x-4)]$$

$$f'(x) = (x-2)(x+3)(x-4)$$

Put $f'(x) = 0$

$$(x-2)(x+3)(x-4) = 0$$

$$x = 2, -3, 4$$

		Intervals	$f'(x)$ sign	nature
$f'(x) > 0$	strictly increasing	$(-\infty, -3)$	-ve	decreasing
$f'(x) < 0$	strictly decreasing	$(-3, 2)$	+ve	increasing
		$(2, 4)$	-ve	decreasing
		$(4, \infty)$	+ve	increasing

(a) Strictly increasing = $(-3,2) \cup (4,\infty)$

(b) Strictly decreasing = $(-\infty,-3) \cup (2,4)$

Qno 15

(A)

$y = \sin^{-1}(\sin x)$

$\frac{dy}{dx} = \cot(\sin x) \cdot \cot x \Rightarrow \cot x = \cot(\sin x) = \frac{1}{\cot x} \cdot \frac{dy}{dx}$

Now, $\frac{d^2y}{dx^2} = -\cot(\sin x)\sin x + \cos x(-\sin(\sin x)\cot x)$

$\frac{d^2y}{dx^2} = -\sin x \cot(\sin x) - \cot^2 x \sin(\sin x)$.

$\frac{d^2y}{dx^2} = -\sin x \times \frac{1}{\cot x} \times \frac{dy}{dx} - \cot^2 x\, y$.

$\frac{d^2y}{dx^2} = -\tan x \frac{dy}{dx} - \cot^2 x\, y$.

$\frac{d^2y}{dx^2} + \tan x \frac{dy}{dx} + y\cot^2 x = 0$.

Hence Proved

Ans 14°.

(A) ✓

$x = a(2\theta - \sin 2\theta)$

$\frac{dx}{d\theta} = a(2 - 2\cos 2\theta)$

$\frac{dx}{d\theta} = 2a(1 - \cos 2\theta)$ ✓1✓

$y = a(1 - \cos 2\theta)$

$\frac{dy}{d\theta} = a(0 + 2\sin 2\theta)$

$\frac{dy}{d\theta} = 2a \sin 2\theta$ ✓1✓

$\frac{dy}{dx} = \frac{dy}{d\theta} \times \frac{d\theta}{dx} = \frac{2a \sin 2\theta}{2a(1 - \cos 2\theta)} = \frac{2 \sin\theta \cos\theta}{2 \sin^2\theta}$

$\frac{dy}{dx} = \cot\theta$ ✓1✓

$\left(\frac{dy}{dx}\right)_{(\theta = \pi/3)} = \cot\frac{\pi}{3}$

$= \cot(60^\circ)$

$= \boxed{\frac{1}{\sqrt{3}}}$ Ans ✓1✓

Ans 13.

(A)

$$\begin{vmatrix} 1 & 1 & 1+3x \\ 1+3y & 1 & 1 \\ 1 & 1+3x & 1 \end{vmatrix}$$

$C_1 \to C_1 - C_2$

$$\begin{vmatrix} 0 & 1 & 1+3x \\ 3y & 1 & 1 \\ -3x & 1+3x & 1 \end{vmatrix}$$

taking 3 common from C_1

$$3\begin{vmatrix} 0 & 1 & 1+3x \\ y & 1 & 1 \\ -x & 1+3x & 1 \end{vmatrix}$$

$R_2 \to R_2 - R_1$

$$3\begin{vmatrix} 0 & 1 & -1+3x \\ y & 0 & -3x \\ -x & 1+3x & 1 \end{vmatrix}$$

Expanding along R_1

$3[-1(y - 3xz) + (1+3x)(y+3xy)]$

$3[-y + 3xz + y + 3xy + 3xy + 9xyz]$

$3[9xyz + 3xz + 3xy + 3xy)$

$9(3xyz + xy + yz + zx)$ Ans.

Ans 12.

