ESE 2024 Prelims Solutions

General Studies & Engineering Aptitude

Set-A

Scroll down

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General Studies and Engineering Aptitude Paper Analysis of ESE 2024 Preliminary Examination		
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1	Current issues of national and international importance	15
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UPSC ESE Prelims 2024

General Studies & Engg. Aptitude (Paper-1) analysis

by MADE EASY faculties

Q.1 The standard deviation of the exponential distribution of

$$f_X(x) = \begin{cases} \lambda e^{-\lambda x}, & x \geq 0 \\ 0, & x < 0 \end{cases} \text{ is}$$

(a) $\frac{1}{\lambda}$ (b) $\frac{2}{\lambda^2}$

(c) $\frac{3}{\lambda^3}$ (d) $\frac{2}{\lambda^3}$

Ans. **(a)**

In exponential distribution, if λ is the parameter then mean = S.D = $\frac{1}{\lambda}$.

End of Solution

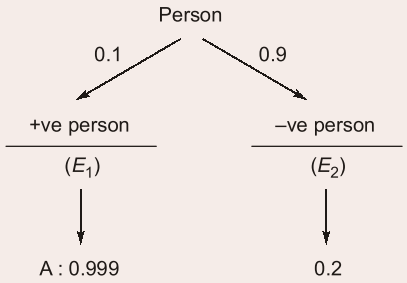
Q.2 Suppose that 0.1% of the people in a certain area have a disease *D* and that a mass screening test is used to detect cases. The test gives either a positive or a negative result for each person. Ideally, the test would always give a positive result for a person who has *D*, and would never do so for a person who has not. In practice the test gives a positive result with probability 99.9% for a person who has *D*, and with probability 0.2% for a person who has not. What is the probability that a person for whom the test is positive actually has the disease?

(a) $\frac{1}{3}$ (b) $\frac{5}{3}$

(c) $\frac{4}{3}$ (d) $\frac{2}{3}$

Ans. **(a)**

A = {Test is +ve}



$$P(A) = 0.1 \times 0.999 + 0.9 \times 0.2 = 0.2799$$

$$P(\text{Actually +ve}) = P\left(\frac{E_1}{A}\right) = \frac{0.1 \times 0.999}{P(A)}$$

$$= \frac{0.1 \times 0.999}{0.2799} = \frac{999}{2799} = 0.356 \approx \frac{1}{3}$$

End of Solution

Q.3 Let the random variables X and Y have joint density function given by

$$f_{X,Y}(x,\ y) = \begin{cases} c(1-y), & 0 \le x \le y \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Then the marginal density function for X is

(a) $f_X(x) = 6\left(\frac{1}{2} - x - \frac{x^2}{2}\right)$ for $0 \le x \le 1$ (b) $f_X(x) = 6\left(\frac{1}{2} + x + \frac{x^2}{2}\right)$ for $0 \le x \le 1$

(c) $f_X(x) = 6\left(\frac{1}{2} + x - \frac{x^2}{2}\right)$ for $0 \le x \le 1$ (d) $f_X(x) = 6\left(\frac{1}{2} - x + \frac{x^2}{2}\right)$ for $0 \le x \le 1$

Ans. **(d)**

We know that,

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f_{xy}(x,y)\,dy\,dx = 1$$

$$\therefore \quad \int_{x=0}^{1}\int_{y=x}^{1} c(1-y)\,dy\,dx = 1$$

$$= c\int_0^1 \frac{(1-y)^2}{-2}\Big]_x^1 dx = 1$$

$$= \frac{c}{-2}\int_0^1 \left[0-(1-x)^2\right]dx = 1$$

$$= \frac{c}{2}\frac{(1-x)^3}{-3}\Big]_0^1 = 1 \Rightarrow \frac{c}{6}[1-0] = 1 \Rightarrow c = 6$$

So M.D.F. is

$$f_x(x) = \int_{y=x}^{0} 6(1-y)\,dy$$

$$= 6\left(y - \frac{y^2}{2}\right)_x^0 = 6\left[(0) - \left(x - \frac{x^2}{2}\right)\right]$$

$$= -6x + 3x^2 = +6\left(-x + \frac{x^2}{2}\right)$$

End of Solution

Q.4 The continuous-time signal $f(t) = e^{-2\omega t}$, where ω is a real constant, is sampled when $t \geq 0$ at intervals T. What is the z transform of the resulting sequence of samples?

(a) $\dfrac{z}{z - e^{-2\omega T}}$ (b) $\dfrac{z}{1 - e^{-2\omega T}}$

(c) $\dfrac{z}{z - e^{-\omega T}}$ (d) $\dfrac{z}{z - e^{2\omega T}}$

Ans. (a)

$$f(t) = e^{-2\omega t}$$

$$z\{a^n\} = \frac{z}{z-a}$$

$$z[e^{-2\omega t}] = \frac{z}{z - e^{-2\omega T}}$$

End of Solution

Q.5 If $(z) = \dfrac{z}{z^2 - z + 1}$, then the inverse z transform of $Y(z)$ is

(a) $\sqrt{\frac{1}{3}}\sin\frac{1}{3}k\pi$ (b) $2\sqrt{\frac{1}{3}}\sin\frac{1}{3}k\pi$

(c) $2\sqrt{\frac{1}{3}}\cos\frac{1}{3}k\pi$ (d) $2\sqrt{\frac{1}{3}}\sin k\pi$

Ans. (b)

$$z^{-1}(Y(z)) = z^{-1}\left(\frac{z}{z^2 - z + 1}\right)$$

$$z^{-1} = \left(\frac{z^{-1}}{1 - z^{-1} + z^{-2}} = \frac{z^{-1}}{z^{-2} - z^{-1} + 1}\right)$$

$$z^{-1} = \left(\frac{2}{\sqrt{3}} \cdot \frac{\frac{\sqrt{3}}{2} \cdot z^{-1}}{z^{-2} - z^{-1} + 1}\right)$$

$$z^{-1} = \left(\frac{2}{\sqrt{3}} \frac{\sin\frac{\pi}{3} z^{-1}}{1 - 2\left(\cos\frac{\pi}{3}\right) z^{-1} + z^{-2}}\right)$$

$$= \frac{2}{\sqrt{3}}\sin\frac{\pi n}{3}u(n) = \frac{2}{\sqrt{3}}\sin\frac{\pi n}{3}$$

Formula:

$$z^{-1}\left[\frac{\sin(\omega_0)z^{-1}}{1 - 2\cos\omega_0 z^{-1} + z^{-2}}\right] = \sin(n\omega_0)u(n)$$

End of Solution

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Q.6 The temperature distribution $T(x)$ at a distance x, measured from one end, along a bar of length L is given by $T(x) = Kx(L-x)$ $(0 \le x \le L)$, K = constant. A Fourier series expansion consisting of sine terms only for $T(x)$ is

(a) $\frac{8KL^2}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$ (b) $\frac{8KL^2}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}\sin\frac{(2n-1)\pi x}{L}$

(c) $\frac{8KL^3}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$ (d) $\frac{8KL^3}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}\sin\frac{(2n-1)\pi x}{L}$

Ans. **(a)**

Fourier Sine series of $T(x)$ is $[0, L]$ is given by half range. Sine series

$$T(x) = \sum_{n=1}^{\infty} b_n \sin\frac{n\pi x}{L}$$

$$b_n = \frac{2}{L}\int_0^L T(x)\sin\frac{n\pi x}{L}dx$$

$$= \frac{2}{L}\int_0^L Kx(L-x)\sin\frac{n\pi x}{L}dx$$

$$= \frac{2K}{L}\left[(Lx-x^2)\left(\frac{-\cos\frac{n\pi x}{L}}{\frac{n\pi}{L}}\right)\right] - (L-2x)\left(\frac{-\sin\frac{n\pi x}{L}}{\frac{n^2\pi^2}{L^2}}\right)$$

$$+(-2)\left(\frac{\cos\frac{n\pi x}{L}}{\frac{n^3\pi^3}{L^3}}\right)\Bigg]_0^L$$

$$= \frac{2K}{L}\left\{\left[\frac{-2L^3}{n^3\pi^3}\cos n\pi + \frac{2L^3}{n^3\pi^3}\right]\right.$$

$$b_n = \frac{4KL^3}{Ln^3\pi^3}[1-(-1)]^n$$

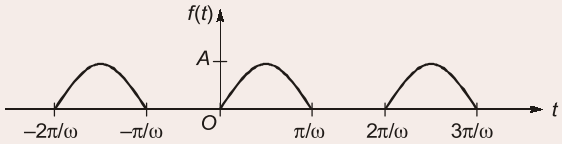
n is odd

$$b_{2n-1} = \frac{8KL^2}{(2n-1)^3\pi^3}$$

$$\therefore \quad T(x) = \frac{8KL^2}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$$

End of Solution

Q.7 Passing a sinusoidal voltage $A \sin \omega t$ through a half-wave rectifier produces the clipped sine wave shown in the following figure.



