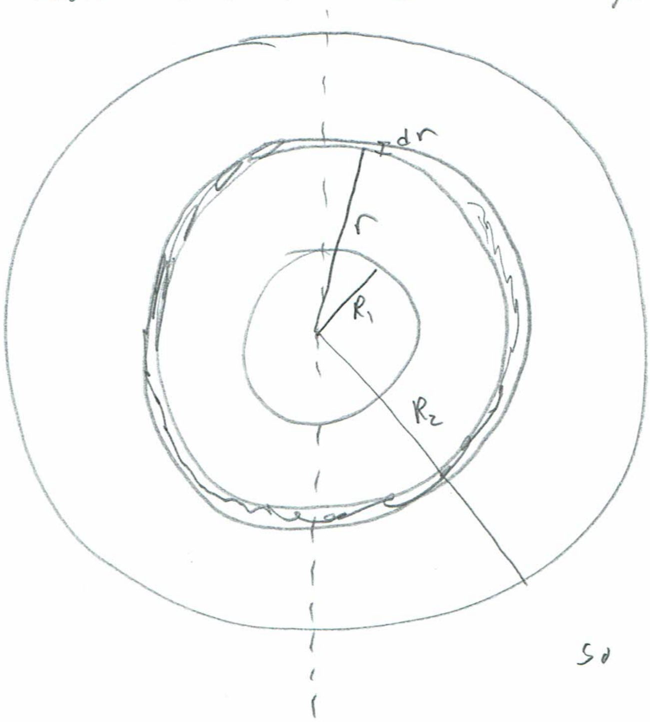
6. Chop the washer into rings; and parameterized with their radius r. r will range from R_1 to R_2.



$dA = 2\pi r\, dr$ ("unwind" the ring: it has length $2\pi r$ and width dr).

so $dm = \sigma\, dA = 2\pi r \sigma\, dr$

$$dI = \tfrac{1}{2} dm\, r^2 = \tfrac{1}{2}(2\pi r \sigma\, dr) r^2 = \pi r^3 \sigma\, dr$$

r because this is the radius of each ring

so $$\int dI = I = \int_{R_1}^{R_2} \pi r^3 \sigma\, dr$$

$$= \left.\frac{\pi \sigma r^4}{4}\right|_{R_1}^{R_2}$$

$$= \frac{\pi\sigma}{4}\left(R_2^4 - R_1^4\right)$$

6) A ~~3~~ 2.0 kg air-track glider is attached to a spring with spring constant 50 N/m. The glider is pulled 0.25 m to the right of the equilibrium position and released at time zero.

a) Write the values for the following constants: (2 points)

k= 50 N/m, m= 2 kg, ω= $5\ s^{-1}$, f= 0.80 Hz T= 1.26 s, A= 0.25 m, v_{max} = 1.25 m/s, a_{max} = 12.5 m/s²

$$w = \sqrt{\frac{k}{m}} = \sqrt{\frac{50\ N/m}{2\ kg}} = 5\ s^{-1}$$

$$f = \frac{w}{2\pi} = 0.80\ Hz$$

$$T = \frac{1}{f} = 1.26\ s$$

$$V_{max} = wA = 1.25\ m/s$$

$$a_{max} = w^2 A = \text{XXXX}\ m/s^2$$

6.25

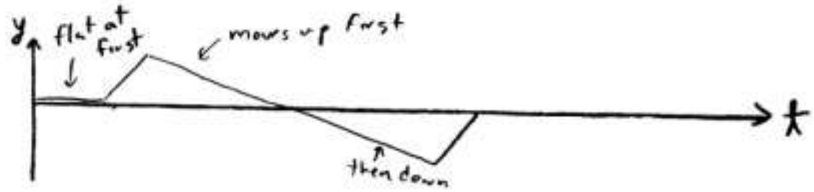
b) What is the position of the glider at t=1.00 s? (2 points)

$$x = A\cos(wt) = (0.25\ m)(\cos(5\ s^{-1} \cdot 1\ s))$$

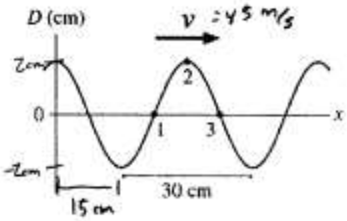
$$= 0.071\ m$$

6) The diagram below shows a snapshot graph of a wave on a string that is travelling to the right at time t=0.

Draw a history graph representing the motion of point A. (2 points).



6. The figure below shows a snapshot of a wave travelling to the right along a string at 45 m/s.



$\lambda = 30\text{cm}$ $\qquad k = \frac{2\pi}{\lambda} = 0.209\ \text{cm}^{-1}$

so $v = f\lambda$

$\Rightarrow f = \frac{v}{\lambda} = \frac{45\ \text{m/s}}{0.3\text{m}} = 150\ \text{Hz}$

$w = 2\pi f = 942\ \cancel{\text{Hz}}\ \text{rad/s}$

a) Write the equation of motion of the wave (y as a function of x and t). (2 points)

$y(x,t) = A\cos(kx - wt)$, where $k = 0.209\text{cm}^{-1}$

and $w = 942\ \text{rad/s}$

I use cosine b/c at $t=0$, displacement is maximum at $x=0$

b) At this instant, what is the velocity of points 1, 2, and 3? (Be sure to pay attention to signs). (1 point)

point 1 is at $x = 15\text{m} + \frac{15\text{m}}{2} = 22.5\text{cm}$

" 2 " at $x = 30\text{cm}$

" 3 " " $x = 30\text{m} + \frac{15}{2}\text{m} = 37.5\text{cm}$

$X(x,0) = A\cos(kx)$, $A = 2\text{cm}$, $k = 0.209\ \text{m}^{-1}$

$v(x,0) = Aw\sin(kx)$

so $v(22.5\text{cm}, 0) = (2\text{cm})(942\frac{\text{rad}}{\text{s}})\overset{\sin}{\cancel{\cos}}(kx_1) = 2(942)(-1)$
$= -1884\ \text{cm/s}$

$v(30\text{cm}, 0) = 0$

$v(37.5\text{cm}, 0) = 1884\text{cm/s}$

4.

a) This is the third harmonic (3 antinodes).

$$f_3 = \frac{3}{2L}\sqrt{\frac{T}{\mu}} \quad , \text{where } \mu = m/L$$

$$= 237 \text{ Hz}$$

b) $f_1 = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$, so $\frac{1}{3}$ of the above answer

which is 79. Hz