CLASS TEST

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ENGINEERING MATHEMATICS

CE | ME

Date of Test : 02/02/2026

ANSWER KEY

1.	(b)	7.	(c)	13.	(a)	19.	(b)	25.	(c)
2.	(d)	8.	(a)	14.	(a)	20.	(c)	26.	(d)
3.	(d)	9.	(a)	15.	(b)	21.	(b)	27.	(b)
4.	(a)	10.	(a)	16.	(c)	22.	(b)	28.	(c)
5.	(b)	11.	(d)	17.	(c)	23.	(c)	29.	(c)
6.	(d)	12.	(b)	18.	(d)	24.	(c)	30.	(c)

DETAILED EXPLANATIONS

1. (b)

$$f(x) = \frac{1}{15-0} = \frac{1}{15}$$

$$P\{5 < x < 9\} = \int_5^9 \frac{1}{15}\,dx = \frac{4}{15}$$

2. (d)

$$f'(x) = 4x - 5$$

For minima/maxima,

$$f'(x) = 0$$

$$4x - 5 = 0$$

$$x = \frac{5}{4}$$

$$f''(x) = 4 > 0 \Rightarrow \text{Minima}$$

3. (d)

$$1+\left(\frac{d^3y}{dx^3}\right)^{7/5-5/7} = 0$$

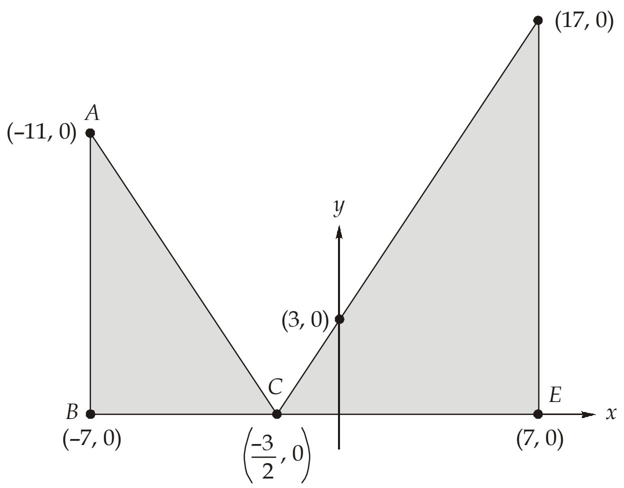
$$\left(\frac{d^3y}{dx^3}\right)^{24/35} = -1$$

Raising power 35 on both sides.

$$\left(\frac{d^3y}{dx^3}\right)^{24} = -1$$

From here degree of equation is 24.

4. (a)



The value of integral is equal to area of shaded region.

$$\text{Area} = \frac{1}{2}\times AB\times BC+\frac{1}{2}\times DE\times EC = \frac{1}{2}\times 11\times\frac{11}{2}+\frac{1}{2}\times 17\times\frac{17}{2} = \frac{410}{4} = 102.5$$

5. (b)

Let X be the number of rejections

$$n = 8$$
$$p = 0.16$$
$$q = 0.84$$

Probability of at least one rejection

$$= 1 - P\,(X \le 0)$$
$$= 1 - P\,(X_0)$$

$$P\,(X_0) = {}^nC_r p^r q^{n-r} = {}^8C_0(0.16)^0(0.84)^8 = 0.2479$$

Probability of at least one rejection = 1 – 0.2479 = 0.7521

6. (d)

$$f_x(X) = \begin{cases} 1 & 0 < x < 1 \\ 0 & \text{Otherwise} \end{cases}$$

$$E(X^4) = \int_{-\infty}^{\infty} x^4 \cdot f_x(X)\,dx$$

$$= \int_0^1 x^4 = \left.\frac{x^5}{5}\right|_0^1 = \frac{1}{5} = 0.2$$

7. (c)

Eigen values of $(A + 7I)$ are $\gamma + 7$ and $\delta + 7$

Eigen values of $(A + 7I)^{-1} = \dfrac{1}{\gamma+7}$ and $\dfrac{1}{\delta+7}$

8. (a)

$$D^2 - 4D + 4 = 0$$
$$(D - 2)\,(D - 2) = 0$$
$$D = 2, 2$$
$$y = (C_1 + C_2 x)e^{2x}$$
$$y(0) = C_1 = 0 \Rightarrow C_1 = 0$$
$$y(1) = e^2 = C_2 \cdot e^2 \Rightarrow C_2 = 1$$
$$y = xe^{2x}$$
$$y(2) = 2e^4 = 109.196$$

