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Senior Secondary School Certificate Examination

July'2018

Marking Scheme — Mathematics 65B (Compt.)

General Instructions:

1. The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the Marking Scheme are suggested answers. The content is thus indicative. If a student has given any other answer which is different from the one given in the Marking Scheme, but conveys the meaning, such answers should be given full weightage.

2. Evaluation is to be done as per instructions provided in the marking scheme. It should not be done according to one's own interpretation or any other consideration — Marking Scheme should be strictly adhered to and religiously followed.

3. Alternative methods are accepted. Proportional marks are to be awarded.

4. In question (s) on differential equations, constant of integration has to be written.

5. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.

6. A full scale of marks - 0 to 100 has to be used. Please do not hesitate to award full marks if the answer deserves it.

7. Separate Marking Scheme for all the three sets has been given.

8. As per orders of the Hon'ble Supreme Court. The candidates would now be permitted to obtain photocopy of the Answer book on request on payment of the prescribed fee. All examiners/ Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

QUESTION PAPER CODE 65(B)

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. $|A| = |3B| = 3^3 \times |B| = 27 \times 2 = 54$ $\frac{1}{2}+\frac{1}{2}$

2. Put $\sin^{-1} x = t \Rightarrow \frac{1}{\sqrt{1-x^2}}dx = dt$ $\frac{1}{2}$

$\therefore \quad I = \int t\, dt = \frac{t^2}{2} + c = \frac{1}{2}(\sin^{-1} x)^2 + c$ $\frac{1}{2}$

3. $u = \tan x \Rightarrow \frac{du}{dx} = \sec^2 x$

$v = \sec x \Rightarrow \frac{dv}{dx} = \sec x \tan x$ (any one correct) $\frac{1}{2}$

$\therefore \quad \frac{du}{dv} = \frac{\sec^2 x}{\sec x \cdot \tan x}$ or cosec x $\frac{1}{2}$

4. $|\hat{a} - \hat{b}| = 1 \Rightarrow |\hat{a} - \hat{b}|^2 = 1 \Rightarrow |\hat{a}|^2 + |\hat{b}|^2 - 2|\hat{a}||\hat{b}|\cos\theta = 1$ $\frac{1}{2}$

$\Rightarrow \quad \cos\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{3}$ $\frac{1}{2}$

SECTION B

5. Put $\cot^{-1}(-x) = \theta \Rightarrow x = -\cot\theta = \cot(\pi - \theta)$ 1

$\Rightarrow \quad \pi - \theta = \cot^{-1} x$

$\Rightarrow \quad \theta = \pi - \cot^{-1} x$

$\Rightarrow \quad \cot^{-1}(-x) = \pi - \cot^{-1} x$ 1

6. $\sin^{-1}\frac{2}{7} + \cos^{-1} 2x = \sin^{-1} 1 = \frac{\pi}{2}$ 1

$\Rightarrow \quad \frac{2}{7} = 2x \quad \Rightarrow \quad x = \frac{1}{7}$ 1

7. $2X = \begin{pmatrix} 7 & 4 \\ -1 & 10 \end{pmatrix} - 3\begin{pmatrix} 3 & 2 \\ 1 & 4 \end{pmatrix} = \begin{pmatrix} -2 & -2 \\ -4 & -2 \end{pmatrix}$ $1\frac{1}{2}$

$\therefore \quad X = \begin{pmatrix} -1 & -1 \\ -2 & -1 \end{pmatrix}$ $\frac{1}{2}$

8. f being polynomial is continuous in [1, 3] and differentiable in (1, 3) with $f'(x) = 3x^2 - 10x - 3$ $\frac{1}{2}$

$\therefore \quad f'(c) = \frac{f(3) - f(1)}{3 - 1} \Rightarrow 3c^2 - 10c - 3 = -10$

$\Rightarrow \quad 3c^2 - 10c + 7 = 0$ 1

$\Rightarrow \quad c = 1, \frac{7}{3}$

Since $1 \notin (1, 3)$, $\frac{7}{3} \in (1, 3)$ $\frac{1}{2}$

$\therefore$ Theorem verified.

