DETAILED SOLUTIONS

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ESE 2022 : Prelims Exam
CLASSROOM TEST SERIES
GS & ENGINEERING APTITUDE
Test 1

Section A : Reasoning & Aptitude **[All topics]**

Section B : Engineering Mathematics **[All topics]**

ANSWER KEY

1.	(d)	11.	(b)	21.	(b)	31.	(d)	41.	(d)*
2.	(c)	12.	(c)	22.	(d)	32.	(d)	42.	(c)
3.	(b)	13.	(c)	23.	(a)	33.	(b)	43.	(c)
4.	(b)	14.	(a)	24.	(c)	34.	(d)	44.	(c)
5.	(d)	15.	(c)	25.	(a)	35.	(b)	45.	(a)*
6.	(b)	16.	(b)	26.	(a)	36.	(a)	46.	(c)
7.	(d)	17.	(d)	27.	(d)	37.	(a)	47.	(c)
8.	(c)	18.	(c)	28.	(d)	38.	(b)	48.	(c)
9.	(b)	19.	(b)	29.	(a)	39.	(a)	49.	(b)
10.	(b)	20.	(d)	30.	(a)	40.	(d)	50.	(a)

***Q.3, Q.41 & Q.45.** *Marks to all*

DETAILED EXPLANATIONS

1. (d)

The possibilities are:

4 from part A and 6 from part B.

or 5 from part A and 5 from part B.

or 6 from part A and 4 from part B.

Therefore, the required number of ways is

$$^6C_4 \times {}^7C_6 + {}^6C_5 \times {}^7C_5 + {}^6C_6 \times {}^7C_4 = \frac{6!}{4!\times 2!}\times\frac{7!}{6!\times 1!}+\frac{6!}{5!\times 1!}\times\frac{7!}{5!\times 2!}+\frac{6!}{6!}\times\frac{7!}{4!\times 3!}$$

$$= 105 + 126 + 35 = 266$$

2. (c)

Series follows the pattern,

$$\begin{aligned} a_{n+1} &= a_n \times a_{n+2} \\ a_2 &= 4 = 2 \times 2 \\ a_3 &= 2 = 4 \times 0.5 \\ a_4 &= 0.5 = 2 \times 0.25 \\ a_5 &= 0.25 = 0.5 \times 0.5 \\ a_6 &= 0.5 = 0.25 \times x \\ \Rightarrow \quad x &= \frac{0.5}{0.25} = 2 \end{aligned}$$

3. (b)

We note that there are 3 consonants M, C and T and 3 vowels E, A and O. Since no two vowels have to be together the possible choice for vowels are the places marked as 'X'.

X M X C X T X,

These vowels can arranged in $^4P_3$ ways and 3 consonants can be arranged in 3! ways. Hence, the required number of ways = 3! × $^4P_3$

$$= 3!\times\frac{4!}{1!} = 144$$

4. (b)

$$\begin{aligned} x+\frac{1}{x} &= 2 \\ \Rightarrow \quad x^2+\frac{1}{x^2}+2 &= 4 \\ \Rightarrow \quad x^2+\frac{1}{x^2} &= 2 \\ \Rightarrow \quad x^4+\frac{1}{x^4}+2 &= 4 \\ \Rightarrow \quad x^4+\frac{1}{x^4} &= 2 \end{aligned}$$

5. (d)

Series is following given pattern,

$$\begin{aligned} 1 \times 7 + 17 &= 24 \\ 2 \times 4 + 24 &= 32 \\ 3 \times 2 + 32 &= 38 \\ 3 \times 8 + 38 &= 62 \\ 6 \times 2 + 62 &= 74 \\ 7 \times 4 + 74 &= 102 \end{aligned}$$

6. (b)

$$\begin{aligned} \text{LCM of 3, 4, 6 and 12} &= 12 \\ \sqrt[3]{4} &= \sqrt[12]{4^4} = \sqrt[12]{256} \\ \sqrt[4]{6} &= \sqrt[12]{6^3} = \sqrt[12]{216} \\ \sqrt[6]{17} &= \sqrt[12]{17^2} = \sqrt[12]{289} \\ \sqrt[12]{222} &= \sqrt[12]{222} \\ \text{Smallest} &= \sqrt[12]{216} = \sqrt[4]{6} \end{aligned}$$