9. (a)

Probability of drawing a card = $\dfrac{1}{80}$

$$E(x_i) = 1\times\frac{1}{80} + 2\times\frac{1}{80} + \ldots + 80\times\frac{1}{80} = \frac{1}{80}\times\frac{(80)(80+1)}{2} = \frac{81}{2}$$

Expected value of the sum of numbers on the ticket drawn:

$$E\,(x_1 + x_2 + x_3 + \ldots) = E(x_1) + E(x_2) + \ldots + E(x_{30})$$

$$30\,E(x_i) = 30\times\frac{81}{2} = 1215$$

10. (a)

Let $$y = x^x$$

Taking logarithm on both sides, we get

$$\log y = x \log x$$

Differentiating w.r.t. x, we get

$$\frac{1}{y}\cdot\frac{dy}{dx} = x\cdot\frac{1}{x} + \log x\cdot 1$$

$$\Rightarrow \quad \frac{dy}{dx} = y(1 + \log x) = x^x(1 + \log x)$$

11. (d)

$$y = \frac{2}{3}\frac{\ln x}{x}$$

$$\frac{dy}{dx} = \frac{2}{3x}\cdot\frac{1}{x} + \frac{2}{3}\ln x\left(\frac{-1}{x^2}\right)$$

$$= \frac{2}{3x^2}(1 - \ln x)$$

For maxima, $$\frac{dy}{dx} = 0$$

$$\ln x = 1 \quad \Rightarrow \quad x = e \text{ is a stationary point}$$

$$\frac{d^2y}{dx^2} = \frac{-2}{3x^3}(3 - 2\ln x)$$

At $x = e$

$$\left(\frac{d^2y}{dx^2}\right)_{x=e} = \frac{-2}{3e^3} < 0$$

Hence maxima at $x = e$

12. (b)

$$y^2 = 2ax$$

$$x = \frac{y^2}{2a} \quad \text{...(i)}$$

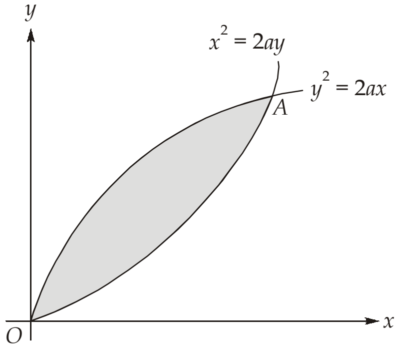
$$x^2 = 2ay$$

Using equation (i)

$$\frac{y^4}{4a^2} = 2ay$$

$$y^4 - 8a^3y = 0$$

$$y = 0, y = 2a$$



The parabolas intersect at 0 (0, 0) and A $(2a, 2a)$

$$\text{Required area} = \int_0^{2a}\int_{x^2/2a}^{\sqrt{2ax}} dy\,dx$$

$$= \int_0^{2a}\left(\sqrt{2ax}-\frac{x^2}{2a}\right)dx = \left|\sqrt{2a}\,\frac{2}{3}x^{3/2}-\frac{1}{2a}\cdot\frac{x^3}{3}\right|_0^{2a}$$

$$= \sqrt{2a}\,\frac{2}{3}(2a)^{3/2}-\frac{1}{2a}\frac{(2a)^3}{3} = \frac{8a^2}{3}-\frac{4a^2}{3}=\frac{4a^2}{3}$$

13. (a)

Parabola given : $x^2 = 4y$ ...(i)