9. $6y = x^3 + 2 \Rightarrow 6\frac{dy}{dt} = 3x^2 \cdot \frac{dx}{dt}$ ...(1) $\frac{1}{2}$

Given: $\frac{dy}{dt} = 2 \cdot \frac{dx}{dt}$ ...(2) $\frac{1}{2}$

from (1) and (2), $2\left(2\frac{dx}{dt}\right) = x^2 \cdot \frac{dx}{dt} \Rightarrow x = \pm 2$

when $x = 2$, $y = \frac{5}{3}$; when $x = -2$, $y = -1$

$\therefore$ Points are $\left(2, \frac{5}{3}\right)$ and $(-2, -1)$ 1

10. $I = \int \frac{\sin(x + a - 2a)}{\sin(x + a)} dx$ $\frac{1}{2}$

$= \int \frac{\sin(x+a)\cos 2a - \cos(x+a)\cdot\sin 2a}{\sin(x+a)} dx$

$= x\cos 2a - \sin 2a \cdot \log|\sin(x+a)| + c$ $1\frac{1}{2}$

11. Diagonals of parallelogram are $\vec{a} + \vec{b}$ and $\vec{b} - \vec{a}$ [or $\vec{a} - \vec{b}$]

$\vec{a} + \vec{b} = 3\hat{i} - 8\hat{j} + 4\hat{k}$ and $\vec{b} - \vec{a} = \hat{i} - 6\hat{j} - 2\hat{k}$ 1

Req. area $= \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -8 & 4 \\ 1 & -6 & -2 \end{vmatrix} = \frac{1}{2}|40\hat{i} + 10\hat{j} - 10\hat{k}|$

$= \frac{1}{2}\sqrt{1800} = 15\sqrt{2}$ sq. units 1

12. P (getting an odd no. atleast once)

= 1 – P(even no. & even no. & even no.) 1

$= 1 - \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2} = \frac{7}{8}$ 1

SECTION C

13. $R_1 \to x\cdot R_1, R_2 \to y\cdot R_2, R_3 \to z\cdot R_3$

$\text{LHS} = \frac{1}{xyz}\begin{vmatrix} x^2y & x^2z & x(x^2+1) \\ y(y^2+1) & y^2z & xy^2 \\ yz^2 & z(z^2+1) & xz^2 \end{vmatrix}$ 1

taking y, z and x respectively common from C_1, C_2, C_3

$= \frac{xyz}{xyz}\begin{vmatrix} x^2 & x^2 & x^2+1 \\ y^2+1 & y^2 & y^2 \\ z^2 & z^2+1 & z^2 \end{vmatrix}$ 1

$R_1 \to R_1 + R_2 + R_3$

$$= \begin{vmatrix} 1+x^2+y^2+z^2 & 1+x^2+y^2+z^2 & 1+x^2+y^2+z^2 \\ y^2+1 & y^2 & y^2 \\ z^2 & z^2+1 & z^2 \end{vmatrix}$$

$$= (1+x^2+y^2+z^2)\begin{vmatrix} 1 & 1 & 1 \\ y^2+1 & y^2 & y^2 \\ z^2 & z^2+1 & z^2 \end{vmatrix}$$ 1

$C_1 \to C_1 - C_3,\ C_2 \to C_2 - C_3$

$$= (1+x^2+y^2+z^2)\begin{vmatrix} 0 & 0 & 1 \\ 1 & 0 & y^2 \\ 0 & 1 & z^2 \end{vmatrix} = 1+x^2+y^2+z^2$$ 1

$= \text{RHS}$

OR

$\text{LHS} = A^2 - 7A + 10I_3$

$$= \begin{pmatrix} 11 & 14 & 0 \\ 7 & 18 & 0 \\ 0 & 0 & 25 \end{pmatrix} - \begin{pmatrix} 21 & 14 & 0 \\ 7 & 28 & 0 \\ 0 & 0 & 35 \end{pmatrix} + \begin{pmatrix} 10 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 10 \end{pmatrix}$$ $1\frac{1}{2}+1$

$$= \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} = O$$ $\frac{1}{2}$

Now, $A^2 - 7A + 10I = O$

$$\Rightarrow \quad A^{-1}(A^2 - 7A + 10I) = A^{-1}.\ O \Rightarrow A^{-1} = \frac{1}{10}(7I - A)$$ $\frac{1}{2}$

$$= \frac{1}{10}\begin{pmatrix} 4 & -2 & 0 \\ -1 & 3 & 0 \\ 0 & 0 & 2 \end{pmatrix}$$ $\frac{1}{2}$