7. (d)

$$\frac{2.32^3 + 1.44^3 + 2.88^3 - 3 \times 2.32 \times 1.44 \times 2.88}{2.32^2 + 1.44^2 + 4 \times 1.44^2 - 2 \times 1.44^2 - 2.32 \times 1.44 - 2.32 \times 2.88}$$

$$\frac{2.32^3 + 1.44^3 + 2.88^3 - 3 \times 2.32 \times 1.44 \times 2.88}{2.32^2 + 1.44^2 + 2.88^2 - 2.88 \times 1.44 - 2.32 \times 1.44 - 2.32 \times 2.88}$$

$$\Rightarrow \quad \frac{a^3 + b^3 + c^3 - 3abc}{a^2 + b^2 + c^2 - ab - bc - ca} = a + b + c$$

$$2.32 + 1.44 + 2.88 = 6.64$$

8. (c)

Work done by the waste pipe in 1 min = $\frac{1}{20} - \left(\frac{1}{30} + \frac{1}{36}\right) = -\frac{1}{90}$ (–ve means emptying)

$$\therefore \quad \text{Volume of } \frac{1}{90} \text{ part} = 50 \text{ litre}$$

$$\Rightarrow \quad \text{Volume of tank} = 50 \times 90 = 4500 \text{ litre}$$

9. (b)

$$(x + y)\text{'s one hour work} = \frac{1}{6} + \frac{1}{7.5} = \frac{3}{10}$$

$$(x + z)\text{'s one hour work} = \frac{1}{6} + \frac{1}{10} = \frac{4}{15}$$

$$\text{Part filled in 2 hours} = \frac{3}{10} + \frac{4}{15} = \frac{17}{30}$$

$$\text{Part filled in 3 hours} = \frac{17}{30} + \frac{3}{10} = \frac{13}{15}$$

$$\text{Remaining part} = 1 - \frac{13}{15} = \frac{2}{15}$$

$\Rightarrow$ $(x + z)$ will take 30 mins to fill this part.

$$\text{Total time required} = 3 + 0.5 = 3.5 \text{ hours}$$

10. (b)

Time from 4 pm on a day to 9 pm on the following day = 29 hours.

$$\text{24 hrs 10 min of this clock} = \text{24 hrs of the correct clock}$$

$$\text{29 hrs of this clock} = \frac{24 \times 29}{24\frac{1}{6}} = \frac{24 \times 29 \times 6}{145} = \frac{144}{5} = 28\frac{4}{5} = 28 \text{ hrs } 48 \text{ min}$$

$\Rightarrow$ 48 min past 8

11. (b)

Let the quantity of wine in the cast originally be x litres.

Then, quantity of wine left in the cast after 5 operation

$$= \left[x\left(1 - \frac{24}{x}\right)^5\right] \text{litres}$$

$$\therefore \quad \frac{x\left(1 - \frac{24}{x}\right)^5}{x} = \frac{32}{32 + 211} = \frac{32}{243}$$

$$\Rightarrow \quad \left(1 - \frac{24}{x}\right)^5 = \left(\frac{2}{3}\right)^5$$

$$\Rightarrow \quad x = 72 \text{ litres}$$

12. (c)

There are two serieses: $(22,\ 16,\ 10,\ 4)$ and

$-6 \quad -6 \quad -6$

(0, 9, 36, 81)

$0^2, 3^2, 6^2, 9^2$

13. (c)

$$6 \times 6 - 0 = 36$$
$$36 \times 5 - 1 = 179$$
$$179 \times 4 - 2 = 714$$
$$714 \times 3 - 3 = 2139$$
$$2139 \times 2 - 4 = 4274$$

14. (a)

$$(16,\ 16,\ 24,\ 60,\ 240,\ 1440)$$

$$\times 1 \quad \times 1.5 \quad \times 2.5 \quad \times 4 \quad \times 6$$

$$0.5 \quad 1 \quad 1.5 \quad 2$$

15. (c)

So, $(13^7 - 7^7) + (2^6 - 4^6)$, both are divisible by 6

$\Rightarrow$ Remainder $= -2 + 6 = 4$

$(a^n - b^n)$ is divisible by $(a - b)$

$(a^n - b^n)$ is divisible by $(a + b)$ if 'n' is even natural number

16. (b)

7	729	Remainder
7	104	1
7	14	6
7	2	0
	0	2

$$(729)_{10} = (2061)_7$$

17. (d)

$$SP = 1026$$

$$\text{Profit} = 14\%$$

$$CP = \frac{1026}{1+0.14} = \text{Rs.}900$$

If it had been sold for 693 then,

$$\text{Loss} = 900 - 693 = \text{Rs. } 207$$

18. (c)

Suppose, the quantity sold at loss be y kg.

