DPP – 2

SOLUTION

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1. $x = at + bt^2 - ct^3$

$v = \frac{dx}{dt} = a + 2bt - 3ct^2$

$a = \frac{dv}{dt} = 2b - 6ct$

$a = 0 \Rightarrow 2b = 6ct$

$t = \frac{b}{3c}$

$V_{at} \;\; t = \frac{b}{3c}$

$v = a + 2b \times \frac{b}{3c} - 3c \times \left(\frac{b}{3c}\right)^2$

$= a + \frac{2b^2}{3c} - \frac{3cb^2}{9c^2}$

$= a + \frac{2b^2}{3c} - \frac{b^2}{3c}$

$v = a + \frac{b^2}{3c}$

2. first we find position of particle at $t = \tau$ time .

$\frac{dx}{dt} = b\sqrt{x}$

$\int_0^x \frac{dx}{\sqrt{x}} = \int_0^\tau bdt$

$2\sqrt{x} = b\tau$

$\sqrt{x} = \frac{b\tau}{2}$

$x = \frac{b^2\tau^2}{4}$

$v = b\sqrt{x}$

$v_{at} t = \tau = b\left[\frac{b\tau}{2}\right]$

$v_{at} t = \tau = \frac{b\tau^2}{2}$

3. $\frac{dv}{dt} = -2.5\sqrt{v}$

$\int_{6.25}^{0} \frac{dv}{\sqrt{v}} = \int_0^t -2.5dt$

$[2\sqrt{v}]_{6.25}^{0} = -2.5t$

$-2 - \sqrt{6.25} = -2.5t$

$02 \times 2.5 = 2.5t$

$t = 2sec$

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4. $x = at^3 + bt^2 + ct + d$

$v = 3at^2 + 2bt + c$

$t = 0 \ v = c3$

$a = \frac{dv}{dt} = 6at + 2b$

$a\frac{ab}{t=0} = 2b.$

$\frac{a}{v} = \frac{2b}{c}$

5. $u = kt$

$K = 2m/s^2$

$\frac{dx}{dt} = kt$

$\int_0^{dx} = \int_0^3 \ ktdt$

$x = k\left(\frac{g}{2}\right)$

$x = 2 \times \frac{9}{2} = 9 \text{ m}$

6. $S = \frac{t^2}{2} + \frac{t^3}{3}$

$\theta = \frac{2t}{2} + \frac{3t^2}{3} = t + t^2$

$a = 1 + 2t$

$\text{at } t = 2\text{sec}$

$a_T = 1 + 2 \times 2 = 5 \text{ m/m}^2$

$t = 2 \ V = 2 + 4 = 6 \text{ m/m}^2$

$a = \sqrt{a_c^2 + a_t^2} = \sqrt{\left(\frac{36}{3}\right)^2 + 25}$

$a = \sqrt{144 + 25} = 13 \text{ m/s}^2$

7. $Y = a + bt + ct^2 - dt^4$

$v = \frac{dY}{dt} = +b + 2ct - 4dt^3$

$t = 0 \ v = b$

$a = \frac{dv}{dt} = 2c$

8. $f = at$

$\frac{dv}{dt} = at$

$\int_v^v dv = \int_0^u atdt$

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$v - u = \frac{at^2}{2} + c$

$v = u + \frac{at^2}{2}$

9. $x_p = dt + \beta t^2.$

$x_Q = ft - t^2.$

$v_p = d + 2\beta t \; v_p = f - 2t$

$v_p = v_\rho \Rightarrow d + 2\beta t = f - 2t$

$2(\beta + 1)t = f - d$

$t = \frac{f-d}{2(1+\beta)}$

10. $s = 6t^2 - t^3$

$v = 12t - 3t^2$

$3t(4 - t) = 0$

$t = 0$

$t = 4sec$

11. $\frac{dx}{dt}$

$\vec{a} \cdot \vec{v} = avcos\,\theta$

$A\,cos\,\theta = \frac{\vec{a} \cdot v}{v}$

Projection of a in dis of $\vec{v}$. if is also called tangential accelontion. So option C & D both.

12. $x = t^3 - 9t^2 + 6t$

$v = 3t^2 - 18t + 6$

$v = 0 \Rightarrow 3t^2 - 18t + 6 = 0$

$t^2 - 6t + 2 = 0$

$t = \frac{6 \pm \sqrt{36 - 4 \times 1 \times 2}}{2}$

$t = \frac{6 \pm \sqrt{28}}{2}$

$t = 3 \pm \sqrt{7}$

$t = 3 - \sqrt{7}$

$t = 3 + \sqrt{7}$

(A)

$\frac{dx}{dt} = 3t^2 - 18t + 6$

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$\int dx = \int_{3-\sqrt{7}}^{3+\sqrt{7}} (3t^2 - 18t + 6)dt$

$S = \left[\frac{3t^3}{3} - \frac{18t^2}{2} + 6t\right]_{3-\sqrt{7}}^{3+\sqrt{7}}$

$S = -74\ cm$

check inequality $\vec{a} \cdot \vec{v} > 0$

13. non zero acceleration co.

constant velocity is not possible.

$a = \frac{dv}{dt} \rightarrow$ true

14. $\vec{v}_{\text{ins}} = \frac{d\vec{s}}{dt}$

instantaneous velocity depends on rate of change of position.

statement 2 $-\ \bar{v}_{\text{ins}} = \frac{ds}{dt}$

$\vec{v}_{av} = \frac{\text{total displacement}}{\text{total time.}}$

False

15. to 16.

$\frac{dv}{dt} = 6 - 3v$

$a = 6 - 3v$ ...(i)

$\int_0^v \frac{dv}{6-3v} = \int_0^t dt$

$\frac{1}{-3}[ln\ 6 - 3v]_0^v = t$

$Ln\left(\frac{6-3v}{6}\right) = -3t$

$\frac{6-3x}{6} = e^{-3t}$

$6 - 3u = 6e^{-3t}$

$3v = 6 - 6e^{-3t}$

$v = 2(1 - e^{-3t})$

$a_{initial} = \frac{6\ m}{s^2}$

$V_{\text{Terminat} \rightarrow \text{means } a=0} a = 0$

$3v = 6\ v = 2\ m/s$

OR $t = \infty$

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$v = 2\left(1 - \frac{1}{e^{\infty}}\right)$

$v = 2\,m/s$

17. $v = dt + \beta t^2$

$\frac{ds}{dt} = dt^{\infty} + \beta t^2$

$\int ds = \int_1^2 (dt + \beta t^2)dt$

$s = \left[\frac{dt^2}{2} + \frac{\beta t^3}{3}\right]_1^2$

$= \left(\frac{d\times4}{2} + \frac{\beta\times8}{3} - \frac{d}{2} - \frac{\beta}{3}\right)$

$= 2d + \frac{8\beta}{3} - \frac{d}{2} - \frac{\beta}{3}$

$s = \frac{3d}{2} + \frac{7\beta}{3}$ (A)