A Fourier series expansion of the rectified wave is

(a) $f(t) = \frac{A}{\pi}\left[1 + \frac{\pi}{2}\sin\omega t + 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2 - 1}\right]$

(b) $f(t) = \frac{A}{\pi}\left[1 + \frac{\pi}{2}\sin\omega t - 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2 - 1}\right]$

(c) $f(t) = \frac{A}{\pi}\left[1 - \frac{\pi}{2}\sin\omega t - 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2 - 1}\right]$

(d) $f(t) = \frac{A}{\pi}\left[1 - \frac{\pi}{2}\sin\omega t + 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2 - 1}\right]$

Ans. (b)

$$f(t) = \begin{cases} A\sin\omega t, & 0 \le t \le \frac{\pi}{\omega} \\ 0, & \frac{\pi}{\omega} Mt \le \frac{2\pi}{\omega} \end{cases} \quad \left(0, \frac{\omega\pi}{\omega}\right) \Rightarrow l = \frac{\pi}{\omega}$$

$$a_0 = \frac{1}{l}\int_0^{2l} f(t)\,dt = \frac{1}{\frac{\pi}{\omega}}\int_0^{\frac{2\pi}{\omega}} f(t)\,dt = \frac{\omega}{\pi}\left[\int_0^{\frac{\pi}{\omega}} A\sin\omega t\,dt + 0\right]$$

$$= \frac{A\cdot\omega}{\pi}\left(-\frac{\cos\omega t}{\omega}\right)_0^{\frac{\pi}{\omega}} = -\frac{A}{\pi}[\cos\pi - 1] = \frac{2A}{\pi}$$

$$a_n = \frac{1}{l}\int_0^{2l} f(t)\cos\left(\frac{n\pi t}{l}\right)dt = \frac{1}{\frac{\pi}{\omega}}\int_0^{\frac{2\pi}{\omega}} f(t)\cdot\cos(n\omega t)\cdot dt$$

$$= \frac{\omega}{\pi}\left[\int_0^{\frac{\pi}{\omega}} A\sin\omega t\cdot\cos(n\omega t)\cdot dt + 0\right]$$

$$= \frac{\omega A}{2\pi}\int_0^{\frac{\pi}{\omega}}[\sin(1+n)\omega t + \sin(1-n)\omega t]\,dt$$

$$= \frac{\omega A}{2\pi}\left[\frac{-\cos(1+n)\omega t}{(1+n)\omega} - \frac{\cos(1-n)\omega t}{(1-n)\omega}\right]_0^{\frac{\pi}{\omega}}$$

$$= \frac{A}{2\pi}\left[\frac{-\cos(1+n)\pi+1}{1+n}+\frac{-\cos(1-n)\pi+1}{1-n}\right]$$

$$= \begin{cases} 0, & n = \text{odd} \\ \frac{A}{2\pi}\left(\frac{2}{1+n}+\frac{2}{1-n}\right), & n = \text{even} = \frac{-2A}{(n^2-1)\pi} \end{cases} \quad n = \text{even}$$

$$b_1 = \frac{1}{l}\int_0^{2l} f(t)\sin\left(\frac{\pi t}{l}\right)dt = \frac{1}{\frac{\pi}{\omega}}\int_0^{\frac{2\pi}{\omega}} f(t)\cdot\sin\omega t\,dt$$

$$= \frac{\omega}{\pi}\left[\int_0^{\frac{\pi}{\omega}} A\cdot\sin\omega t\cdot\sin\omega t\,dt + 0\right] = \frac{A\omega}{\pi}\int_0^{\frac{\pi}{\omega}}\left(\frac{1-\cos 2\omega t}{2}\right)dt$$

$$= \frac{A\omega}{2\pi}\left[t-\frac{\sin 2\omega t}{2w}\right]_0^{\frac{\pi}{\omega}} = \frac{A\omega}{2\pi}\left[\left(\frac{\pi}{\omega}-0\right)-(0-0)\right] = \frac{A}{2}$$

So Fourier series is $f(n) = \frac{a_0}{2}+\sum a_n\cos\left(\frac{n\pi t}{l}\right)+\sum b_n\sin\left(\frac{n\pi t}{l}\right)$

$$f(n) = \frac{A}{\pi}+\frac{A}{2}\sin\omega t-\frac{2A}{\omega\pi}\sum_{n=\text{even}}\left(\frac{\cos n\omega t}{n^2-1}\right)$$

where, $n = 2N$

So answer is option (b).

End of Solution

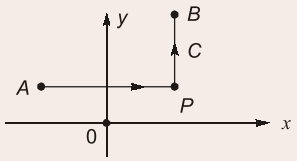
Q.8 What is the contour integral $\int_C z^2 dz$ along the path C from $-1 + j$ to $5 + 3j$ and composed of two straight line segments, the first from $-1 + j$ to $5 + j$ and the second from $5 + j$ to $5 + 3j$?

(a) $-4+\frac{196}{3}j$ (b) $-4-\frac{196}{3}j$

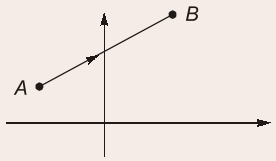
(c) $4-\frac{196}{3}j$ (d) $4+\frac{196}{3}j$

Ans. (a)

$\because$ $f(z) = z^2$ is an analytic function and given contour is an open contour, so integral will be path independent i.e.



or



$A = -1 + i$
$B = 5 + 3i$
$P = 5 + i$

Now, $$I = \int_C z^2 dz = \int_{AB} z^2 dz = \int_{z=-1+i}^{5+3i} z^2 dz = \left(\frac{z^3}{3}\right)_{-1+i}^{5+3i}$$

$$= \frac{1}{3}\left[(5+3i)^3 - (-1+i)^3\right]$$

$$= \frac{1}{3}\left[\{125 - 27i + 225i - 135\} + \{-2 - 2i\}\right]$$

$$= \frac{1}{3}\left[(-10 + 198i) + (2 - 2i)\right]$$

$$= \frac{1}{3}\left[-12 + 196i\right] = -4 + \frac{196}{3}i$$

End of Solution

Q.9 The image in the w plane of the circle $\left|z + \frac{3}{4} + j\right| = \frac{7}{4}$ under the inversion mapping $w = 1/z$ is

(a) a circle centre (1/2, 2/3) and radius 7/6
(b) a circle centre (1/2, –2/3) and radius 7/6
(c) a circle centre (–1/2, 2/3) and radius 7/6
(d) a circle centre (–1/2, –2/3) and radius 7/6

Ans. (c)

Given circle $\left|z + \frac{3}{4} + j\right| = \frac{7}{4}$

Put $$w = \frac{1}{z} \Rightarrow z = \frac{1}{w}$$

$$\left|\frac{1}{w} + \frac{3}{4} + 0\right| = \frac{7}{4}$$

$$\left|1 + \left(\frac{3}{4} + j\right)w\right| = \frac{7}{4}|w|$$

$$\left|1 + \left(\frac{3}{4} + j\right)(4 + jv)\right| = \frac{7}{4}|u + iv|$$

$$\left|1 + \frac{3}{4}4 + j\left(\frac{3}{4}v + u\right) - v\right| = \frac{7}{4}\sqrt{(u^2 + v^2)}$$

$$\left(1 + \frac{3}{4}u - v\right)^2 + \left(\frac{3}{4}v + u\right)^2 = \frac{49}{16}(u^2 + v^2)$$

$$= \frac{9}{16}u^2 + (1-v)^2 + 2\left(\frac{3}{4}u\right)(1-v) + \frac{9}{16}v^2 + u^2 + \frac{3}{2}uv$$

$$= +\frac{49}{16}u^2 + \frac{49}{16}v^2$$

$$= \left(\frac{25}{16} - \frac{49}{16}\right)u^2 + v^2\left[\frac{25}{16} - \frac{49}{16}\right] - 2v + \frac{3}{2}u + 1 = 0$$

$$= u^2 + v^2 + u - \frac{4}{3}v + \frac{2}{3} = 0$$

$$2gv = u \Rightarrow 2g = 1 \Rightarrow 9 = \frac{1}{2}$$

$$2fv = -\frac{4}{3}v \Rightarrow f = -\frac{2}{3} \Rightarrow -\frac{2}{3}$$

$\therefore$ Centre $(-g, -f) = \left(-\frac{1}{2}, +\frac{2}{3}\right)$

Radius $= r = \sqrt{g^2 + f^2 - c} = \sqrt{\frac{1}{4} + \frac{4}{9} + \frac{2}{3}} = \frac{7}{6}$

End of Solution

Q.10 The plane $x = 1$ intersects the paraboloid $z = x^2 + y^2$ in parabola. The slope of the tangent line to the parabola at (1, 2, 5) is

(a) 2 (b) 6

(c) 4 (d) 5

Ans. (c)

At $x = 1, \quad z = x^2 + y^2$

$\Rightarrow$ $z = 1 + y^2$

Then $\frac{dz}{dy} = 2y$

So $\left(\frac{dz}{dy}\right)_{y=2} = 2(2) = 4$

End of Solution

Q.11 Suppose we do not know the path of a hang glider, but only its acceleration vector $a(t) = -(3 \cos t)i - (3 \sin t)j + 2k$. We also know that initially (at time $t = 0$) the glider departed from the point (4, 0, 0) with velocity $v(0) = 3j$. What is the glider's position as a function of t?