14. $k = \lim_{x\to 0} \frac{(3^{\sin x} - 1)^2}{x \log(1+5x)}$

$$= \lim_{x\to 0} \frac{(3^{\sin x} - 1)^2}{\sin^2 x} \times \lim_{x\to 0} \frac{\sin^2 x}{x^2} \times \frac{1}{5} \lim_{x\to 0} \frac{1}{\frac{\log(1+5x)}{5x}}$$ 1+1+1

$$= \frac{1}{5}(\log 3)^2$$ 1

OR

Getting

$$\frac{dy}{dx} = \frac{-1}{\sqrt{1-x}\,(1+x)^{3/2}}$$ 2

$$\therefore \quad \text{LHS} = (1-x^2)\cdot\left(\frac{-1}{\sqrt{1-x}\,(1+x)^{3/2}}\right) + \sqrt{\frac{1-x}{1+x}}$$ 1

$$= -\sqrt{\frac{1-x}{1+x}} + \sqrt{\frac{1-x}{1+x}} = 0 = \text{R.H.S.}$$ 1

15. $y \cdot \log(\sin x) = \log(x+y)$

$$\Rightarrow y \cdot \frac{\cos x}{\sin x} + \log(\sin x)\cdot\frac{dy}{dx} = \frac{1}{x+y}\left(1 + \frac{dy}{dx}\right)$$ 2

$$\Rightarrow \left(y \cot x - \frac{1}{x+y}\right) = \left(\frac{1}{x+y} - \log(\sin x)\right)\cdot\frac{dy}{dx}$$ 1

$$\Rightarrow [(x+y)\cdot y \cot x - 1] = [1 - (x+y)\log(\sin x)]\cdot\frac{dy}{dx}$$

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

16. Let $\frac{x^2+x}{(x-1)(x^2+1)} = \frac{A}{x-1} + \frac{Bx+C}{x^2+1}$ 1

Getting A = 1, B = 0, C = 1 1

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

$$= \log|x-1| + \tan^{-1}x + C$$ 1+1

OR

$$I = \int \cos(3x+1)\cdot e^{2x}dx$$

$$= \cos(3x+1)\cdot\frac{e^{2x}}{2} - \int -3\sin(3x+1)\cdot\frac{e^{2x}}{2}dx$$ 1

$$= \frac{1}{2}\cdot e^{2x}\cos(3x+1) + \frac{3}{2}\int \sin(3x+1)\cdot e^{2x}dx$$

$$= \frac{1}{2}e^{2x}\cos(3x+1) + \frac{3}{2}\left[\sin(3x+1)\cdot\frac{e^{2x}}{2} - \int 3\cos(3x+1)\cdot\frac{e^{2x}}{2}dx\right]$$ 1

$$= \frac{1}{2}e^{2x}\cos(3x+1) + \frac{3}{4}\sin(3x+1)\cdot e^{2x} - \frac{9}{4}I$$ 1

$$\Rightarrow I = \frac{e^{2x}}{13}[2\cos(3x+1) + 3\sin(3x+1)] + C$$ 1

17. $$I = \int_0^{\pi/2} \frac{\sin^2 x}{\sin x + \cos x}dx = \int_0^{\pi/2} \frac{\sin^2(\pi/2 - x)}{\sin(\pi/2 - x) + \cos(\pi/2 - x)}dx$$ 1

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

$$\therefore 2I = \int_0^{\pi/2} \frac{1}{\sin x + \cos x}dx$$ $\frac{1}{2}$

$$2I = \frac{1}{\sqrt{2}}\int_0^{\pi/2} \frac{1}{\frac{1}{\sqrt{2}}\sin x + \frac{1}{\sqrt{2}}\cos x}dx = \frac{1}{\sqrt{2}}\int_0^{\pi/2} \operatorname{cosec}(\pi/4 + x)dx$$ 1

$I = \frac{1}{2\sqrt{2}} \log |\operatorname{cosec}(\pi/4 + x) - \cot(\pi/4 + x)|]_0^{\pi/2}$ 1

$= \frac{1}{2\sqrt{2}} \{\log(\sqrt{2}+1) - \log(\sqrt{2}-1)\}$ $\frac{1}{2}$

18. I.F. = $e^{\int -3\cot x\, dx = e^{-3\log(\sin x)}} = \operatorname{cosec}^3 x$ 1

solution is given by:

$y \cdot \operatorname{cosec}^3 x = \int \sin 2x \cdot \operatorname{cosec}^3 x\, dx + c$ 1