Let E_1 = "Event of obtaining the sum 8"

$E_1 = \{(2,6)(6,2)(3,5)(5,3)(4,4)\}$

and F = "Event that red die result in a number less than 4."

$$F = \{(1,1)(2,1)(3,1)(4,1)(5,1)(6,1), (1,2)(2,2)(3,2)(4,2)(5,2)(6,2), (1,3)(2,3)(3,3)(4,3)(5,3)(6,3)\}$$

$$P(E/F) = \frac{P(E \cap F)}{P(F)} \text{ or } \frac{n(E \cap F)}{n(F)}$$

$E \cap F = \{(6,2),(5,3)\}$

$n(E \cap F) = \frac{2}{36}$, $n(F) = \frac{18}{36}$

$$P(E/F) = \frac{\frac{2}{36}}{\frac{18}{36}} = \frac{2}{18} = \boxed{\frac{1}{9}}$$ Ans

Ans 11. Let $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$

$|\vec{a}| = \sqrt{1+4+9} = \sqrt{14}$

$\vec{b} = 3\hat{i} - 2\hat{j} + \hat{k}$

$|\vec{b}| = \sqrt{9+4+1} = \sqrt{14}$

$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 3 \\ 3 & -2 & 1 \end{vmatrix}$

$= 4\hat{i} + 8\hat{j} + 4\hat{k}$

$|\vec{a} \times \vec{b}| = \sqrt{16+64+16} = \sqrt{96} = 4\sqrt{6}$

$|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$

$4\sqrt{6} = \sqrt{14} \times \sqrt{14} \times \sin\theta$

$4\sqrt{6} = 14 \sin\theta$

$\sin\theta = \frac{4\sqrt{6}}{14} = \frac{2\sqrt{6}}{7}$

$\theta = \sin^{-1}\left(\frac{2\sqrt{6}}{7}\right)$ Ans.

Ans 10.

$y = ae^{bx+5}$

$\frac{dy}{dx} = ae^{bx+5}(b)$

$\frac{dy}{dx} = abe^{bx+5}$

$\frac{dy}{dx} = by$

$\frac{1}{y} \cdot \frac{dy}{dx} = b$

Differentiating again w.r.t x

$$\frac{y\frac{d^2y}{dx^2} - \frac{dy}{dx}\times\frac{dy}{dx}}{y^2} = 0$$

$$\therefore \quad y\frac{d^2y}{dx^2} - \left(\frac{dy}{dx}\right)^2 = 0 \quad \text{Proved.}$$

201

Ans 9.

$$\int \frac{\cos 2x + 2\sin^2 x}{\cos^2 x}\,dx$$

$$\int \frac{1 - 2\sin^2 x + 2\sin^2 x}{\cos^2 x}\,dx$$

$$\int \frac{dx}{\cos^2 x}$$

$$\int \sec^2 x\,dx$$

$$\Rightarrow \tan x + c \quad \text{Ans.}$$

Ans 8° $C(x) = 0.005x^3 - 0.02x^2 + 30x + 5000$

(2) $C'(x) = 0.005(3x^2) - 0.02(2x) + 30$

$C'(x) = 0.015x^2 - 0.04x + 30$

when $x = 3$.

$C'(3) = 0.015(3)^2 - 0.04(3) + 30$

$= 0.015(9) - 0.04(3) + 30$

$= 0.135 - 0.12 + 30$

$= 30.015$ Ans

Ans 7° $\tan^{-1}\left(\frac{1+\cos x}{\sin x}\right)$

(2) $y = \tan^{-1}\left(\frac{2\cos^2 x/2}{2\sin x/2 \cos x/2}\right)$

$y = \tan^{-1}\left(\frac{\cos x/2}{\sin x/2}\right)$

$y = \tan^{-1}(\cot x/2)$

$y = \tan^{-1}[\tan(\pi/2 - x/2)]$

$y = \frac{\pi}{2} - \frac{x}{2}$

$$y = \frac{\pi}{2} - \frac{x}{2}$$

Differentiating w.r.t x

$$\frac{dy}{dx} = 0 - \frac{1}{2}$$

$$\frac{dy}{dx} = -\frac{1}{2} \quad \text{Ans}$$

$\frac{1}{2}$

201

Ans 6°

$$A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$$

$$|A| = 14 - 12 = 2$$

$|A| \neq 0$ hence inverse exist

Now, $C_{11} = 7$, $C_{12} = +4$

$C_{21} = +3$, $C_{22} = 2$

$$\text{Adj}(A) = \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$$

$$A^{-1} = \frac{1}{|A|} \text{adj}(A) = \frac{1}{2}\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix} \quad \text{Ans}$$

