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127. The displacement s of a particle is given by $s = \frac{1}{3}t^3 - 3t^2 + 8t$. Find the acceleration of the particle at the instants when its velocity is zero.

128. A particle moves along a straight line with velocity $v = 4t^3 - 12t^2$ m/s. Find the acceleration of the particle when $t = 3$.

2. The curve has equation $\frac{\log_e(5x^2+4)}{7x^3-5x}$ where $x \neq 0$.

Find the gradient of the curve at the point where $x = 1$. Write in exact form. Simplify your answer in terms of $\frac{a}{b} + c \ln(9)$. [5]

3. Find $\int_1^3 \frac{2y^3+7y^2+5}{4y} dy$. Write in exact form. [4]

10. Find the gradient of the curve $\frac{7x^2e^{9x^2-8x}}{5x^3-4}$ where $x = 2$. Write in exact form. [6]

Question1

- a. $20x^3$
- b. $27x^5$
- c. $21x^2$
- d. $180x^8$
- e. $16x$
- f. $44x^{10}$
- g. $63x^6$
- h. $180x$
- i. $135x^2$

Question2

- a. $-\frac{8}{3x^3}$
- b. $-\frac{3}{7x^4}$
- c. $-\frac{80}{x^5}$
- d. $-\frac{2}{7x^2}$
- e. $\frac{10}{x^5}$
- f. $-\frac{1}{x^4}$
- g. $\frac{63}{10x^8}$
- h. $-\frac{1}{5x^5}$
- i. $-\frac{9}{4x^4}$

Question3

- a. $\frac{5}{2\sqrt{x}}$
- b. $6\sqrt{x}$
- c. $-\frac{7}{2x\sqrt{x}}$
- d. $-\frac{15}{4x\sqrt{x}}$
- e. $\frac{1}{5\sqrt{x}}$

f. $-\frac{3}{8x^{5/2}}$

g. $\frac{1}{10\sqrt{x}}$

h. $\frac{7}{4\sqrt{x}}$

i. $-\frac{9}{16x\sqrt{x}}$

Question4

- a. $24x^3 - 6x^2$
- b. $6x + 1$
- c. $6x + \frac{4}{x^2}$
- d. $56x^6 + 27x^2 - 2$
- e. $-1 + 20x^4$

Question5

- a. $1 + \frac{7}{x^2}$
- b. $-\frac{1}{2x^{3/2}} - \frac{3\sqrt{x}}{2} + \frac{5x^{3/2}}{2}$
- c. $1 - \frac{9}{x^2}$
- d. $12x + \frac{5}{2x^{3/2}}$
- e. $-\frac{2}{x^2} + \frac{12}{x^3}$

Question6

- a. $12(3x + 1)^3$
- b. $30(6x - 7)^4$
- c. $9(x + 2)^8$
- d. $6\left(\frac{3}{2}x + 1\right)^3$
- e. $30(5x - 6)^5$
- f. $-8(6 - 2x)^3$
- g. $5(2x - 1)(x^2 - x + 2)^4$
- h. $-10x(7 - x^2)^4$
- i. $12x(x^2 - 1)^5$

Question 94

- Integral: $\int_1^2 \left(\frac{1}{x^2} + 3x \right) dx = \left[-\frac{1}{x} + \frac{3}{2}x^2 \right]_1^2$
- Evaluation: $\left(-\frac{1}{2} + 6 \right) - \left(-1 + \frac{3}{2} \right) = \frac{11}{2} - \frac{1}{2}$
- Answer: 5

Question 95

- Integral: $\int_0^1 (e^x + 2) dx = [e^x + 2x]_0^1$
- Evaluation: $(e + 2) - (1 + 0)$
- Answer: $e + 1$

Question 96

- Integral: $\int_1^4 \left(\sqrt{x} - \frac{1}{\sqrt{x}} \right) dx = \left[\frac{2}{3}x^{3/2} - 2x^{1/2} \right]_1^4$
- Evaluation: $\left(\frac{16}{3} - 4 \right) - \left(\frac{2}{3} - 2 \right) = \frac{4}{3} - \left(-\frac{4}{3} \right)$
- Answer: $\frac{8}{3}$

Question 97

- Integral: $\int_0^{\pi/2} (2 \cos x - 3 \sin x) dx = [2 \sin x + 3 \cos x]_0^{\pi/2}$
- Evaluation: $(2 + 0) - (0 + 3)$
- Answer: -1

Question 98

- Integral: $\int_1^3 (x^2 + x - 2) dx = \left[\frac{x^3}{3} + \frac{x^2}{2} - 2x \right]_1^3$
- Evaluation: $\left(9 + \frac{9}{2} - 6 \right) - \left(\frac{1}{3} + \frac{1}{2} - 2 \right) = \frac{15}{2} - \left(-\frac{7}{6} \right)$
- Answer: $\frac{26}{3}$

Question 99

- Integral: $\int_0^2 (x^3 - 3x^2 + 2) dx = \left[\frac{x^4}{4} - x^3 + 2x \right]_0^2$
- Evaluation: $(4 - 8 + 4) - 0$
- Answer: 0

Question 100

- Integral: $\int_1^e \left(\frac{2}{x} + 4x^3 \right) dx = [2 \ln |x| + x^4]_1^e$
- Evaluation: $(2 + e^4) - (0 + 1)$
- Answer: $e^4 + 1$

Question 138

- **Given Conditions:**

$$a(t) = 2t - 6, \quad v(0) = 5 \text{ m/s}, \quad s(0) = 0$$

- **Step 1: Find velocity function $v(t)$**

$$v(t) = \int (2t - 6) dt = t^2 - 6t + C_1$$

$$v(0) = 5 \Rightarrow C_1 = 5 \Rightarrow v(t) = t^2 - 6t + 5 = (t - 1)(t - 5)$$

Turning points occur at $t = 1$ s and $t = 5$ s.

- **Step 2: Find displacement function $s(t)$**

$$s(t) = \int (t^2 - 6t + 5) dt = \frac{1}{3}t^3 - 3t^2 + 5t \quad (C_2 = 0)$$

- **Step 3: Calculate displacement at key times ($t = 0, 1, 5$)**

- $s(0) = 0$ m

- $s(1) = \frac{1}{3}(1)^3 - 3(1)^2 + 5(1) = \frac{7}{3}$ m

- $s(5) = \frac{1}{3}(5)^3 - 3(5)^2 + 5(5) = \frac{125}{3} - 50 = -\frac{25}{3}$ m

- **Step 4: Calculate total distance in the first 5 seconds**

- $t = 0 \rightarrow 1: \left| \frac{7}{3} - 0 \right| = \frac{7}{3}$ m

- $t = 1 \rightarrow 5: \left| -\frac{25}{3} - \frac{7}{3} \right| = \left| -\frac{32}{3} \right| = \frac{32}{3}$ m

$$\text{Total Distance} = \frac{7}{3} + \frac{32}{3} = \frac{39}{3} = 13 \text{ m}$$

Answer: Total distance = 13 m