$= 2\int \cot x \cdot \operatorname{cosec} x\, dx + c$

$= -2 \operatorname{cosec} x + c$ 1

$\therefore\ y = -2\sin^2 x + c\sin^3 x$

when $y = 2,\ x = \frac{\pi}{2} \Rightarrow c = 4$ $\frac{1}{2}$

$\therefore\ y = = -2\sin^2 x + 4\sin^3 x$ $\frac{1}{2}$

19. Equation of ellipse is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1;\ a > b$ 1

$\Rightarrow \frac{2x}{a^2} + \frac{2y \cdot y'}{b^2} = 0$

$\Rightarrow \frac{yy'}{x} = -\frac{b^2}{a^2}$ 1

differentiating again,

$\Rightarrow \frac{x[y \cdot y'' + y' \cdot y'] - yy' \cdot 1}{x^2} = 0$ 1

$\Rightarrow xy \cdot y'' + x(y')^2 - yy' = 0$

or $xy\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - y\left(\frac{dy}{dx}\right) = 0$ 1

20. For coplanarity $[\overrightarrow{AB} \quad \overrightarrow{AC} \quad \overrightarrow{AD}] = 0$ 1

$\overrightarrow{AB} = [\hat{i} + (x-2)\hat{j} + 4\hat{k}]$

$\overrightarrow{AC} = \hat{i} - 3\hat{k}$ $1\frac{1}{2}$

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

$\Rightarrow \begin{vmatrix} 1 & x-2 & 4 \\ 1 & 0 & -3 \\ 3 & 3 & -2 \end{vmatrix} = 0$ 1

$\Rightarrow x = 5$ $\frac{1}{2}$

21. Here, $\vec{a}_2 - \vec{a}_1 = 3\hat{i} + 3\hat{j} + 3\hat{k}$ $\frac{1}{2}$

$\vec{b}_1 \times \vec{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -3 & 2 \\ 2 & 3 & 1 \end{vmatrix} = -9\hat{i} + 3\hat{j} + 9\hat{k}$ 1

$|\vec{b}_1 \times \vec{b}_2| = \sqrt{81+9+81} = \sqrt{171}$ $\frac{1}{2}$

S.D. $= \left| \dfrac{(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)}{|\vec{b}_1 \times \vec{b}_2|} \right|$ $\frac{1}{2}$

$= \dfrac{3(-9) + 3(3) + 3(9)}{\sqrt{171}} = \dfrac{3}{\sqrt{19}}$ units $1\frac{1}{2}$

22. E_1: Bag A is selected; E_2: Bag B is selected

E_3: Bag C is selected; A: Getting the Red ball $\frac{1}{2}$

$P(E_1) = P(E_2) = P(E_3) = 1/3$ $\frac{1}{2}$

$P(A/E_1) = 1/2$, $P(A/E_2) = 3/8$, $P(A/E_3) = 5/8$ 1

Using Bayes' theorem, $P(E_2/A) = \dfrac{P(E_2)\cdot P(A/E_2)}{P(E_1)\cdot P(A/E_1) + P(E_2)\cdot P(A/E_2) + P(E_3)\cdot P(A/E_3)}$

$$= \frac{\frac{1}{3}\times\frac{3}{8}}{\frac{1}{3}\times\frac{4}{8}+\frac{1}{3}\times\frac{3}{8}+\frac{1}{3}\times\frac{5}{8}} \qquad 1\frac{1}{2}$$

$$= \frac{1}{4} \qquad \frac{1}{2}$$

23. Let X represent the no. of kings

$\therefore$ X = 0, 1, 2 $\qquad \frac{1}{2}$

$$\left.\begin{aligned} P(X=0) &= \frac{48}{52}\times\frac{47}{51}=\frac{564}{663} \\ P(X=1) &= 2\times\frac{4}{52}\times\frac{48}{51}=\frac{96}{663} \\ P(X=2) &= \frac{4}{52}\times\frac{3}{51}=\frac{3}{663.} \end{aligned}\right\} \qquad 2$$

Probability distribution table is:

X	0	1	2
P(X)	$\frac{564}{663}$	$\frac{96}{663}$	$\frac{3}{663}$

$\frac{1}{2}$

$$\text{Mean} = \sum X\cdot P(X) = 1\times\frac{96}{663}+2\times\frac{3}{663}=\frac{2}{13} \qquad 1$$

