

$$M_1 - M_2 = -\frac{5}{2} \log(b_1/b_2)$$

two different object
one kind of magnitude

$$\rightarrow -0.4(M_1 - M_2) = \log(b_1/b_2)$$

10

$$m - M = 5 \log(D/10 \text{ pc})$$

one object
both kinds of magnitude

$$2a) \quad M_{c1} - M_{c2} = \Delta M_c$$

$$\textcircled{1} \quad M_{c1} - M_{c1} = 5 \log (D_{c1}/10pc)$$

$$\textcircled{2} \quad m_{c2} - M_{c2} = 5 \log (D_{c2}/10pc)$$

$\textcircled{1} - \textcircled{2}$

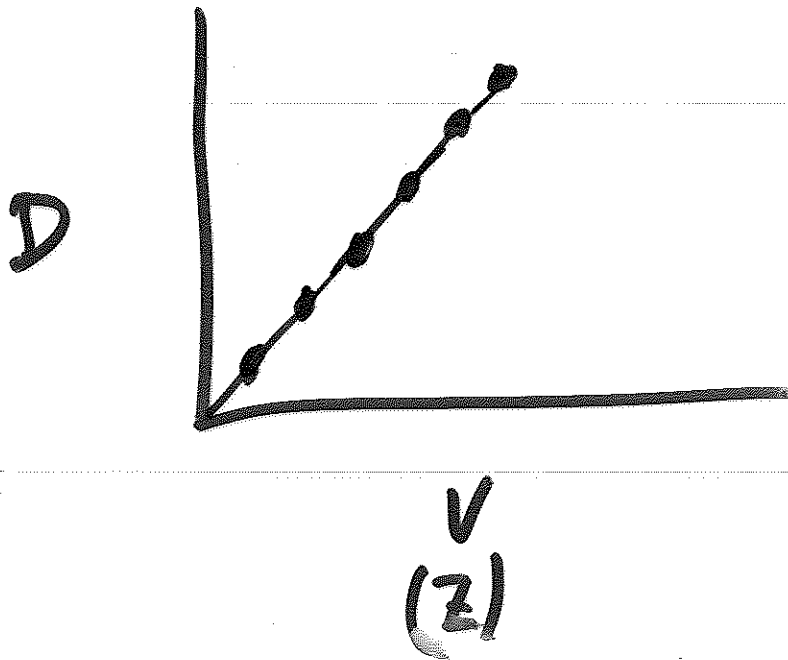
$$M_{c1} - m_{c2} - [M_{c1} - M_{c2}]$$

$$= 5 [\log (D_{c1}/10pc) - \log (D_{c2}/10pc)]$$

zero

$$\begin{aligned} \log(x) - \log(y) \\ = \log(x/y) \end{aligned}$$

↑↑
+ info elsewhere in problem

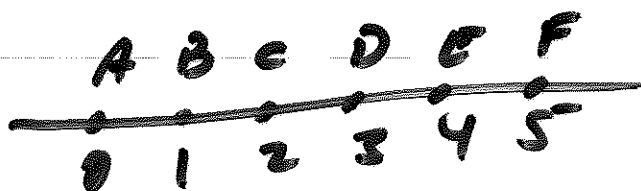


$$V = H D$$

↑
Hubble's
constant

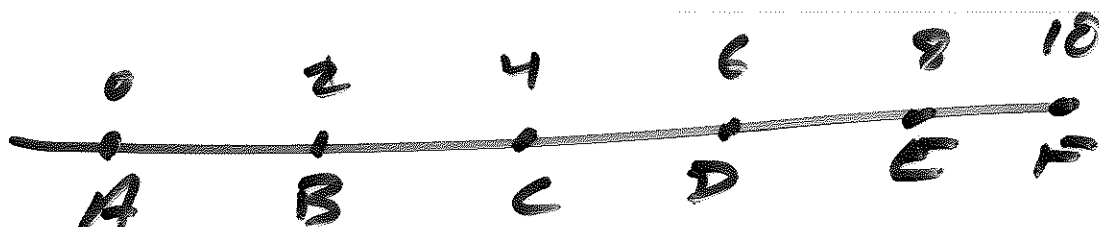
⇒ universe is expanding
 → Big Bang
 → age of universe
 → ultimate fate of universe