Straight line is $x - 2y + 4 = 0$

$$y = \frac{x+4}{2}\text{, put in (i)}$$

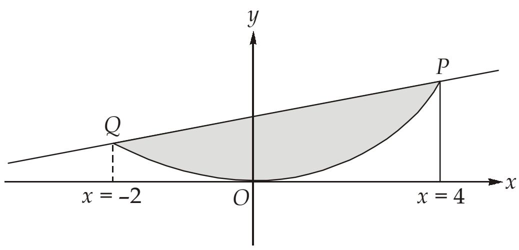
$\Rightarrow$ $x^2 = 2(x+4)$

$\Rightarrow$ $x^2 - 2x - 8 = 0$

$\Rightarrow$ $x^2 - 4x + 2x - 8 = 0$

$\Rightarrow$ $x(x-4) + 2(x-4) = 0$

$\Rightarrow$ $x = 4, -2$



Required area $= POQ$

$$= \int_{-2}^{4} y\,dx \text{ from straight line} - \int_{-2}^{4} y\,dx \text{ from parabola}$$

$$= \int_{-2}^{4}\left(\frac{x+4}{2}\right) - \int_{-2}^{4}\frac{x^2}{4}dx$$

$$= \frac{1}{2}\left|\frac{x^2}{2}+4x\right|_{-2}^{4} - \frac{1}{4}\left|\frac{x^3}{3}\right|_{-2}^{4}$$

$$= \frac{1}{2}\{8+16-(-6)\}-\frac{1}{12}(64+8) = \frac{1}{2}\times 30-\frac{1}{12}\times 72 = 15-6 = 9$$

14. (a)

For $f(x)$ to be probability density function $= \int_{-\infty}^{\infty} f(x)dx = 1$

$$\frac{1}{A}\int_3^6(3x+5)\,dx = 1 \;\Rightarrow\; \frac{1}{A}\left|\frac{3x^2}{2}+5x\right|_3^6 = 1$$

$$A = \left(\frac{3}{2}\cdot 6^2-\frac{3}{2}\cdot 3^2\right)+5(6-3) = \frac{3}{2}\cdot 27+15 = 55.5$$

15. (b)

$$|A-\lambda I| = \begin{vmatrix} 2-\lambda & 2 & 6 \\ 2 & 10-\lambda & 2 \\ 6 & 2 & 2-\lambda \end{vmatrix} = 0$$

$$\lambda^3 - 14\lambda^2 + 288 = 0$$

From here

$$p+q+r = 14$$
$$pq+qr+rp = 0$$
$$pqr = -288$$
$$pq+qr+rp-pqr = 0-(-288)$$
$$= 288$$

16. (c)

$$\int_0^5 f(x)\cdot dx = \frac{h}{2}\left[(y_0+y_5)+2(y_1+y_2+y_3+y_4)\right]$$
$$= \frac{1}{2}\left[(2+0.077)+2(1+0.4+0.2+0.1176)\right]$$
$$\simeq 2.75$$

17. (c)

$$A^{-1} = \frac{(adj\ A)}{|A|}$$
$$|A| = -8\times 5 = -40$$
$$|A|\cdot\left(A^{-1}\right) = (\text{adj } A)$$
$$\lambda \text{ of adj } A = \frac{|A|}{\lambda_1}, \frac{|A|}{\lambda_2} = \frac{-40}{-8}, \frac{-40}{5} = 5, -8$$

18. (d)

$$x = (N)^{1/2N}$$
$$x^{2N} = N$$
$$x^{2N} - N = 0$$
$$f(x) = x^{2N} - N$$
$$f'(x) = 2N\cdot x^{2N-1}$$

According to Newton Raphson method

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)} = x_k - \frac{x_k^{2N}-N}{2Nx_k^{2N-1}} = \frac{2Nx_k^{2N}-x_k^{2N}+N}{2Nx_k^{2N-1}}$$

$$x_{k+1} = \left(\frac{2N-1}{2N}\right)x_k + \frac{x_k^{1-2N}}{2}$$

19. (b)

$$y^2 = 9x$$
$$2y\frac{dy}{dx} = 9$$

$$\frac{dy}{dx} = \frac{9}{2y} = \text{slope of tangent } (m_1)$$

$$\text{Slope of normal } (m_2) = \frac{-2y}{9} \qquad [as\ m_1 m_2 = -1]$$

Slope of the given line is $\frac{-2}{3}$

$$\frac{-2y}{9} = -\frac{2}{3}$$

$$y = 3$$

For $y = 3$

$$3^2 = 9x$$

$$x = 1$$

For (1, 3) to lie on the given line

$$\lambda = 2x + 3y = 2 + 9 = 11$$

20. (c)