SECTION D

24. Let $x_1, x_2 \in [-1, 1]$

Let $f(x_1) = f(x_2)$

$$\Rightarrow \frac{x_1}{x_1+2} = \frac{x_2}{x_2+2} \Rightarrow x_1x_2 + 2x_1 = x_1x_2 + 2x_2$$

$\Rightarrow x_1 = x_2 \Rightarrow$ f is 1 – 1 function 2

For, f: $[-1, 1] \to R_f$

Given, co-domain = Range $\Rightarrow$ f is onto 1

$\Rightarrow$ f is invertible

To find f^{-1}: Let $y = f(x) \Rightarrow x = f^{-1}(y)$

Now, $y = \dfrac{x}{x+2} \quad \Rightarrow \quad x = \dfrac{2y}{1-y};\ y \neq 1$

$\therefore \quad f^{-1}(x) = \dfrac{2x}{1-x};\ x \neq 1$ 1

getting $f^{-1}\left(\dfrac{-1}{3}\right) = \dfrac{-1}{2}$ 1

$f^{-1}\left(\dfrac{1}{5}\right) = \dfrac{1}{2}$ 1

OR

$b * a = \dfrac{b+a}{2} = \dfrac{a+b}{2} = a * b \ \forall\ a, b \in R$

$\therefore$ * is commutative. 2

Let $a, b, c \in R$

Consider $(a * b) * c = \left(\dfrac{a+b}{2}\right) * c = \dfrac{a+b+2c}{2}$

and, $a * (b * c) = a * \left(\dfrac{b+c}{2}\right) = \dfrac{2a+b+c}{2}$

clearly, $(a * b) * c \neq a * (b * c)$

$\Rightarrow$ * is not associative. [Can be shown by example] 2

Let $e \in R$ be identity (if exists)

then, $a * e = a = e * a$

$\Rightarrow \frac{a+e}{2} = a = \frac{e+a}{2} \Rightarrow a + e = 2a$

$\Rightarrow e = a$, which is not unique 2

$\therefore$ e does not exist.

25. Given system can be written as

$$\begin{bmatrix} 1 & -1 & 2 \\ 3 & 4 & -5 \\ 2 & -1 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ -5 \\ 12 \end{bmatrix}$$ 1

i.e, AX = B

$|A| = 4 \neq 0 \Rightarrow A^{-1}$ exists.

Now, $A_{11} = 7, \quad A_{12} = -19, \quad A_{13} = -11$

$A_{21} = 1, \quad A_{22} = -1, \quad A_{23} = -1$ 2

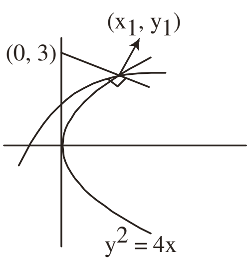
$A_{31} = -3, \quad A_{32} = 11, \quad A_{33} = 7$

$$\therefore A^{-1} = \frac{1}{4}\begin{bmatrix} 7 & 1 & -3 \\ -19 & -1 & 11 \\ -11 & -1 & 7 \end{bmatrix}$$ 1

$$\therefore \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{4}\begin{bmatrix} 7 & 1 & -3 \\ -19 & -1 & 11 \\ -11 & -1 & 7 \end{bmatrix}\begin{bmatrix} 7 \\ -5 \\ 12 \end{bmatrix}$$ $\frac{1}{2}$

$$= \frac{1}{4}\begin{bmatrix} 8 \\ 4 \\ 12 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix} \Rightarrow x = 2, y = 1, z = 3$$ $1\frac{1}{2}$

26.



$y^2 = 4x \Rightarrow 2y\frac{dy}{dx} = 4 \Rightarrow \frac{dy}{dx} = \frac{2}{y}$ $\frac{1}{2}$

$\therefore \left.\frac{dy}{dx}\right]_{(x_1, y_1)} = \frac{2}{y_1}$

$\Rightarrow$ slope of normal $= -\frac{y_1}{2}$ $\frac{1}{2}$

Equation of normal: $y - y_1 = -\frac{y_1}{2}(x - x_1)$ 1

Normal passes through (0, 3)

$\therefore\ 3 - y_1 = -\frac{y_1}{2}(0 - x_1) \;\Rightarrow\; 6 - 2y_1 = x_1 y_1 \quad ...(1)$ $\frac{1}{2}$

also, (x_1, y_1) lies on $y^2 = 4x \Rightarrow {y_1}^2 = 4x_1 \quad ...(2)$

Solving (1) and (2), $x_1 = 1, y_1 = 2 \therefore (x_1, y_1) = (1, 2)$ $1\frac{1}{2}$

Slope of normal $= \frac{-y_1}{2} = \frac{-2}{2} = -1$

Equation of normal is $y - 2 = -(x - 1) \Rightarrow x + y = 3$ 2

OR

Let perimeter of square be x cm, then circumference of circle is (28 – x) cm.