Let CP per kg = x

$$\text{Total SP} = 1.1 \times (20 - y)x + 0.95 \times y \times x$$

$$= (22 - 1.1y + 0.95y) \times x$$

$$= (22 - 0.15y) \times x = 1.08x \times 20$$

$$22 - 0.15y = 21.6$$

$$y = \frac{0.4}{0.15} = 2.67 \text{ kg}$$

19. (b)

$$SI = 1062 - 750 = 312$$

$$312 = \frac{750 \times 3 \times R}{100} + \frac{750 \times 4 \times 5}{100}$$

$$R = 7.2\%$$

20. (d)

2	11880
2	5940
2	2970
3	1485
3	495
3	165
5	55
11	11
	1

$$11880 = 2^3 \times 3^3 \times 5 \times 11$$

$$\text{Sum of all factors} = \frac{(2^4-1)(3^4-1)(5^2-1)(11^2-1)}{(2-1)(3-1)(5-1)(11-1)}$$

$$= \frac{15 \times 80 \times 24 \times 120}{1 \times 2 \times 4 \times 10} = 43200$$

Since unity is excluded,

The net sum of all factors = 43200 – 1 = 43199

21. (b)

It will be along the longest diagonal,

$$d = \sqrt{40^2 + 56^2 + 13^2} = 70.0357 \text{ m}$$

22. (d)

Let equal sides of the isosceles triangle be x,

Then $x^2 + x^2 = 10^2$

$$x = 5\sqrt{2} \text{ cm}$$

So, $$\text{Final area} = 8 \times \left(\frac{1}{8} \times \pi \times 10^2 - \frac{1}{2} 5\sqrt{2} \times 5\sqrt{2}\right)$$

$$= \pi \times 10^2 - 4 \times 25 \times 2$$

$$= 100\pi - 200$$

$$\text{Area} = 114.16 \text{ cm}^2$$

23. (a)

man × day = 40 × 400 = 16000

After 32 days ⇒ 32 × 400 = 12800

So, Remaining, man × day = 3200

∴ 80 × Day = 3200

Day = 40 days

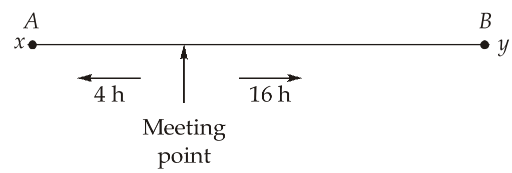
24. (c)

$$\frac{\alpha}{\beta}+\frac{\beta}{\alpha} = \frac{\alpha^2+\beta^2}{\alpha\beta}=\frac{(\alpha+\beta)^2-2\alpha\beta}{\alpha\beta}=\frac{(\alpha+\beta)^2}{\alpha\beta}-2$$

$$= \frac{(12/8)^2}{a/8}-2=\frac{144}{8a}-2=\frac{18}{a}-2$$

Minimum value $= -2$ (When $a \to \infty$)

25. (a)



In this case,

$$\frac{S_1}{S_2} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$$

$$\frac{40}{S_2} = \frac{\sqrt{4}}{\sqrt{16}}$$

$$S_2 = 80 \text{ kmph}$$

26. (a)

$[A]$ = diag [1×6, 2×1, 7×2] + diag [2, 3, 4]

$[A]$ = diag [6+2, 2+3, 14+4]

$$|A| = \begin{vmatrix} 8 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 18 \end{vmatrix} = 8\times 5\times 18 = 720$$

27. (d)

Three second order principal sub-matrix,

$$\begin{bmatrix} 1 & 3 \\ 5 & 11 \end{bmatrix}, \begin{bmatrix} 1 & 2 \\ 7 & 6 \end{bmatrix}, \begin{bmatrix} 11 & 2 \\ 3 & 6 \end{bmatrix}$$

Three first order principal sub-matrix,

[1], [11], [6]

28. (d)

Rank (AB) $\leq$ min[Rank (A), Rank (B)]

Rank (AB) $\leq$ 3

$\because$ We don't know the dimension of A and B, we cannot predict the exact rank of AB but its maximum rank will be 3.

