Major 2 - 012
~~Q12~~ solutions for
Q7 - Q12 (Q13)
ch 9 & ch10

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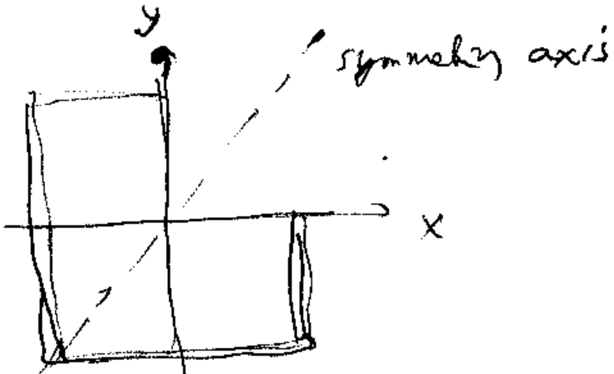
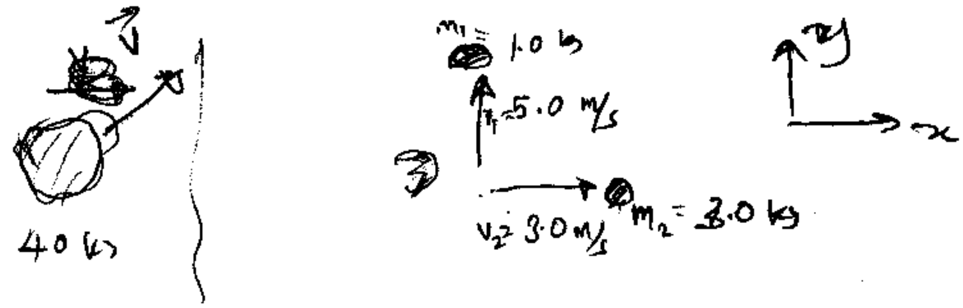
(Q7) O



COM is in III rd quadrant

(Q8)



No external force horizontally (frictionless surface)

$$\vec{P}_i = \vec{P}_f$$

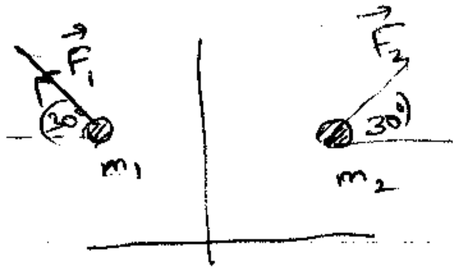
$$4\vec{v} = (1.0)(5.0\hat{j}) + (3.0)(3.0\hat{i})$$

$$\vec{v} = \frac{1}{4}(9\hat{i} + 5\hat{j})$$

$$v = \frac{1}{4}\sqrt{9^2 + 5^2}$$

$$v = 2.6$$

(Q9)



$m_1 = m_2 = 5.0$ kg

$F_1 = F_2 = 12$ N

$$\Sigma \vec{F}_{ext} = M \vec{a}_{cm}$$

$$\vec{F}_1 = \langle -F_1 \cos 30 ,\ F_1 \sin 30 \rangle$$

$$\vec{F}_2 = \langle F_2 \cos 30 ,\ F_2 \sin 30 \rangle$$

$$\Sigma \vec{F}_{ext} = \vec{F}_1 + \vec{F}_2 = (F_1 \cos 30 - F_2 \cos 30)\,\hat{i} + (F_1 \sin 30 + F_2 \sin 30)\,\hat{j}$$

$$= ~~12 \sin 30~~ \; 0\hat{i} + 2(12 \sin 30)\hat{j}$$

$$\vec{a}_{cm} = \frac{\Sigma \vec{F}}{M}$$

$$= \frac{24 \sin 30}{10} \hat{j} \ (m/s^2)$$

$$\boxed{\vec{a}_{cm} = 1.2\,\hat{j} \ m/s^2}$$

(Q10)

$\Delta \vec{p} = \int \vec{F} \cdot dt$ = area under the curve of F vs. t

$= \frac{1}{2}(6-2)(10-0)$

$= \frac{1}{2}(4)(10)$

$= 20$ (N.s.)

(Q11)

ELASTIC collision: Both KE & Momentum are conserved

INELASTIC collision: KE not conserved
Momentum is conserved

(Q12)

$KE = \frac{1}{2}(m_A + m_B) V_f^2 =$

~~$\vec{P}_i = \vec{P}_f = M\vec{V}_{cm}$~~

$M v_{cm} = \sum_i \vec{P}_i = \vec{P}$ (total)

$M = m_A + m_B$

Conservation of momentum $\vec{P}_i = \vec{P}_f$

$\therefore M\vec{v}_{cm} = \vec{P}_i = \vec{P}_f$

$\Rightarrow M v_{cm} = M v_f$

$\vec{V}_f = \vec{v}_{cm}$

$$KE = \frac{1}{2}(m_A + m_B) V_{cm}^2$$

$$= \frac{1}{2}(3+2)\, 4^2$$

$$\boxed{KE = 40\,J}$$

(Q13)

$\omega_0 = ?$

$\Delta t = 3.00$ s

$\omega = 98$ rad/s

$\Delta\theta = 37$ rev

$\alpha = ?$

find ω_0. α is not needed (the missing quantity in the question)

the equation to use is

$$\Delta\theta = \frac{1}{2}(\omega + \omega_0)\, t$$

~~But you should convert better conv~~

~~Convert~~ ~~$\Delta\theta$~~ Find $\Delta\theta$ in rad

$$\Delta\theta = 37\,(\text{rev})\ \frac{2\pi(\text{rad})}{1(\text{rev})} = 232\ \text{rad}$$

(Note: always make a habit of using the calculator value of π by pressing the "π" button).

$$232 = \frac{1}{2}(98 + \omega_0)(3.00)$$

$$\boxed{\omega_0 = 57.0\ \text{rad/s}}$$