(a) $r(t) = (1 + 3 \cos t)i - 3 \sin tj + t^2k$

(b) $r(t) = (-1 + 3 \cos t)i + 3 \sin tj + t^2k$

(c) $r(t) = (1 - 3 \cos t)i + 3 \sin tj + t^2k$

(d) $r(t) = (1 + 3 \cos t)i + 3 \sin tj + t^2k$

Ans. (d)

$a(t) = -(3\cos t)\hat{i} - (3\sin t)\hat{j} + 2\hat{k}$; $v(0) = 3\hat{j}$, $r(0) = 4\hat{i}$

Integrating, $v(t) = -(3\sin t)\hat{i} + (3\cos t)\hat{j} + (2t)\hat{k} + C_1$

Using $v(0) = 3\hat{j} \Rightarrow C_1 = 0$

So, $v(t) = -(3\sin t)\hat{i} + (3\cos t)\hat{j} + (2t)\hat{k}$

Again integrating, $r(t) = (3\cos t)\hat{i} + (3\sin t)\hat{j} + (t^2)\hat{k} + C_2$;

Using $r(0) = 4\hat{i} \Rightarrow C_2 = \hat{i}$

i.e. $r(t) = (3\cos t + 1)\hat{i} + (3\sin t)\hat{j} + (t^2)\hat{k}$

End of Solution

Q.12 What is the absolute minimum value of $f(x, y) = 2 + 2x + 4y - x^2 - y^2$ on the triangular region in the first quadrant bounded by the lines $x = 0$, $y = 0$, and $y = 9 - x$?

(a) –11 (b) –43

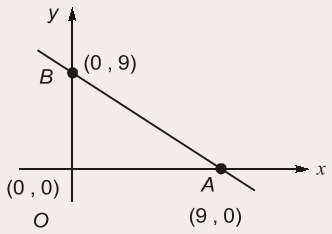
(c) –61 (d) –41

Ans. (c)

$$f(x, y) = 2 + 2x + 4y - x^2 - y^2 \quad ...(1)$$

$$f_x = 2 - 2x, \quad f_y = 4 - 2y$$

$$f_{xx} = -2 = r, \quad f_{yy} = -2 = t, \quad f_{xy} = 0 = s$$



Turning points are

$$\frac{\partial f}{\partial x} = 0, \quad \frac{\partial f}{\partial y} = 0$$

$$2 - 2x = 0, \quad 4 - 2y = 0$$

$$x = 1, \quad y = 2 \text{ i.e. } P(1, 2)$$

Now at $P(1, 2)$; $rt - s^2 > 0$ and $r < 0$ so $P(1, 2)$ is point of maxima.

Hence, Minima will occur at corner points

$$f(0, 0) = 2 + 0 + 0 - 0 - 0 = 2$$

$$f(9, 0) = 2 + 18 + 0 - 81 - 0 = -61 \Rightarrow \text{Answer}$$

$$f(0, 9) = 2 + 0 + 36 - 0 - 81 = -43$$

End of Solution

Q.13 What is the centroid ($\delta = 1$) of the solid enclosed by the cylinder $x^2 + y^2 = 4$, bounded above by the paraboloid $z = x^2 + y^2$, and bounded below by the xy-plane?

(a) $\left(0, 0, \frac{3}{4}\right)$ (b) $\left(0, 0, \frac{4}{3}\right)$

(c) $\left(0, 0, \frac{5}{4}\right)$ (d) $\left(0, 0, \frac{4}{5}\right)$

Ans. (b)

Given solid bounded by $x^2 + y^2 = 4$ above $z = x^2 + y^2$ below xy-plane, $z = 0$ and density $(\delta = 1)$.

So, the cylindrical coordinates will be $x = r\cos\theta$, $y = r\sin\theta$, $z = z$, $x^2 + y^2 = r^2$

$$R = \{(x, y, z) \mid 0 \le z \le r^2,\ 0 \le r \le 2,\ 0 \le \theta \le 2x\}$$

We know that,

$$\text{mass} = \iiint_R \delta\, dv = \int_0^{2\pi}\int_0^{2}\int_0^{r^2} 1\, r\, dr\, d\theta\, dz$$

$$= \int_{\theta=0}^{2\pi}\int_{r=0}^{0}\int_0^{r^2} r\, dz\, dr\, d\theta = \int_0^{2\pi}\int_0^{2} r\left(r^2\right) dr\, d\theta$$

$$= \left(\frac{r^4}{4}\right)_0^2 (\theta)_0^{2\pi} = 2\pi$$

Centroid is given by center of mass $(\bar{x}, \bar{y}, \bar{z})$

Center of mass $\bar{x} = \frac{1}{m}\iiint_R x\,\delta\, dv = \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} (r\cos\theta) r\, dz\, d\theta\, dr$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2} r^4\cos\theta\, dr\, d\theta = \frac{1}{8\pi}\left(\frac{r^5}{5}\right)_0^2 (\sin\theta)_0^{2\pi} = 0$$

and $\bar{y} = \frac{1}{m}\iiint_R y\,\delta\, dv$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} r\sin\theta\, r\, dz\, dr\, d\theta = \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2} r^4\sin\theta\, dr\, d\theta = 0$$

and $\bar{z} = \frac{1}{m}\iiint_R z\,\delta\, dv = \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} z\, r\, dz\, dr\, d\theta$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\left[\frac{z^2}{2}\right]_0^{r^2} dr\, d\theta = \frac{1}{8\pi}\int_0^{2\pi}\left(\frac{r^5}{10}\right)_0^2 d\theta = \frac{4}{3}$$

$\therefore$ Centroid $(\bar{x}, y, z) = \left(0, 0, \frac{4}{3}\right)$

End of Solution

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Q.14 What is the integral

$\int_1^2 \int_{1/y}^{y} \sqrt{\frac{y}{x}} e^{\sqrt{xy}} dx dy$?

(a) $2e(e + 2)$ (b) $2e(1 - e)$

(c) $2e(e - 2)$ (d) $2e(1 + e)$

Ans. **(c)**

$$I = \int_1^2 \int_{\frac{1}{y}}^{y} \sqrt{\frac{y}{x}} \cdot e^{\sqrt{xy}} \cdot dx\, dy$$

Put, $\sqrt{xy} = t$ — At $x = \frac{1}{y}$, $t = 1$; At $x = y$, $t = y$

$$\frac{1}{\sqrt{x}} dx = \frac{2dt}{\sqrt{y}}$$

$$= \int_1^2 \left[\int_{x=\frac{1}{y}}^{y} \frac{e^{\sqrt{xy}}}{\sqrt{x}} dx \right] \sqrt{y}\, dy$$

So, $$I = \int_1^2 \left(e^t \cdot \frac{2dt}{\sqrt{y}} \right)_1^y \cdot \sqrt{y}\, dy$$

$$= 2 \int_{y=1}^{2} \left(e^y - e \right) dy$$

$$= 2\left(e^y - y \cdot e \right)_1^2 = 2\left[\left(e^2 - 2e \right) - \left(e^1 - e \right) \right] = 2e(e-2)$$

End of Solution

Q.15 Fourier transform of

$f(t) = \begin{cases} \sin at, & |t| \le \pi / a \\ 0, & |t| > \pi / a \end{cases}$ is

(a) $\frac{2j \sin \pi\omega / a}{-a^2 - \omega^2}$ (b) $\frac{j \sin \pi\omega / a}{-a^2 - \omega^2}$

(c) $\frac{j \sin \pi\omega / a}{a^2 - \omega^2}$ (d) $\frac{2aj \sin \pi\omega / a}{\omega^2 - a^2}$

Ans. **(d)**

$$f(t) = \begin{cases} \sin at, & |t| \le \frac{\pi}{a} \\ 0, & |t| > \frac{\pi}{a} \end{cases} = \begin{cases} \sin at, & -\frac{\pi}{a} \le t \le \frac{\pi}{a} \\ 0, & \text{otherwise} \end{cases}$$

$$F\{f(t)\} = \int_{-\infty}^{\infty} e^{-iwt} \cdot f(t)\,dt = \int_{-\frac{\pi}{a}}^{\frac{\pi}{a}} e^{-i\omega t} \cdot \sin at\,dt$$

$$= \left\{\text{Using } \int e^{ax}\sin bx\,dx = \frac{e^{ax}}{a^2+b^2}(a\sin bx - b\cos bx)\right\}$$

$$= \left[\frac{e^{-i\omega t}}{-\omega^2+a^2}(-i\omega\sin at - a\cos at)\right]_{-\frac{\pi}{a}}^{\frac{\pi}{a}}$$

$$= \frac{1}{a^2-\omega^2}\left[\left\{e^{-i\omega\frac{\pi}{a}}(0 - a\cos\pi)\right\} - \left\{e^{i\omega\frac{\pi}{a}}(0 - a\cos(-\pi))\right\}\right]$$

$$= \frac{1}{a^2-\omega^2}\left[ae^{-i\omega\frac{\pi}{a}} - ae^{i\omega\frac{\pi}{a}}\right] = \frac{1}{\omega^2-a^2}\left[e^{i\omega\frac{\pi}{a}} - e^{-i\omega\frac{\pi}{a}}\right]$$

$$= \frac{1}{\omega^2-a^2}\left(2i\sin\left(\frac{\pi\omega}{a}\right)\right) = \frac{2ai}{\omega^2-a^2}\sin\left(\frac{\pi\omega}{a}\right)$$

End of Solution

Q.16 Brianna, Ryan, Tyler, and Ashley were recently elected as the new class officers (president, vice president, secretary, treasurer) of the sophomore class at Summit College. From the following clues, determine which position each holds.