29. (a)

$$[A] = \begin{bmatrix} 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 2 \\ 2 & 0 & 0 & 0 \end{bmatrix}$$

$$[A - \lambda I] = \begin{bmatrix} -\lambda & 2 & 0 & 0 \\ 0 & -\lambda & 2 & 0 \\ 0 & 0 & -\lambda & 2 \\ 2 & 0 & 0 & -\lambda \end{bmatrix} = 0$$

$$[A - \lambda I] = -\lambda \begin{vmatrix} -\lambda & 2 & 0 \\ 0 & -\lambda & 2 \\ 0 & 0 & -\lambda \end{vmatrix} - 2 \begin{vmatrix} 0 & 2 & 0 \\ 0 & -\lambda & 2 \\ 2 & 0 & -\lambda \end{vmatrix} = 0$$

$$\Rightarrow \quad \lambda^2(\lambda^2) - 2(-2)\begin{vmatrix} 0 & 2 \\ 2 & -\lambda \end{vmatrix} = 0$$

$$\Rightarrow \quad \lambda^4 - 16 = 0$$

$$(\lambda^2 - 4)(\lambda^2 + 4) = 0$$

$$(\lambda - 2)(\lambda + 2)(\lambda - 2i)(\lambda + 2i) = 0$$

$$\text{Eigen values} = 2, -2, 2i, -2i$$

30. (a)

$$\tan^{-1}(x) = x - \frac{x^3}{3} + \frac{x^5}{5}$$

$$\tan^{-1}(0.6) = 0.6 - \frac{0.6^3}{3} + \frac{0.6^5}{5}$$

$$\tan^{-1}(0.6) = 0.5435$$

31. (d)

Let,
$$U = V + W$$

$$V = \frac{x^2y^2z^2}{x+y+z}$$

$$V(tx, ty, tz) = \frac{t^6x^2y^2z^2}{t(x+y+z)} = t^5V(x,y,z)$$

$\therefore V$ is homogeneous function of degree 5,

$$x\frac{\partial V}{\partial x} + y\frac{\partial V}{\partial y} + z\frac{\partial V}{\partial z} = 5V \qquad \text{... (i)} \qquad \text{[From Euler's theorem]}$$

$$W(tx, ty, tz) = \log\left(\frac{t^2x^2y + t^2yz + t^2zx}{t^2x^2 + t^2y^2 + t^2z^2}\right) = t^0W(x,y,z)$$

$$\Rightarrow \qquad x\frac{\partial W}{\partial x}+y\frac{\partial W}{\partial y}+z\frac{\partial W}{\partial z} = 0 \qquad \text{... (ii)}$$

Equation (i) and equation (ii),

$$x\left(\frac{\partial V}{\partial x}+\frac{\partial W}{\partial x}\right)+y\left(\frac{\partial V}{\partial y}+\frac{\partial W}{\partial y}\right)+z\left(\frac{\partial V}{\partial z}+\frac{\partial W}{\partial z}\right)=5V$$

$$x\frac{\partial U}{\partial x}+y\frac{\partial U}{\partial y}+z\frac{\partial U}{\partial z} = 5\frac{x^2y^2z^2}{x+y+z}$$

32. (d)

$$y = \sqrt{a^x+y}$$

$$y^2 = a^x+y$$

$$2y\frac{dy}{dx} = a^x\ln a+\frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{a^x\ln a}{(2y-1)}$$

33. (b)

Let $\qquad y = \lim_{x\to 0^+} x^x$

Taking natural log, $\qquad \ln y = \lim_{x\to 0^+}\ln\left(x^x\right)=\lim_{x\to 0^+} x\ln x=\lim_{x\to 0^+}\frac{\ln x}{1/x}$

Using L' Hospital's rule, $\qquad \ln y = \lim_{x\to 0^+}\frac{1/x}{-1/x^2}=\lim_{x\to 0^+}-x=0$

$\Rightarrow \qquad y = e^0=1$

34. (d)

$$f(x) = f(3)+(x-3)f'(3)+\frac{(x-3)^2}{2!}f''(3)\ \ldots\ldots\ldots.$$

For quadratic approximation, neglecting rest terms,

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

$$f(x) = e^{-3}\left[1+(3-x)+\frac{(x-3)^2}{2}\right]$$

$$f(x) = e^{-3}\left[1+3-x+\frac{x^2+9-6x}{2}\right]$$

$$f(x) = \frac{1}{2}e^{-3}\left[8-2x+x^2+9-6x\right]$$

$$f(x) = \frac{1}{2}e^{-3}\left[x^2-8x+17\right]$$

35. (b)