$$2A^{-1} = 9I - A$$

$$2 \times \frac{1}{2}\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix} = 9\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$$

$$\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix} = \begin{bmatrix} 9 & 0 \\ 0 & 9 \end{bmatrix} - \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$$

$$\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$$

Hence Proved.

Ans 5.

Q2

$3\sin^{-1}x = \sin^{-1}(3x - 4x^3)$

R.H.S. $\sin^{-1}(3x - 4x^3)$

Put $x = \sin\theta$

$\sin^{-1}(3\sin\theta - 4\sin^3\theta)$

$\sin^{-1}(\sin 3\theta)$

3θ

$3\sin^{-1}x$

RHS = LHS

Hence Proved

$\frac{1}{2}$

1

$\frac{1}{2}$

$\neq$

$-\frac{1}{2} \le x \le \frac{1}{2}$

$-\frac{1}{2} \le \sin\theta \le \frac{1}{2}$

$\sin^{-1}\left(-\frac{1}{2}\right) \le \theta \le \sin^{-1}\left(\frac{1}{2}\right)$

$-\frac{\pi}{3} \le \theta \le \frac{\pi}{3}$

$\left[\frac{\pi}{3}, \frac{\pi}{3}\right] \subset \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Ans 4.

$a \circ b = (a * b) + 3$

$5 \circ 10 = (5 * 10) + 3$

$= 10 + 3$

$= 13$ Ans

Ans 3.

$|\vec{a}| = |\vec{b}|$

$\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$

$\frac{9}{2} = |\vec{a}|\,|\vec{a}| \cos 60^\circ$

$\frac{9}{2} = |\vec{a}|^2 \times \frac{1}{2}$

$9 = |\vec{a}|^2$

$|\vec{a}| = 3.$

Also $|\vec{a}| = |\vec{b}|$

$|\vec{b}| = 3$

$|\vec{a}| = |\vec{b}| = 3$ Ans

Qn 2: A is a skew symmetric matrix

$\Rightarrow A' = -A$

$$A = \begin{bmatrix} 0 & a & -3 \\ 2 & 0 & -1 \\ b & 1 & 0 \end{bmatrix}$$

$$A' = \begin{bmatrix} 0 & 2 & b \\ a & 0 & 1 \\ -3 & -1 & 0 \end{bmatrix}$$

$A' = -A$

Now,

$$\begin{bmatrix} 0 & 2 & b \\ a & 0 & 1 \\ -3 & -1 & 0 \end{bmatrix} = -\begin{bmatrix} 0 & a & -3 \\ 2 & 0 & -1 \\ b & 1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 2 & b \\ a & 0 & 1 \\ -3 & -1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & -a & 3 \\ -2 & 0 & 1 \\ -b & -1 & 0 \end{bmatrix}$$

On comparing we get,

$$\boxed{\begin{matrix} b = 3 \\ a = -2 \end{matrix}}$$

Ans.

Ans 1°

$\tan^{-1}\sqrt{3} - \cot^{-1}(-\sqrt{3})$

$\tan^{-1}\sqrt{3} - (\pi - \cot^{-1}\sqrt{3})$

$\tan^{-1}\sqrt{3} - \pi + \cot^{-1}\sqrt{3}$

$\tan^{-1}\sqrt{3} + \cot^{-1}\sqrt{3} - \pi$

$\frac{\pi}{2} - \pi$

$\frac{\pi - 2\pi}{2} = -\frac{\pi}{2}$ Ans

As we know that

$\tan^{-1}x + \cot^{-1}x = \pi/2$.

1/2
1/2

One Hundred only
Evaluated as according to the Marking scheme