1. Ashley is younger than the president but older than the treasurer.
2. Brianna and the secretary are both the same age, and they are the youngest members of the group.
3. Tyler and the secretary are next door neighbors.

(a) Tyler is the president, Ashley is the vice president, Ryan is the secretary, and Brianna is the treasurer.

(b) Tyler is the president, Ashley is the vice president, Brianna is the secretary, and Ryan is the treasurer.

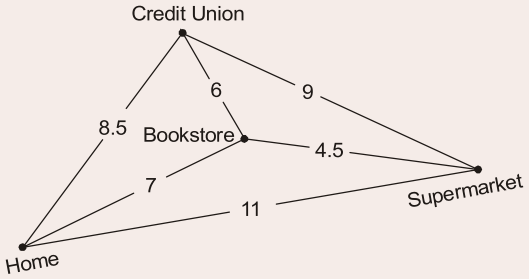
(c) Tyler is the president, Ryan is the vice president, Ashley is the secretary, and Brianna is the treasurer.

(d) Tyler is the president, Ryan is the vice president, Brianna is the secretary, and Ashley is the treasurer.

Ans. (a)

End of Solution

Q.17 You need to buy groceries at the supermarket, deposit a cheque at credit union, and purchase a book at the bookstore. You can complete the errands in any order, however, you must start and end at your home. The driving time, in minutes, between each of these locations is given in the following figure.



What is the route whose total driving time is less than 30 minutes?

(a) home, bookstore, credit union, supermarket, home
(b) home, supermarket, bookstore, credit union, home
(c) home, bookstore, supermarket, credit union, home
(d) home, supermarket, credit union, bookstore, home

Ans. (c)

End of Solution

Q.18 Each of four siblings (Anita, Tony, Maria and Jose) is given ₹5000 to invest in the stock market. Each chooses a different stock. One chooses a utility stock, another an automotive stock, another a technology stock, and the other an oil stock.

1. Anita and the owner of the utility stock purchased their shares through an online brokerage, whereas Tony and the owner of the automotive stock did not.
2. The gain in value of Maria's stock is twice the gain in value of the automotive stock.
3. The technology stock is traded on NASDAQ, whereas the stock that Tony bought is traded on the New York Stock Exchange.

From the above clues, match the name of the sibling and stock bought.

(a) Maria: the utility stock; Jose: the automotive stock; Anita: the technology stock; Tony: the oil stock
(b) Maria: the utility stock; Anita: the automotive stock; Jose: the technology stock; Tony: the oil stock
(c) Maria: the utility stock; Tony: the automotive stock; Anita: the technology stock; Jose: the oil stock
(d) Jose: the utility stock; Maria: the automotive stock; Anita: the technology stock; Tony: the oil stock

Ans. (a)

End of Solution

Q.19 If six people greet each other at a meeting by shaking hands with one another, how many handshakes will take place?

(a) 14 (b) 16
(c) 15 (d) 18

Ans. (c)

End of Solution

Q.20 Anuhya picks a number. She doubles the number, squares the result, divides the square by 3, subtracts 30 from the quotient, and gets 18. What are the possible numbers that Anuhya could have picked?

(a) 6 or –6 (b) 16 or –16
(c) 26 or –26 (d) 36 or –36

Ans. (a)

End of Solution

Q.21 Nothing is known about the personal life of the ancient Green Mathematician Diophantus except for the information in the following:

"Diophantus passed $\frac{1}{6}$ of his life in childhood, $\frac{1}{12}$ in youth, and $\frac{1}{7}$ more as a bechelor. Five years after his marriage was born a son who died four years before his father, at $\frac{1}{2}$ his father's (final) age." How old was Diophantus when he died?

(a) 64 (b) 54
(c) 74 (d) 84

Ans. (d)

End of Solution

Q.22 Select a two-digit number between 50 and 100. Add 83 to your number. From this number form a new number by adding the digit in the hundreds place to the number formed by the other two digits (the digits in the tens place and the ones place). Now subtract this newly formed number from your original number, to arrive at the final result. What is the final result?

(a) 16 (b) 26
(c) 36 (d) 46

Ans. (a)

End of Solution

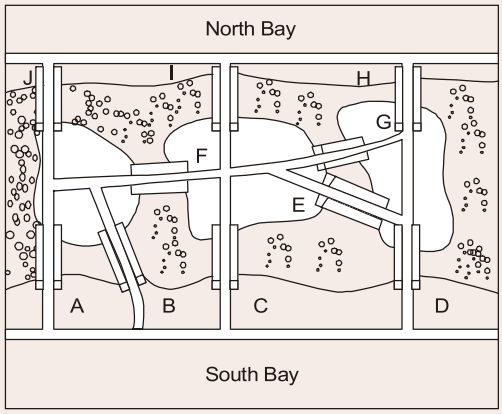
Q.23 An activities director for a cruise ship has surveyed 240 passengers. Of the 240 passengers, 135 like swimming, 80 like swimming and dancing, 150 like dancing, 40 like swimming and games, 65 like games, 25 like dancing and games, 15 like all three activities. How many passengers like exactly two of the three types of activities?

(a) 220
(b) 20
(c) 30
(d) 100

Ans. (d)

End of Solution

Q.24 The following map shows the 10 bridges and 3 islands between the suburbs of North Bay and South Bay. During your morning workout, you decide to jog over each bridge exactly once. Which one of the following statements is correct?



(a) You want to start from North Bay and that your workout concludes after you jog over the 'D' bridge.
(b) You want to start from North Bay and that your workout concludes after you jog over the 'E' bridge.
(c) You want to start from North Bay and that your workout concludes after you jog over the 'H' bridge.
(d) You want to start from North Bay and that your workout concludes after you jog over the 'G' bridge.

Ans. (b)

End of Solution

Q.25 Fifty people were asked to rank their preferences of five varieties of chocolate candy, using 1 for their favorite and 5 for their least favorite. The results are shown in the table below.

	Rankings					
Caramel center	5	4	4	4	2	4
Vanilla center	1	5	5	5	5	5
Almond center	2	3	2	1	3	3
Toffee center	4	1	1	3	4	2
Solid chocolate	3	2	3	2	1	1
Number of voters	17	11	9	8	3	2

According to the table (see the column in grey), three voters ranked solid chocolate first, caramel centers second, almond centers third, toffee centers fourth, and vanila centers fifth. According to this table, which variety of candy would win the teste test using the plurality voting system?

(a) Almond centers
(b) Vanilla centers
(c) Toffee centers
(d) Caramel centers

Ans. (c)

End of Solution

Q.26 The members of a club are going to elect a president from four nominees. In each first-place vote receives 4 points, each second-place vote receives 3 points, each third-place vote receives 2 points, and each last place vote receives 1 point. If the 100 members of the club mark their ballots as shown in the table below, who will be elected president?

	Rankings					
Avalon	2	2	2	2	3	2
Branson	1	4	4	4	2	1
Columbus	3	3	1	3	1	3
Dunkrirk	4	1	3	1	4	4
Number of voters	30	24	18	12	10	6

(a) Avalon
(b) Branson
(c) Columbus
(d) Dunkirk

Ans. (a)

End of Solution

Q.27 Study the given information carefully and answer the question :

There are seven books, one each of Psychology, Hindi, English, Sociology, Economics, Education and Accountancy lying on a table one above the other. Sociology is on the top of all books. Accountancy is immediately below Education which is immediate below Sociology. Economics is immediately above Psychology but not in the middle. Hindi is immediately below Psychology.

Which three books are between Accountancy and Hindi?

(a) English, Economics and Psychology
(b) Economics, Psychology and Education
(c) Economics, Psychology and Hindi
(d) Cannot be determined

Ans. (a)

End of Solution

Q.28 Read the information given below and answer the questions :

There is a group of five girls. Hasini is second in height but younger than Madhavi. Pooja is taller than Pranati but younger in age. Madhavi and Pranati are of the same age but Madhavi is tallest among them. Neelam is taller than Pooja and elder to Madhavi.

If they are arranged in the descending order of their ages who will be in fourth position?

(a) Neelam
(b) Hasini
(c) Pranati
(d) Data inadequate

Ans. (d)

End of Solution

Q.29 Read the following information and answer the question :

Seven students P, Q, R, S, T, U and V take a series of tests. No two students get similar marks. V always scores more than P. P always scores more than Q. Each time either R scores the highest and T gets the least, or alternatively S scores the highest and U or Q scores the least.

If V is ranked fifth, which one of the following is correct?

(a) S scores the highest
(b) R is ranked second
(c) T is ranked third
(d) Q is ranked fourth

Ans. (a)

End of Solution

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Q.30 A man has a certain number of small boxes to pack into parcels. If he packs 3, 4, 5 or 6 in a parcel, he is left one, if he packs 7 in a parcel, none is left over. What is the number of boxes, he may have to pack?

(a) 106 (b) 301
(c) 309 (d) 400

Ans. (b)

End of Solution

Q.31 Which one of the following transmission media is/are used for the remote control communication for televisions, VCRs, and stereos etc.?

(a) Fiber optics (b) Fiber cables
(c) The electromagnetic spectrum (d) Unguided infrared and millimeter waves

Ans. (d)

End of Solution

Q.32 Which one of the following protocols, is used to wrap IP packets with the additional feature of multiplexing and de-multiplexing multiple processes using a single IP address?