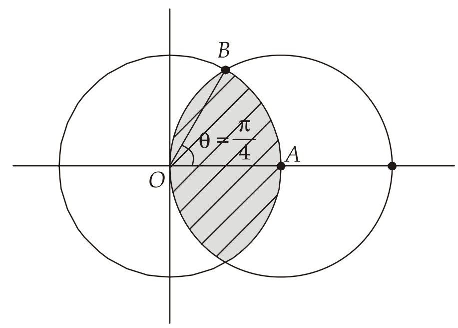
Given: $r = \sqrt{2}a$ and $r = 2a\cos\theta$

Point of intersection,

$$\sqrt{2}a = 2a\cos\theta$$

$$\cos\theta = \frac{1}{\sqrt{2}}$$

$$\theta = \frac{\pi}{4}$$



$$\text{Area, } A = 2\left[\frac{1}{2}\int_0^{\pi/4} r^2 d\theta + \frac{1}{2}\int_{\pi/4}^{\pi/2} r^2 d\theta\right]$$

$$A = \int_0^{\pi/4}\left(\sqrt{2}a\right)^2 d\theta + \int_{\pi/4}^{\pi/2} 4a^2\cos^2\theta d\theta$$

$$A = 2a^2\times\frac{\pi}{4} + 2a^2\left(\frac{\pi}{2}-\frac{\pi}{4}-\frac{1}{2}\right)$$

$$A = a^2(\pi - 1)$$

36. (a)

$$\text{div}\left(\vec{V}\right) = \frac{\partial V_1}{\partial x}+\frac{\partial V_2}{\partial y}+\frac{\partial V_3}{\partial z}$$

$$\text{div}\left(\vec{V}\right) = 4xy + 3x + 10z$$

At (0, 2, 1), $\text{div}\left(\vec{V}\right) = 4\times 0\times 2 + 3\times 0 + 10\times 1$

$$= 10$$

37. (a)

$$f(x) = xe^{-x}$$
$$f(0) = 0$$
$$f'(x) = e^{-x} - xe^{-x}, \qquad f'(0) = 1$$
$$f''(x) = -e^{-x} - e^{-x} + xe^{-x}, \qquad f''(0) = -2$$
$$f'''(x) = 2e^{-x} + e^{-x} - xe^{-x}, \qquad f'''(0) = 3$$

$$\Rightarrow \quad xe^{-x} = x - 2\frac{x^2}{2!} + 3\frac{x^3}{3!}$$

$$\Rightarrow \quad xe^{-x} = x - x^2 + \frac{x^3}{2}$$

38. (b)

$$\int_0^4 f(t)\,dt = \int_0^1 \left(1 - 3t^2\right)dt + \int_1^4 2t\,dt$$
$$= t - t^3\Big|_0^1 + t^2\Big|_1^4 = 15$$

39. (a)

$$\int_1^2 \frac{(x-1)^3}{x^2}dx = \int_1^2 \frac{x^3 - 1 + 3x - 3x^2}{x^2}dx = \int_1^2\left(x - \frac{1}{x^2} + \frac{3}{x} - 3\right)dx$$
$$= \left[\frac{x^2}{2} + \frac{1}{x} + 3\ln x - 3x\right]_1^2$$
$$= \left(1 - \frac{1}{2}\right) + \left(\frac{1}{2} - 1\right) + 3\ln 2 - 3(2-1)$$
$$= 3\ln 2 - 1$$

40. (d)

$$y = \sqrt[3]{x} \Rightarrow x = y^3$$
$$y = \frac{x}{9} \Rightarrow x = 9y$$
$$\Rightarrow \quad 9y = y^3$$
$$y = \pm 3 \text{ (Point of intersection)}$$

For first quadrant, $y = 3$, $x = 27$

$$V = \int_0^3 A(y)\,dy = \int_0^3 \pi\left[(9y)^2 - \left(y^3\right)^2\right]dy$$
$$V = \pi\int_0^3 \left(81y^2 - y^6\right)dy = 416.57\pi \text{ unit}^3$$

41. (d)