Probability of hitting target = $\frac{1}{6}$

Probability of missing target = $\frac{5}{6}$

Probability of hitting target as least once = 1 – (Probability of not hitting n times)

$$= 1 - {}^nC_0 p^0 q^n = 1 - \left(\frac{5}{6}\right)^n$$

$$1 - \left(\frac{5}{6}\right)^n > \frac{2}{5}$$

$$\left(\frac{5}{6}\right)^n < \frac{3}{5}$$

$$n > 2.8$$

$$n_{\text{least}} = 3$$

21. (b)

Since the probability of occurrence is very small, this follows Poisson distribution.

$$\text{mean} = m = np$$

$$= 1500 \times 0.002 = 3$$

Probability that more than 2 will get a hanging problem

$$= 1 - P(0) - P(1) - P(2)$$

$$= 1 - \left[e^{-m} + \frac{e^{-m}.\ m^1}{1!} + \frac{e^{-m}.\ m^2}{2!}\right] = 1 - \left[e^{-3} + \frac{e^{-3}.\ 3}{1} + \frac{e^{-3}.\ 3^2}{2}\right]$$

$$= 1 - \left[\frac{1}{e^3} + \frac{3}{e^3} + \frac{9/2}{e^3}\right] = 1 - \frac{17}{2e^3}$$

22. **(b)**

Rearranging the equation,

$$\frac{dy}{dx} - \frac{y}{(2x+1)} = e^{4x}(2x+1)$$

The equation is of the form

$$\frac{dy}{dx} + P(x)y = Q(x)$$

$$IF = e^{\int P(x)dx} = e^{\int \frac{-1}{2x+1}dx} = e^{-\frac{\ln(2x+1)}{2}} = \frac{1}{\sqrt{2x+1}}$$

23. **(c)** $AX = B$

$$\begin{bmatrix} p & q \\ r & s \end{bmatrix}\begin{bmatrix} \frac{9}{2} & -6 \\ \frac{3}{2} & \frac{-3}{2} \end{bmatrix} = \begin{bmatrix} \frac{15}{2} & 3 \\ -3 & \frac{3}{2} \end{bmatrix}$$

$$\frac{9}{2}p + \frac{3}{2}q = \frac{15}{2} \qquad -6p - \frac{3}{2}q = 3$$

$$p = -7 \qquad q = 26$$

$$\frac{9}{2}r + \frac{3}{2}s = -3 \qquad -6r - \frac{3}{2}s = \frac{3}{2}$$

$$r = 1 \qquad s = -5$$

$$\Rightarrow \qquad A = \begin{bmatrix} -7 & 26 \\ 1 & -5 \end{bmatrix}$$

$$|A| = \begin{vmatrix} -7 & 26 \\ 1 & -5 \end{vmatrix} = 35 - 26 = 9$$

24. **(c)**

We parameterize the curve using $t = y$

$$x = 2 - 3t^2 \qquad -1 \le t \le 1$$

$$y = t$$

Then

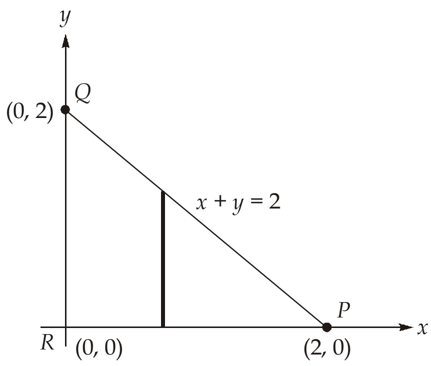
$$dx = -6t\,dt$$

$$dy = dt$$

$$\int_c 2y^3dx + 3x^2dy = \int_{-1}^{1}\left[2t^3(-6t) + 3\left(2-3t^2\right)^2\right]dt = \int_{-1}^{1}\left(15t^4 - 36t^2 + 12\right)dt$$

$$= \left[\frac{15t^5}{5} - \frac{36t^3}{3} + 12t\right]_{-1}^{1} = \left[3t^5 - 12t^3 + 12t\right]_{-1}^{1} = 3 + 3 = 6$$