(a) User Datagram Protocol (b) Transport Control Protocol
(c) Internet Protocol (d) Point-to-Point Protocol

Ans. (b*)

UDP (User Datagram Protocol) and TCP (Transmission Control Protocol) perform the demultiplexing and multiplexing jobs by including two special fields in the segment headers: the source port number field and the destination port number field.

End of Solution

Q.33 Which one of the following code modules is/are used where the browser fetches from a special directory on the disk and installs as an extension to itself?

(a) Uniform Resource Locators (b) Browser
(c) Plug-in (d) Client server

Ans. (b)

Browser extension are typically distributed through special directories or web stores.

End of Solution

Q.34 Which one of the following features is/are used when a website is complex, consisting of many pages produced by multiple authors working for the same company, often desirable to have a way to prevent a different page from having a different appearance?

(a) Checkbox (b) Style sheets
(c) Table (d) Forms

Ans. (b)

To maintain a consistent appearance across multiple pages on a complex website produced by multiple authors. The feature commonly used is CSS (Cascading Style Sheet). CSS allows you to define and apply consistent styles (such as colors, font, and layouts) across various pages, ensuring a unified look and feel throughout the website.

End of Solution

Q.35 Which one of the languages is used to develop the web pages in the structured and for automated processing?

(a) eXtensible Markup Language
(b) Hypertext Markup Language
(c) eXtended Hyper Text Markup Language
(d) Markup Language

Ans. (b)

HTML:

For developing a structural web pages than are designed for automated processing, HTML is the primary language. HTML provides a standardized way to structure content on the web, making it suitable for automated processing by web browsers and other tools.

End of Solution

Q.36 Which one of the following interfaces is used to allow web servers to talk to back-end programs and scripts that can accept input and generate HTML pages in response?

(a) Application Programming Inter- face
(b) User Interface
(c) Application Interface Marker
(d) Common Gateway Interface

Ans. (d)

The interface used to allow web servers to communicate with backend programs and scripts, which can accept input and generate HTML pages in response, is typically CGI. Common Gateway Interface (CGI) is a standard protocol that enables web servers to execute external program or scripts and send dynamic content to the browsers.

End of Solution #

Q.37 Which one of the following status code responses gives the internal server error?

(a) 200 (b) 500
(c) 100 (d) 300

Ans. (b)

The HTTP status code that indicates an internal server error is 500 internal server error. This status code is a generic message indicating that the server has encountered an unexpected condition and cannot fulfill the request.

End of Solution

Q.38 Which of the following issues were addressed while establishing an IT Policy?

1. Respect of the intellectual rights of others, including trade secrets, copyrights, patents, and trade- marks
2. Inappropriate use of IT resources, such as Web surfing, blogging, personal emailing, and other use of computers for purposes other than business.
3. The need to protect the security of IT resources through adherence to good security practices, such as not sharing user IDs and passwords, using hard-to-guess passwords, and frequently changing passwords.
4. The use of the computer to intimidate, harass, or insult others through abusive language in emails and by other means.

Select the correct answer using the code given below:

(a) 1 and 3 only
(b) 2 and 3 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

Ans. (d)

Issues addressed in IT Policy:

- Security concern
- Data Privacy
- Uses Policy
- Access control
- Licensing
- Network infrastructure
- Cloud computing
- Ethical use

End of Solution

Q.39 Which one of the following is a harmful program that resides in the active memory of the computer and duplicates itself without human intervention, often sending copies of themselves to other computers by email?

(a) Worms
(b) Viruses
(c) Bugs
(d) Spam

Ans. (b)

End of Solution

Q.40 Which one of the following attacks is one in which a malicious hacker takes over computers via the Internet and causes them to flood a target site with demands for data and other small tasks?

(a) Rootkits
(b) Distributed Denial-of-Service
(c) Phishing
(d) Smishing

Ans. (b)

End of Solution

Q.41 Which one of the following is a set of programs that enables its user to gain administrator-level access to a computer without the end user's consent or knowledge?

(a) Distributed Denial-of-Service
(b) Phishing
(c) Smishing
(d) Rootkit

Ans. (d)

End of Solution

Q.42 Which one of the following is software and/or hardware that monitor system and network resources and activities, and notify network security personnel when it detects network traffic that attempts to circumvent the security measures of a networked computer environment?

(a) An intrusion detection system
(b) A protection of evidence and activity logs system
(c) A critical internet security threats system
(d) An illusion detection system

Ans. (a)

The software/hardware designed to monitor system and network resources, detect anomalous activities and notify network security personnel when it identifies attempts to circumvent security measures of a networked computer environment is: An intrusion detection system (IDS).

IDS tools monitor network or system activities for signs of unauthorized access, attack or policy violation.

End of Solution

Q.43 Which one of the following involves for the examination of Internet records to track down the identity of someone who posted in a discussion forum on one Website might search for clues to the poster's identity on Facebook, Twitter, and other online sources?

(a) Pornography
(b) Internet filter
(c) Doxing
(d) Internet censorship

Ans. (c)

End of Solution

Q.44 Which one of the following Acts mandates schools and libraries in India to use some form of technological protection to block computer access to obscene material, pornography, and anything else considered harmful to minors?

(a) Telecommunications Act
(b) Child Online Protection Act
(c) Children's Internet Protection Act
(d) Communications Decency Act

Ans. (c)

Cyberbullying and sharing of personal information without consent will be considered criminal act.

End of Solution

Q.45 Which of the following Acts is required for the commercial emailers in sending out messages that advertise a commercial product or service?
(a) Controlling the Assault of Non- Solicited Pornography Marketing Act
(b) Communications Assistance for Law Enforcement Act
(c) Communications Act of 1934
(d) Communications Decency Act

Ans. (a)
CAN-SPAM act of USA

End of Solution

Q.46 What are the three stages in the Development of Professional Identity?
(a) Possessing Knowledge, Professional Services, Self-Defining or Integrated Professional
(b) Independent Operator, Professional Services, Self-Defining or Integrated Professional
(c) Possessing Knowledge, Team Oriented Idealist, Self-Defining or Integrated Professional
(d) Independent Operator, Team Oriented Idealist, Self-Defining or Integrated Professional

Ans. (c)

End of Solution

Q.47 The first of the Fundamental Canons of the code of the National Society of Professional Engineers says that engineers shall hold
(a) paramount the safety, health, and welfare of the public
(b) devotion to clients as the first responsibility
(c) devotion to his employer
(d) devotion to the public

Ans. (a)

End of Solution

Q.48 A very compassionate man, Engineer Bernard Amadei in 2001 was pro-foundly affected by the poor living conditions in underdeveloped countries, such as the absence of clean. water. He founded EWB-USA in 2001 for improving the living condition of the poor. Engineering students in EWB are responsible for many projects throughout the world that have enhanced human well-being. What is the full form of the term EWB?
(a) Economically Water Boys
(b) Engineers Well to do Boys
(c) Engineers Without Borders
(d) Engineers Water Boys

Ans. (c)

End of Solution

Q.49 Consider the following statements:

The philosopher W. D. Ross, who constructed a list of basic duties or obligations, which he called prima facie duties. His lists of prima facie duties are given below:

1. Duties resting on previous acts.
2. Duties of gratitude, Duties of justice.
3. Duties of beneficence, Duties of self-improvement.
4. Duties to injure others, unexceptional to be widely practiced.

Which of the above statements are correct?

(a) 1, 2 and 4 (b) 1, 3 and 4
(c) 1, 2 and 3 (d) 2, 3 and 4

Ans. (c)

End of Solution

Q.50 What are the types of Moral Judgments?

(a) Permissible, Intent, Obligatory, Standpoint
(b) Professional, Impermissible, Obligatory, Supererogatory
(c) Permissible, Impermissible, Obligatory, Supererogatory
(d) Professional, Impermissible, Obligatory, Standpoint

Ans. (c)

End of Solution

Q.51 Which of the following tests are suggested by Philosopher Michael Davis that rely on our commonsense morality, but also reflect some of the concepts in moral theories or approaches?

(a) Harm Test, Publicity Test, Defensibility Test, Reversibility Test, Virtue Test, Professional Test, Colleague Test and Organization Test
(b) Defensibility Test, Reversibility Test, Virtue Test, Professional Test, Colleague Test, Heat Test, Organism Test and Purity Test
(c) Purity Test, Defensibility Test, Reversibility Test, Professional Test, Colleague Test, Heat Test Organism and Virtue Test
(d) Defensibility Test, Heat Test, Principal Test, Reversibility Test, Virtue Test, Professional Test, Organism Test and Colleague Test

Ans. (a)

End of Solution

Q.52 If a utilitarian approach requires that we maximize well-being, how should we go about determining the criteria we should use in seeking this maximization? One approach that has appeal from the engineering perspective is CBA, which holds that the course of action that produces the greatest benefit or utility relative to cost should be chosen. What is the full form of the term CBA?