It is an exact differential equation since

$$\frac{\partial M}{\partial y} = 12xy^2 = \frac{\partial N}{\partial x}$$

$$\Rightarrow \int M dx + \int (\text{Terms of N not containing } x) dy = C$$

$$\int (x^4 + 4xy^3) dx + \int y^4 dy = C$$

$$\frac{1}{5}(x^5 + 10x^2y^3 + y^5) = C$$

42. (c)

$$\operatorname*{Res}_{z=1} f(z) = \lim_{z\to 1}(z-1)f(z) = \lim_{z\to 1}\frac{(z+6)(z-3)}{(z+2)} = \frac{7\times(-2)}{3} = -\frac{14}{3}$$

$$\operatorname*{Res}_{z=-2} f(z) = \lim_{z\to -2}(z+2)f(z) = \lim_{z\to -2}\frac{(z+6)(z-3)}{(z-1)} = \frac{4\times(-5)}{-3} = \frac{20}{3}$$

$$\text{Sum of residues} = \operatorname*{Res}_{z=1} f(z) + \operatorname*{Res}_{z=-2} f(z)$$

$$= -\frac{14}{3} + \frac{20}{3} = \frac{6}{3} = 2$$

43. (c)

$$e^{1/z} = 1 + \frac{1}{z} + \frac{1}{2!z^2} + \frac{1}{3!z^3} + \ldots\ldots\ldots$$

So, $e^{1/z}$ has pole at $z = 0$ which lies inside 'C' so, using Cauchy's residue theorem,

$$\int_C e^{1/z} dz = 2\pi i\, [\Sigma \text{Res}(e^{1/z} \text{ at poles inside } C)]$$

$$\operatorname*{Res}_{z\to 0} e^{1/z} = 1$$

$$\int_C e^{1/z} dx = 2\pi i\, [1] = 2\pi i$$

44. (c)

Atmost 2 sixes ⇒ 0 sixes + 1 six + 2six

$$= {}^6C_0\left(\frac{5}{6}\right)^6 + {}^6C_1\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^5 + {}^6C_2\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^4$$

$$= \left(\frac{5}{6}\right)^6 + 6\times\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^5 + \frac{6\times 5}{2\times 1}\left(\frac{1}{36}\right)\left(\frac{5}{6}\right)^4$$

$$= \left(\frac{5}{6}\right)^4\left[\frac{25}{36} + \frac{5}{6} + \frac{5}{12}\right]$$

$$P = \frac{35}{18}\left(\frac{5}{6}\right)^4$$

45. (a)

Required probability is

$$P = \frac{4}{52}\times\frac{2}{51}+\frac{4}{52}\times\frac{2}{51}=\frac{4}{663}$$

46. (c)

$$P(0) + P(1) + P(2) + P(3) = 1$$
$$k + 2k + 3k + 4k = 1$$
$$k = 0.1$$
$$P(x < 2) = P(0) + P(1) = k + 2k = 0.3$$
$$P(x \le 2) = P(0) + P(1) + P(2) = k + 2k + 3k = 6k = 0.6$$
$$P(x < 2) + P(x \le 2) = 0.9$$

47. (c)

Let,
$$f(x) = x^2 - 15$$
$$f'(x) = 2x$$

First iteration:
$$f(x_0) = f(3.5) = 3.5^2 - 15 = -2.75$$
$$f'(x_0) = f'(3.5) = 7$$
$$x_1 = 3.5-\frac{2.75}{7}=3.8929$$

Second iteration:
$$f(x_1) = 0.1543$$
$$f'(x_1) = 7.7857$$
$$x_2 = 3.8929-\frac{0.1543}{7.7857}=3.873$$

49. (b)

$$I = \frac{h}{3}\left[(y_0+y_4)+4(y_1+y_3)+2y_2\right]$$
$$I = \frac{0.1}{3}\left[(1+0.8604)+4(0.9975+0.9776)+2\times 0.9900\right]$$
$$I = 0.39136$$

50. (a)

$$L(\sin 2t) = \frac{2}{s^2+4}$$
$$L(t^2\sin 2t) = \frac{d^2}{ds^2}\times\frac{2}{s^2+4}=\frac{12s^2-16}{\left(s^2+4\right)^3}$$
$$= \frac{-2d}{ds}\times\frac{1}{s^2+4}\times 2s = -4\frac{d}{ds}\times\frac{s}{\left(s^2+4\right)^2}$$
$$= -4\left[\frac{\left(s^2+4\right)^2-2(2s)\left(s^2+4\right)}{\left(s^2+4\right)^4}\right]=-4\left[\frac{s^2+4-3s^2}{\left(s^2+4\right)^3}\right]$$
$$= \frac{12s^2-16}{\left(s^2+4\right)^3}$$

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