Let side of square is a and radius of circle is r, then, $a = \frac{x}{4}, r = \frac{28 - x}{2\pi}$ 1

Now, $A = \left(\frac{x}{4}\right)^2 + \pi\left(\frac{28 - x}{2\pi}\right)^2$ 1

$\therefore\ A = \frac{x^2}{16} + \frac{1}{4\pi}(28 - x)^2$

$\Rightarrow \frac{dA}{dx} = \frac{x}{8} - \frac{1}{2\pi}(28 - x)$ 1

$\frac{dA}{dx} = 0 \Rightarrow x = \frac{112}{\pi + 4}$ cm 1

$\frac{d^2A}{dx^2} = \frac{1}{8} + \frac{1}{2\pi} > 0 \Rightarrow$ Area is minimum 1

other length $= 28 - x = 28 - \frac{112}{\pi + 4}$ cm $= \frac{28\pi}{\pi + 4}$ cm 1

27. $A = \int_2^4 3\sqrt{x}\,dx = 3\times\frac{2}{3}[x^{3/2}]_2^4$ 2+2

$= 2\,(8 - 2^{3/2})$ sq. units 2

OR

$a = 2,\ b = 5,\ nh = 3$ 1

Let $f(x) = 2x^2 + 3x + 1$

$$\int_2^5 (2x^2 + 3x + 1)dx = \lim_{h\to 0} h\cdot[f(2) + f(2+h) + f(2+2h) + ... + f(2+(n-1)h)]$$ 1

here, $f(2) = 2(2)^2 + 3(2) + 1 = 15$

$f(2 + h) = 2(2 + h)^2 + 3(2 + h) + 1 = 2h^2 + 11h + 15$

$f(2 + 2h) = 2[2 + 2h]^2 + 3[2 + 2h] + 1 = 2.2^2h^2 + 22h + 15$

$f(2 + (n-1)h) = 2[2 + (n-1)h]^2 + 3[2 + (n-1)h] + 1$ 1

$= 2(n-1)^2h^2 + 11(n-1)h + 15$

$$\therefore \int_2^5 (2x^2 + 3x + 1)dx$$

$$= \lim_{h\to 0} h\cdot[15 + (2h^2 + 11h + 15) + ... + (2(n-1)^2h^2 + 11(n-1)h + 15)]$$ 1

$$= \lim_{h\to 0} h[15n + 2h^2\cdot(1^2 + 2^2 + ... + (n-1)^2) + 11h(1 + 2 + ... + (n-1))]$$

$$= \lim_{h\to 0}\left(15nh + 2\cdot\frac{(nh)\,(nh-h)\,(2nh-h)}{6} + \frac{11\cdot(nh)\,(nh-h)}{2}\right)$$ 1

$$= \lim_{h\to 0}\left(45 + \frac{1}{3}\times 3(3-h)\,(6-h) + \frac{11}{2}\times 3(3-h)\right)$$

$$= 45 + 18 + \frac{99}{2} = \frac{225}{2}$$ 1

28. Any point on given line is $(3\lambda + 2)\hat{i} + (4\lambda - 1)\hat{j} + (2\lambda + 2)\hat{k}$ 1

If this line and given plane intersect, then

$1(3\lambda + 2) - 1(4\lambda - 1) + 1(2\lambda + 2) = 5 \Rightarrow \lambda = 0$ 2

$\therefore$ Point of intersection is $(2, -1, 2)$ 1

$\therefore$ the distance $= \sqrt{(2+1)^2 + (-1+5)^2 + (2+10)^2} = 13$ units 2

29. Let x kg of food X and y kg of food Y are mixed then,

minimum cost, $Z = 16x + 20y$ 1

subject to following constraints:

$x + 2y \geq 10$

$2x + 2y \geq 12$ or $x + y \geq 6$ 4

$3x + y \geq 8$

$x \geq 0,\ y \geq 0$

Value: Any relevant value. 1