(a) Cost Benefit Approach
(b) Competitive Benefit Approach
(c) Competitive Benefit Analysis
(d) Cost Benefit Analysis

Ans. (d)

End of Solution

Q.53 Joshua B. Kardon presents "an engineer is not liable, or responsible, for damages for every error. Society has decided, through case law, that when you hire an engineer, you buy the engineers normal errors. However, if the error is shown to have been worse than a certain level of error, the engineer is liable". That level, the line between non-negligent and negligent error is called

(a) Engineering Judgement
(b) Normal Distribution
(c) Standard of Care
(d) Performance Relative Standard

Ans. (c)

End of Solution

Q.54 According to Black's Law Dictionary, the law treats the corporation itself as a person which can

(a) monitor
(b) maintain
(c) sue and be sued
(d) give response

Ans. (c)

End of Solution

Q.55 Those who drive automobiles are familiar with blind spots. Applying this term to organizational and business arenas, Dennis Moberg draws an analogy between business blind spots and those we experience when driving. Blind Spot is one of the significant common impediments to responsibility. Which one of the following is NOT the method under Blind Spot?

(a) Self-deception
(b) Willful blindness
(c) Inattentional blindness
(d) Illusion of invulnerability of group

Ans. (a)

End of Solution

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Q.56 Which one of the following is NOT a factor for large scale diversification into unrelated areas by some of the industry Conglomerate in India?

(a) Restriction in growth in the existing line of business
(b) Policies with respect to imports, duties, pricing and reservations
(c) Opening up of newer areas of investments
(d) Desire not to avail tax incentives

Ans. (a)

End of Solution

Q.57 Boston Consulting Group, the BCG matrix classifies the various businesses in a firm's portfolio on the basis of

(a) Relative Share and Relative Growth Rate
(b) Relative Market Share and Substantial Market Share
(c) Relative Market Share and Relative Market Growth Rate
(d) Substantial Growth Rate and Relative Market Growth Rate

Ans. (c)

End of Solution

Q.58 What are the factors that contribute to decline in unit cost with respect to the accumulated volume of production?

(a) Pioneering stage, Rapid growth stage and Economies of scale stage
(b) Learning effects, Technological improvements and Economies of scale
(c) Technological improvements stage, Maturity stage and Decline stage
(d) Pioneering stage, Rapid growth stage and Decline stage

Ans. (a)

End of Solution

Q.59 Consider the following statements :

The broad areas of corporate appraisal and the few important aspects to be considered under them are

1. Marketing and Distribution
2. Production and Operation
3. Research and Development
4. Project Rating

Which of the above statements are correct?

(a) 1, 2, 3
(b) 2, 3, 4
(c) 1, 2, 4
(d) 1, 3, 4

Ans. (a)

End of Solution

Q.60 Which one of the following methods is an important qualitative method under demand forecasting?

(a) Jury of Executive Method
(b) Trend Projection Method
(c) Chain Ratio Method
(d) Bass Diffusion Method

Ans. (a)

End of Solution

Q.61 Why Delphi method of demand forecasting appeals to many organizations?

(a) The biases underlying are subjective, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings
(b) It is intelligible to users, it is a fancy name, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings
(c) It has immense appeal, the biases underlying are subjective, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.
(d) It is an expedition's method, it has immense appeal, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.

Ans. (a)

End of Solution

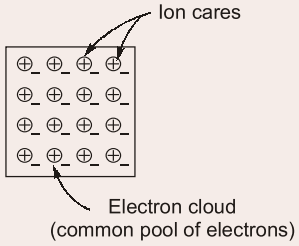
Q.62 Consider the following statements regarding metallic bonding :

1. The metallic sharing changes with time and the bonding electrons resonate between different atoms.
2. The metallic state can be visualized as an array of positive ions, with a common pool of electrons to which all the metal atoms have contributed their outer electrons.
3. These electrons have freedom to move anywhere within the crystal and act like an all-pervasive, mobile glue holding the ion cores together.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (d)



- In metallic bonding, the valence electrons are not bound to any particular atom in the solid and are more or less free to drift throughout the entire metal. They may be thought of belonging to the metal as a whole, or forming a "sea of electrons" or an "electron cloud".

- The free electrons shield the positively charged ion cores from mutually repulsive electrostatic forces. In addition, these electrons acts as a "glue" to hold the ion cares together.

End of Solution

Q.63 Consider the following statements regarding phase diagram rules for the crystal:

1. According to the Gibbs phase rule, the degree of freedom (F) = Number of components (C) + Number of phases (P) + 2.
2. The tie-line rule is applied to determine the compositions of two-coexisting phases in a binary phase diagram.
3. In the lever rule, the tie-line at the temperature of interest is treated as a lever arm, with the fulcrum at the overall composition.

Which of the above statement are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Gibb's phase rule,

$$P + F = C + N$$

F → Degree of freedom

P → Number of phases

C → Number of components forming the system.

N → System variable

N = 2, if variables are temp and pressure

N = 1, if variable is temp only

Let's take, N = 2 (for alloys)

$$P + F = C + 2$$

$$\Rightarrow \quad F = C - P + 2$$

Hence statements-1 is wrong, so options (a), (b) and (d) can not be true. Correct option is (c).

End of Solution

Q.64 Consider the following statements regarding effect of minor elements on steel properties:

1. Sulphur is present in steel either as iron sulphide or manganese sulphide and during the rolling or forging of steel, iron sulphide present in steel gets cracked/teared.
2. Silicon, in the form of ferro-silicon, is used widely as a deoxidant due to its low cost and high efficiency.
3. Silicon opposes the presence of iron oxide (FeO) which is very much detrimental to properties of steel.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

All three statements are correct.

End of Solution

Q.65 Consider the following statements regarding cast iron:

1. Gray cast irons can be classified depending on the shape of graphite that may be present in the form of either flakes or globules.
2. A class of cast iron known as Malleable obtained by treating molten metal by calcium silicide.
3. Meehanite cast irons have graphite nodules but are produced by heat treating white cast irons.

Which of the above statements are NOT correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (c)

Statement-1 is correct so option (a), (b) and (d) can bot be answer. Correct answer is option (c).

End of Solution

Q.66 Consider the following statements regarding the characteristics of covalent compounds and covalent solids:

1. Covalent compounds are soluble in paraffins.
2. Covalent solids do not form closed-packet structures because the covalent bonds are very strong and rigid.
3. The simplest covalent structure is that of diamond which is fairly open and empty and far from close-packed.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (b)

Covalent compounds do not form closed pack structure due to directional nature of bond. Hence statement-2 is wrong, so options (a), (c) and (d) can not be answer. So correct option is (b).

End of Solution

Q.67 Consider the following statements regarding the gas caburizing.

1. Case depth can be obtained accurately.
2. More floor space is required than pack carburizing.
3. Process is rapid as less time is required than in pack carburizing.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (b)

Pack carburizing requires more floor space so statements-2 is false.

Charcoal is used as carburizing agent in pack carburizing whereas natural gas or propane is used as carburizing agent in gas carburizing.

End of Solution

Q.68 Which one of the following statements is NOT correct regarding thermal mass?

(a) In solar buildings, it reduces temperature variations between day and night.
(b) It is useful in ordinary buildings as it serves as a reservoir or sink for both heating and cooling.
(c) It provides a means of storing the solar energy that enters through the windows.
(d) The heavier a material is available, then the less thermal mass is available.

Ans. (b)

End of Solution

Q.69 Consider the following statements about ethanol:

1. Ethanol is primarily produced from corn and sugarcane.
2. Ethanol provides a major part of the liquid fuel requirement in Brazil.
3. The production of ethanol accounts for around 90% of the production of biofuels in the world.

Which of the above statements is/are correct?

(a) 1, 2 and 3
(b) 2 and 3 only
(c) 3 only
(d) 1, and 2 only

Ans. (d)

End of Solution

Q.70 Which one of the following statements is NOT correct regarding carbon dioxide?

(a) Carbon dioxide is given off when dead organisms and other organic materials decompose.

(b) When volcanoes erupt, they give off carbon dioxide that is stored in the mantle.

(c) Ocean water releases dissolved carbon dioxide into the atmosphere when water temperature rises.

(d) A good amount of carbon in the atmosphere is present as methane gas.

Ans. (d)

End of Solution

Q.71 Match the following lists:

List-I	List-II
P. Lamarack	1. Evolutionary theory
Q. Lyell	2. Gradual geological processes have gradually shaped Earth's shaped surface.
R. Malthus	3. Human population grow faster than the resources they depend on
S. Wallace	4. Inheritance of acquired characteristics

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	1	4	3
(b)	4	2	3	1
(c)	1	4	3	2
(d)	4	3	1	2

Ans. (b)

End of Solution

Q.72 What is Chaparral?

(a) Chaparrals are plants that grow on other plants

(b) Chaparral is a shrub forest biome dominated by densely-growing evergreen shrubs or small trees, such as scrub oak

(c) Chaparrals are temperate biomes that consist mainly of grasses

(d) Chaparrals are aquatic organisms that live on the surface below a body of water

Ans. (b)

End of Solution

Q.73 The expression of the ability of surfaces to reflect sunlight is known as
(a) the albedo effect
(b) the greenhouse effect
(c) the genshin effect
(d) the permafrost

Ans. (a)

End of Solution

Q.74 Which one of the following refers to efforts to tailor thousands of items. Such as cars or hamburgers to specific customers' needs?
(a) Miniaturization
(b) Mass customization
(c) Reactive mode
(d) Fire-fighting

Ans. (b)

End of Solution

Q.75 Which one of the following is associated with developing a qualitative and/or quantitative evaluation of how changes to system inputs affect system outputs ?
(a) Define
(b) Measure
(c) Analyze
(d) Control

Ans. (b)

End of Solution

Q.76 Consider the following advantages of p-charting method:
1. Requires only go-no-go data, intuitive.
2. No requirement for pre-tested "standard" units.
3. Accounts for all errors including systematic errors.

