

Timothy Evan Ruse

Question 1

a) ~~1) 5)~~

$$60^\circ - 30^\circ = 30^\circ$$

$$90^\circ - 60^\circ = 30^\circ$$

	Vertical	⊥ Plane	Horizontal
S			
u	$70 \sin 30^\circ$	$70 \sin 30^\circ$	$70 \cos 30^\circ$
v			
A	-9.81	$-9.81 \cos 30^\circ$	0
T			

⊥ Plane

$$S = ut + \frac{1}{2} at^2$$

$$S = t(u + \frac{1}{2} at)$$

$$0 = u + \frac{1}{2} at$$

$$= 70 \sin 30^\circ + \frac{(-9.81 \cos 30^\circ)}{2} t$$

$$= 2(70 \sin 30^\circ) = (-9.81 \cos 30^\circ) t$$

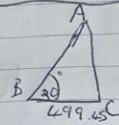
$$t = \frac{2(70 \sin 30^\circ)}{9.81 \cos 30^\circ}$$

$$t = \frac{2(35)}{8.496}$$

$$t = 8.239 \text{ Seconds}$$

$$\begin{aligned} \text{b) } BC &= (70 \cos 30^\circ) t \\ &= (60.62) t \\ &= (60.62) 8.239 \\ &= 499.45 \text{ m} \end{aligned}$$

$$\begin{aligned} AB &= \frac{499.45}{\cos 30^\circ} \\ &= 576.72 \text{ m} \end{aligned}$$



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Question 2

For Particle A $S = 3t^2 + 10t - 8$
Velocity = $\dot{S} = 6t + 10$
Acceleration = $\ddot{S} = 6$

For Particle B $S = 7t^3 + 4t^2 + 4$
Velocity = $\dot{S} = 21t^2 + 8t$
Acceleration = $\ddot{S} = 42t + 8$

For particle C $S = 10t^3 - 30t + 2$
Velocity = $\dot{S} = 30t^2 - 30$
Acceleration = $\ddot{S} = 60t$

a) $21t^2 + 8t = 3(6t + 10)$
 $42t + 8t = 18t + 30$
 $42t + 8t - 18t = 30$
 $32t = 30$
 $t = \frac{30}{32}$
 $t = 0.9375 \text{ seconds}$

b) $42t + 8 = 60t$
 $8 = 60t - 42t$
 $8 = 18t$
 $\frac{8}{18} = t$
 $t = 0.4 \text{ seconds}$

c) $t = 0$	$t = 4$
Particle A = $6 \times 0 + 10 = 10$	Particle A = $6 \times 4 + 10 = 34$
Particle B = $21 \times 0^2 + 8 \times 0 = 0$	Particle B = $21 \times 4^2 + 8 \times 4 = 368$
Particle C = $30 \times 0^2 - 30 = -30$	Particle C = $30 \times 4^2 - 30 = 450$

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Question 4

$$a) F(t) - K_1 x(t) - K_2 x(t) - K_3 x(t) - c_1 \frac{dx}{dt} - c_2 \frac{dx}{dt} = m \frac{d^2 x}{dt^2}$$

$$F(t) - 6x(t) - 2 \frac{dx}{dt} - 2 \frac{dx}{dt} = 6 \frac{d^2 x}{dt^2}$$

$$F(t) = 6 \frac{d^2 x}{dt^2} + 2 \frac{dx}{dt} + 2 \frac{dx}{dt} + 6x(t)$$

Laplace

$$F(s) = 6s^2 X(s) + 2sX(s) + 2sX(s) + 6X(s)$$

$$F(s) = X(s)(6s^2 + 2s + 2s + 6)$$

$$X(s)(6s^2 + 4s + 6)$$

$$T.F = \frac{X(s)}{F(s)} = \frac{1}{6s^2 + 4s + 6}$$

$$b) \frac{\frac{1}{6}}{s^2 + \frac{4}{6}s + 1}$$

$$1 \div 2 = 0.5 \text{ R/s}$$

$$\frac{0.5}{2\pi} = 0.0796$$

$$\frac{0.0796}{\pi} = 0.0253 \text{ Hz}$$

$$d) \frac{\frac{1}{6}}{s^2 + \frac{4}{6}s + \frac{6}{6}} = \frac{\frac{1}{6}}{s^2 + \frac{4}{6}s + 1}$$

$$\omega_n = \sqrt{1} = 1$$

$$2\zeta\omega_n = \frac{4}{6} = 2\zeta = \frac{4}{6}$$

$$\zeta = \frac{4}{12} < 1 \text{ under damped}$$