ONE D universe



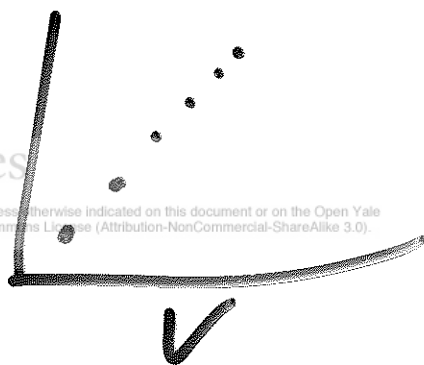
$\times 2$

1 time unit



observer on A			
galaxy	distance (at start)	motion	velocity $\Delta D / \Delta T$
B	1	1 \rightarrow 2	$\Delta D = 1$
C	2	2 \rightarrow 4	$\Delta D = 2$
D	3	3 \rightarrow 6	
E	4	4 \rightarrow 8	
F	5	5 \rightarrow 10	

0

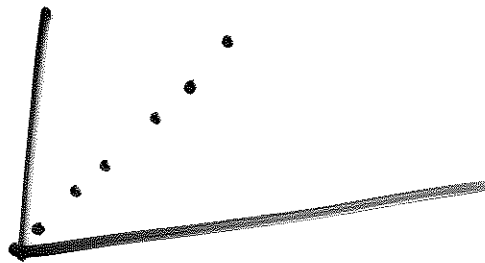


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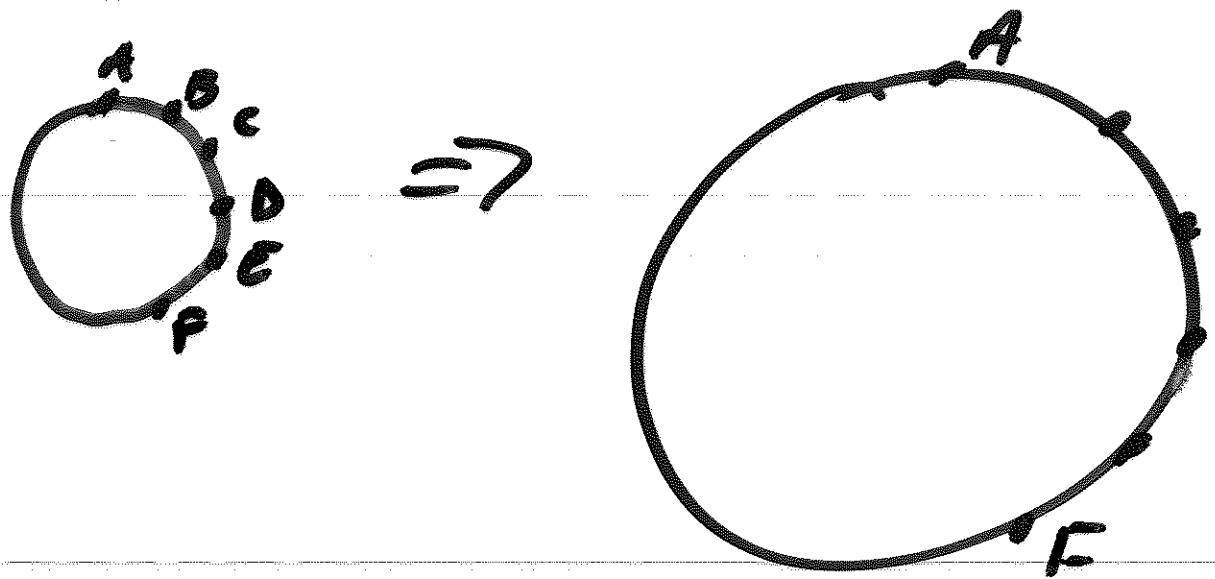
observer on point E

galaxy	distance	motion	velocity
F	1	$(4-5)$ $\rightarrow (8-10)$ $\Delta D = 1$	1
D	1	$(4-3)$ $\rightarrow (8-6)$ $\Delta D = 1$	1
B	3	$(4-1)$ $\rightarrow (8-2)$ $\Delta D = 3$	3



Q1: where is the center?

Q2: what is it expanding into?



UNBOUNDED

(no edge)

(no center)

expands into higher dimension

every object has a
position x, y, z

$a(t)(x, y, z)$



Scale
factor

coordinate position

changes in position (velocity)

1) motion through coord system
"peculiar" motion

2) effect of change (increase)
in scale factor

back in time

$$a(t) = 0$$

$$\begin{array}{c} O(x, y, z) \\ \uparrow \\ E(x, y, z) \end{array}$$