Which of the above advantages is/are correct?
(a) 1 only
(b) 2 only
(c) 1 and 2
(d) 2 and 3

Ans. (c)

End of Solution

Q.77 Which one of the following is an example of discrete random variables?
(a) Triangular Distribution
(b) Normal Distribution
(c) Central Limit Theorem
(d) Negative Binomial Distribution

Ans. (d)

End of Solution

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Q.78 Almost all the quality control problems can be solved if the following conditions for manufacturing the product are met:

1. The quality characteristics are within the appropriate specification tolerance limits determined based on customers' requirements.
2. The variability of the quality characteristics is minimized as much as possible.
3. The mean of each quality characteristic is as close as possible to the target value of the characteristic.

Which of the above conditions are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (d)

End of Solution

Q.79 The manufacturing cost of the components will decrease as a result of using the probabilistic relationship because

(a) manufacturing cost decreases as the tolerance on the quality characteristic decreases
(b) manufacturing cost decreases as the tolerance on the quality characteristic increases
(c) manufacturing cost remains constant as the tolerance on the quality characteristic increases
(d) manufacturing cost increases as the tolerance on the quality characteristic increases

Ans. (b)

End of Solution

Q.80 It is important to carefully identify the needs and expectations of the customer prior to beginning the design of mechanical device. One of the step in formulating usually quantitative statements of expected performance levels, environmental conditions in which the device must operate, limitations on space or weight, or available materials and components that may be used. These are part of which one of the following elements of design?

(a) Functions
(b) Evaluation criterias
(c) Design requirements
(d) Drawings

Ans. (c)

End of Solution

Q.81 What are the functions of axles?

(a) Support the weight of the mower. Permit easy, rolling movement. Provide for mounting on an axle. Ensure safe operation on flat or sloped lawn surfaces.

(b) Support, safely enclose, and protect operating components, including the blade and motor. Accommodate the attachment of two axles and a handle. Permit cut grass to exit the cutting area.

(c) Cut blades of grass and weeds while rotating at high speed. Facilitate connection to motor shaft. Operate safely when foreign objects are encountered, such as stones, sticks, or metal pieces.

(d) Transfer the weight of mower from the housing to the wheels. Allow rotation of the wheels. Maintain location of the wheels relative to the housing.

Ans. (a)

End of Solution

Q.82 Which one of the following is/are used for drawing curves which cannot be drawn with a compass?

(a) Scale
(b) Protractor
(c) French curves
(d) Set square

Ans. (c)

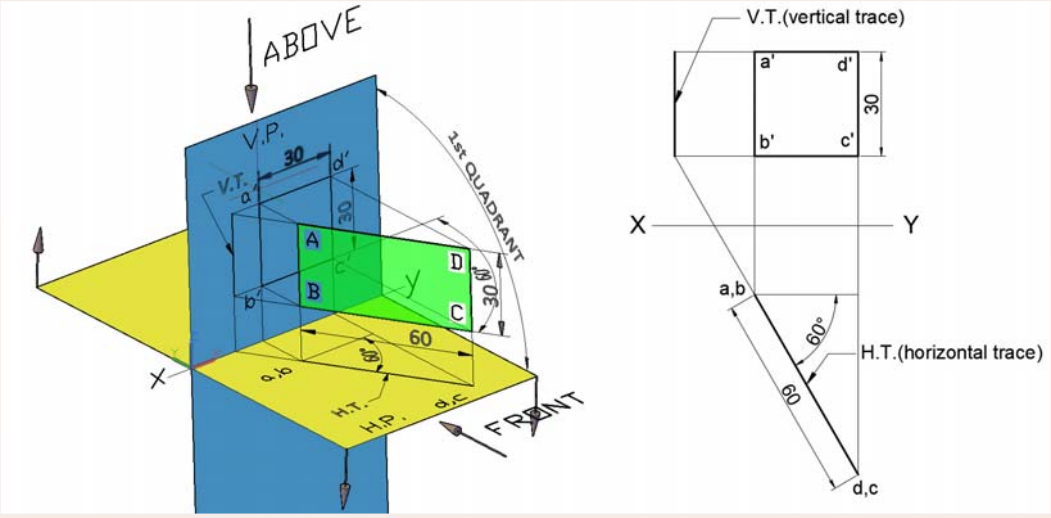
In manual drafting, French curves are used for drawing curves which cannot be drawn by compass. Faint freehand curve is first drawn through the known points. Longest possible curves exactly coinciding with the freehand curve are then found out from the French curve. Finally, neat continuous curve is drawn with the aid of the French curve. Care should be taken to see that no corner is formed anywhere within the drawn curve.

End of Solution

Q.83 A plane, extended if necessary, will meet the reference planes in lines, unless it is parallel to any one of them. These lines are called

(a) Projection lines
(b) Traces of the plane
(c) Dimension lines
(d) Imaginary lines

Ans. (b)



Traces of a plane are defined as line of intersection of plane or plane extended with reference planes or planes of projection.

In figure, you have a rectangular plane ABCD perpendicular to H.P. and inclined to V.P. at an angle of 60°. To obtain the vertical trace of the plane ABCD, you simply extend it in until it intersects the V.P. V.T. (vertical trace) as shown in pictorial diagram is the line of intersection of plane extended and vertical reference plane.

To obtain the Horizontal trace of the plane ABCD, you simply extend it in until it intersects the H.P. H.T. (horizontal trace) as shown in pictorial diagram is the line of intersection of plane extended and Horizontal reference plane.

End of Solution

Q.84 Which of the following are the methods for determining the line of intersection between surfaces of two interpenetrating solids?

(a) Line method and cutting plane method
(b) Line method and box method
(c) Co-ordinate method and cutting plane method
(d) Co-ordinate method and box method

Ans. (a)

There are two methods of determining the line or curve of intersection between surfaces of two interpenetrating solids

Line method: A number of lines are drawn on the lateral surface of one of the solids and in the region of the line of intersection. Points of intersection of these lines with the surface of the other solid are then located. The line or curve drawn through these points will be the line or curve of intersection

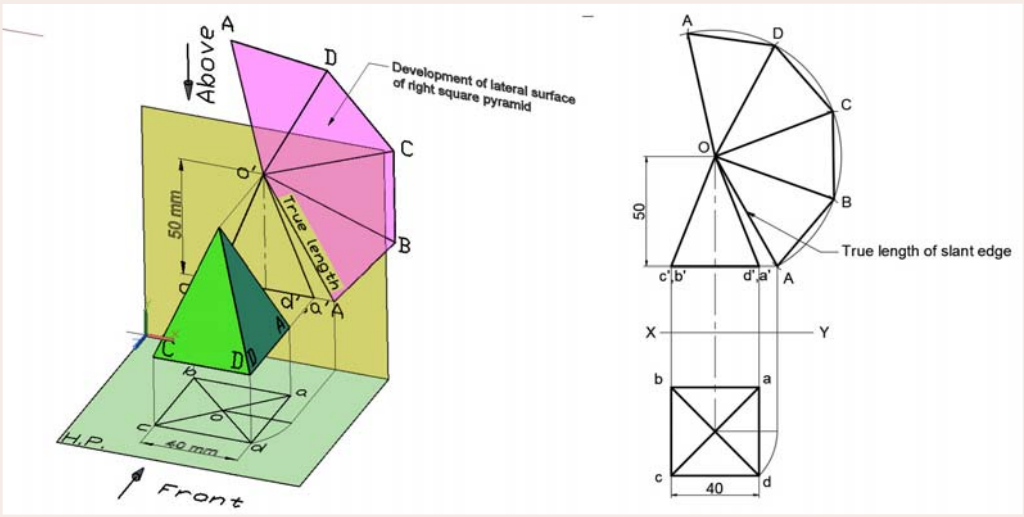
Cutting plane method: The two solids are assumed to be cut by a series of cutting planes. The intersection points of sections of two solids and lying on surface of solid are the required points. These intersection points when joined in proper sequence give the line or curve of intersection.