25. (c)



$$I = \int_0^2 \int_0^{2-x} 5y\,dy\,dx = \int_0^2 \left[\frac{5y^2}{2}\right]_0^{2-x} dx$$

$$= \int_0^2 \frac{5}{2}(2-x)^2 dx = -\frac{5}{2}\frac{(2-x)^3}{3}\Bigg|_0^2$$

$$= -\frac{5(2-x)^3}{6}\Bigg|_0^2 = -\frac{5}{6}(-8) = \frac{20}{3}$$

26. (d)

$$\frac{d^2y}{dx^2} + y = \cos x$$

$$(D^2 + 1)y = \cos x$$

$$PI = \frac{\cos x}{D^2 + 1}$$

Putting $D^2 = -1$

$$PI = \frac{\cos x}{-1+1} \quad \text{[Makes denominator zero]}$$

$\therefore$ Differentiating numerator and denominator

$$PI = x \cdot \frac{\cos x}{2D}$$

$$= \frac{1}{2}x\int \cos x\,dx = \frac{1}{2}x \sin x$$

27. (b)

$$\int_0^4 f(x)\,dx = \frac{h}{3}\left[(y_0 + y_4) + 4(y_1 + y_3) + 2y_2\right]$$

$$= \frac{1}{3}\left[(0.5 + 0.029) + 4(0.25 + 0.05) + 2 \times 0.1\right] \simeq 0.64$$

28. (c)

$$S = 160t - 20t^2$$

For maximum height

$$\frac{dS}{dt} = 160 - 40t = 0$$

and $t = 4$ sec

$$\frac{d^2S}{dt^2} = -40 < 0 \quad \Rightarrow \text{Maxima}$$

$$S_{max} = 160 \times 4 - 20 \times 4^2$$

Maximum height $= 320$ m

29. (c)

$$\text{Output produced by } A = 40\%$$
$$\therefore \quad P(A) = 0.4$$
$$\text{Output produced by } B = 60\%$$
$$\therefore \quad P(B) = 0.6$$

Let, $P\left(\frac{D}{A}\right)$ = probability that item produced by A is defective

$$\therefore \quad P\left(\frac{D}{A}\right) = \frac{9}{1000} = 0.009$$

similarly, $P\left(\frac{D}{B}\right) = \frac{1}{250} = 0.004$

$P\left(\frac{A}{D}\right)$ = Probability that product is produced by A given that it is defective.

$$P\left(\frac{A}{D}\right) = \frac{P(A)\times P\left(\frac{D}{A}\right)}{P(A)\times P\left(\frac{D}{A}\right) + P(B)\times P\left(\frac{D}{B}\right)}$$

$$= \frac{0.4\times 0.009}{0.4\times 0.009 + 0.6\times 0.004}$$

$$P\left(\frac{A}{D}\right) = \frac{0.0036}{0.0036+0.0024} = \frac{0.0036}{0.006} = 0.6$$

$$\therefore \quad P\left(\frac{A}{D}\right) = 0.6$$

30. (c)

Given, $z = f(u, v);\ u = x^2 - 2xy - y^2,\ v = a$

$$\frac{\partial z}{\partial x} = \frac{\partial z}{\partial u}\cdot\frac{\partial u}{\partial x} + \frac{\partial z}{\partial v}\cdot\frac{\partial v}{\partial x}$$

and
$$\frac{\partial z}{\partial y} = \frac{\partial z}{\partial u}\cdot\frac{\partial u}{\partial y} + \frac{\partial z}{\partial v}\cdot\frac{\partial v}{\partial y}$$

Also, $\frac{\partial u}{\partial x} = 2x - 2y$ $\qquad$ $\frac{\partial u}{\partial y} = -2x - 2y$

$\frac{\partial v}{\partial x} = 0$ $\qquad$ $\frac{\partial v}{\partial y} = 0$

$$\frac{\partial z}{\partial x} = (2x-2y)\left(\frac{\partial z}{\partial u}\right) \quad \ldots\text{(i)}, \qquad \frac{\partial z}{\partial y} = -(2x+2y)\left(\frac{\partial z}{\partial u}\right) \quad \ldots\text{(ii)}$$

From equation (i) and (ii), we get

$$(x+y)\frac{\partial z}{\partial x} = (y-x)\frac{\partial z}{\partial y}$$

Hence, option (c) is correct.

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