End of Solution

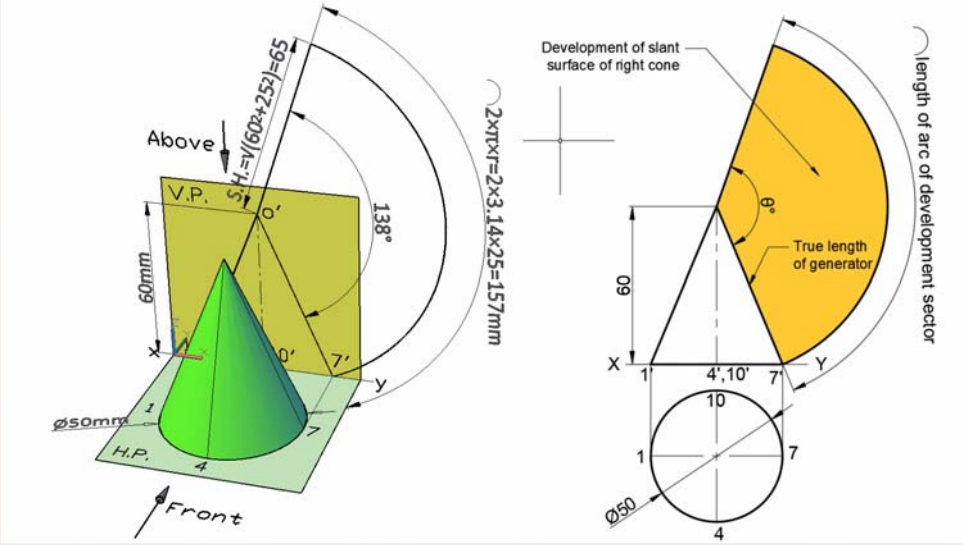
Q.85 Which one of the following is used for pyramids and cones in which the true length of the slant edge or the generator is used as radius?

(a) Parallel-line development
(b) Radial-line development
(c) Triangulation development
(d) Approximate method

Ans. (b)



As shown in figure, Radial line development method is used for development of lateral surface of right pyramids in which the true length of slant edge is used as radius.



As shown in figure, Radial line development method is used for development of lateral surface of right cone in which the true length of generator is used as radius of development sector

Length of arc of development sector = Circumference of base circle of cone

$$\text{Angle of development sector } \theta = \frac{\text{Length of arc}}{\text{Radius of development sector}}$$

$$\text{Angle of development sector } \theta = \frac{\text{Circumference of base circle of cone}}{\text{Slant height of cone}}$$

$$\text{Angle of development sector } \theta = \frac{2\pi R}{\text{S.H.}} \text{ radians}$$

$$\text{Angle of development sector } \theta = 360° \times \frac{\text{Radius of base circle}}{\text{Slant height}}$$

$$\text{Angle of development sector } \theta = 360° \times \frac{R}{\sqrt{(R^2 + H^2)}}$$

where, R = Radius of base circle of right cone
H = Height of right cone

End of Solution

Q.86 Consider the following statements regarding the Global Peace Index 2023:

1. Iceland has retained its position as the most peaceful country since the inaugural study in 2008.
2. Five out of the top 10 most peaceful countries in the world are located in Europe.

Which of the above statements is/are NOT correct?

(a) Both 1 and 2 (b) 1 only
(c) 2 only (d) Neither1 nor 2

Ans. (d)

Global Peace Index experienced a total decline of 0.42%.

Iceland maintains its status as the most peaceful country in the world for the 17th consecutive year.

Top 10 countries are:

1. Iceland
2. Denmark
3. Ireland
4. New Zealand
5. Austria
6. Singapore
7. Portugal
8. Slovenia
9. Japan
10. Switzerland

End of Solution

Q.87 Consider the following statements regarding Henley Passport Index 2023:

1. Japan holds the title of the world's most powerful passport, granting visa-free access to 192 out of 227 global travel destinations.
2. Three European countries, namely Germany, Italy, and Spain, share the second position, with visa-free access to 190 destinations.

Which of the above statements are NOT correct?

(a) Both 1 and 2 (b) 1 only
(c) 2 only (d) Neither1 nor 2

Ans. (b)

Henley Passport Index is a ranking system that evaluates all the world's passport based on the number of travel destinations their holders can access without the need for a prior visa.

Indian passport secured 80th rank, in 2022 rank was 87th that gives visa free access to or countries.

Singapore holds the most powerful passport in the world.

Previously Japan held the top sport on the Henley passport for 5 years.

Germany, Italy and Spain shared the 2nd position.

Japan, Austria, Finland, France, Luxembourg, South Korea and Sweden shared 3rd spot.

End of Solution

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Q.88 Consider the following statements :

1. India's Goods and Services Tax collection for the month of June 2023 reached R. 1.61 trillion, according to the Ministry of Finance.
2. India received its highest-ever FDI inflow of US $83.57 billion in the fiscal year 2021-2022.
3. The net direct tax collection in the current fiscal year has witnessed a significant growth of 16%, reaching Rs. 4.75 lakh crore, indicating a surge in economic activity.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.89 Consider the following statements regarding Hemis Festival :

1. The Hemis Festival in Ladakh is a renowned religious celebration.
2. The Hemis Festival is dedicated to the birth anniversary of Lord Padmasambhava.
3. Hemis Festival offers a mesmerizing experience of Tibetan Tantric Buddhism.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

End of Solution

Q.90 Ministry of Defence signed contract with which one of the following organizations for Upgraded Super Rapid Gun Mount (SRGM) and other equipment for around 3000 crores?

(a) DRDO (b) BHEL
(c) ISRO (d) BEL

Ans. (b)

Ministry of Defence signed contract with Bharat Heavy Electricals Limited, Haridwar for procurement of 16 upgraded Super Rapid Gun Mount (SRGM) along with associated equipment for Indian Navy. SRGM is a light-weight, rapid-fire naval gun providing unrivalled performances and flexibility in any air-defence and anti-surface role, particularly in anti-missile role.

End of Solution

Q.91 Which of the following cities achieved the Guinness World Records by constructing Single Lane Bituminous Concrete Road and longest Double Decker Viaduct with Highway Flyover and Metro Rail?

(a) Amravati and Nagpur
(b) Mumbai and Ahmedabad
(c) Hyderabad and Bangalore
(d) Gautam Buddha Nagar and Ghaziabad

Ans. (a)

Nagpur Metro has created a Guinness World Record by constructing the longest Double Decker Viaduct (metro) of 3.14 km.

It has highway flyover and metro rail supported on a single column.

It is located on Wardha Road, Nagpur.

Length of bituminous concrete road : 42.2 km.

End of Solution

Q.92 Which one of the following Institutions launched Centre of Data for Public Good (CDPG) for multidisciplinary research, bringing together experts from academia, industry, and Government to harness the power of data to benefit the public?

(a) IISc
(b) IIT Madras
(c) DRDO
(d) NITI Aayog

Ans. (a)

IISc launched Centre of Data for Public Good (CDPG) with a first of its kind symposium.

Its initiative is to leverage data for social good.

Centre of Data for Public Good will serve as a hub for multidisciplinary research, bringing together experts from academia industry and government to harness the power of data to benefit the public.

End of Solution

Q.93 AstroSat space telescope has crossed a major milestone by detecting 600th Gamma-Ray Burst launched by which one of the following countries?

(a) USA
(b) Russia
(c) China
(d) India

Ans. (d)

AstroSat is the first dedicated Indian astronomy mission aimed of studying celestial sources in *X*-Ray, optical and UV spectral bands. Astrosat achieved a significant milestone by detecting more than 600 Gamma Ray burst marking the death of a massive star.

End of Solution

Q.94 Which one of the following ships does NOT come under Indian Nayy's eight ASW Shallow Water Craft project?

(a) Mahanav
(b) Mahe
(c) Malvan
(d) Mangrol

Ans. (a)

End of Solution

Q.95 Which Union Ministry announced 5G & Beyond Hackathon 2023' aimed at shortlisting India-focused cutting-edge ideas workable beyond products and solutions?

(a) Ministry of Science and Technology
(b) Ministry of Communication
(c) Ministry of Micro, Small and Medium Enterprises
(d) Ministry of Electronics and Information Technology

Ans. (b)

End of Solution

Q.96 "Scheme for Expansion and Modernization of Fire Services in the States" from the allocation of preparedness and Capacity Building Funding Window under the National Disaster Response Fund for strengthening fire services in the States was introduced by which Union Ministry?

(a) Ministry of Family and Health Affairs
(b) Ministry of Youth Affairs and Sports
(c) Ministry of Defence
(d) Ministry of Home Affairs

Ans. (d)

End of Solution

Q.97 Aim of exercise 'Nomadic Elephant' is to build positive military relations, exchange best practices, develop inter- operability, bonhornie, camaraderie and friendship between India and which one of the following countries?

(a) Bangladesh
(b) Mongolia
(c) Botswana
(d) South Africa

Ans. (b)

End of Solution

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Q.98 Which one of the following is associated with 'SPRINT Challenges' aimed at giving a boost to the usage of 75 new indigenous technologies/ products in collaboration with Innovations for Defence Excellence, NIIO and Technology Development Acceleration Cell?

(a) Indian Coast Guard
(b) Indian Air Force
(c) Indian Army
(d) Indian Navy

Ans. (d)

SPRINT: Supporting Pole-valuting in R & D through Innovation for Defence Excellence.

End of Solution

Q.99 To increase the transparency and consumer awareness and handle the customer complaint a 'Centralised Receipt and Processing Centre' and 'Integrated Ombudsman Scheme has been set up, these two schemes are related to which one of the following institutions?

(a) NITI Aayog
(b) DPIIT
(c) ISRO
(d) RBI

Ans. (d)

End of Solution

Q.100 These days V-CIP is simple, safe and secure. You can complete your V-CIP from wherever you are in India, you only need your PAN card and Aadhaar card. Then, what is the full form of the term "V-CIP"?

(a) Venture Capital Identification Process
(b) Venture Process Capital Investment
(c) Voice based Customer Identification Process
(d) Video based Customer Identification Process

Ans. (d)

V-CIP is alternate method of customer identification with facial recognition.

End of Solution