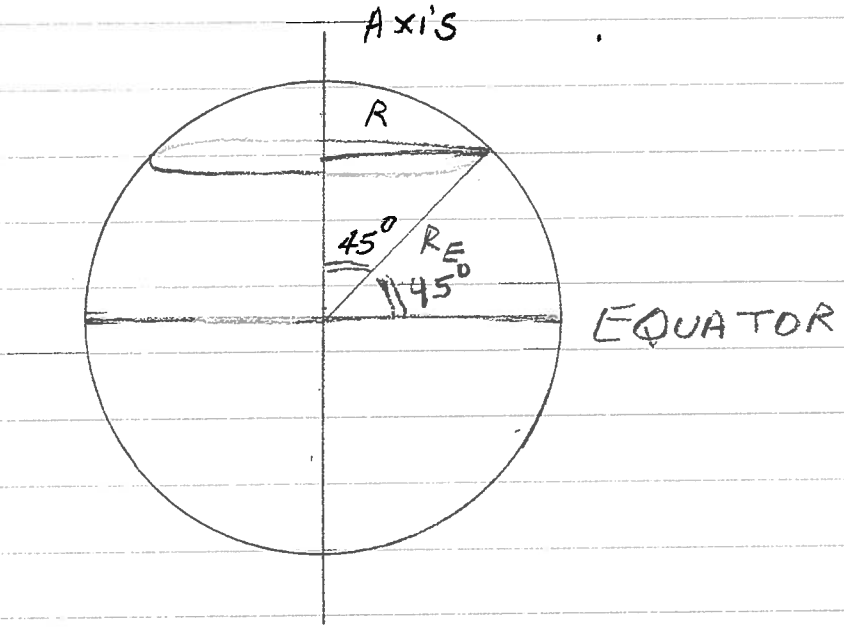
TWO FREE RIDES PLUS SPEED AND SIZE OF MOON.

A The Earth gives us two free rides

(i) Due to rotation of Earth about its axis



TIME FOR ROTATION = 24 hrs

Radius of Earth = 4000 mi = 6400 km

Our latitude 45°

Radius of ⊙ $R = R_E \sin 45 = R_E \cos 45$

$$\text{Speed due to rotation} = \frac{2\pi R}{24} \text{ mph}$$

$$= \frac{2\pi \times 4000 \times \sin 45}{24} \simeq 700 \text{ mph}$$

$$\simeq 1120 \text{ km/hr}$$

(ii) Due to revolution of Earth around the Sun

Radius of Earth's orbit = 93,000,000 mi

Time for Revolution = 1 yr = (365.25 × 24) hrs.

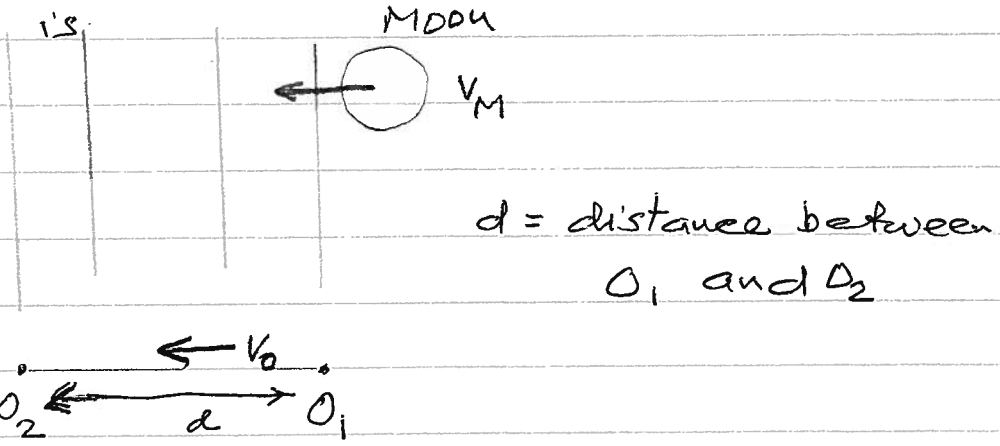
Speed due to revolution $= \frac{2\pi \times 93 \times 10^6}{365.25 \times 24}$

$\simeq$ 67,000 mph

B SPEED AND SIZE OF MOON:

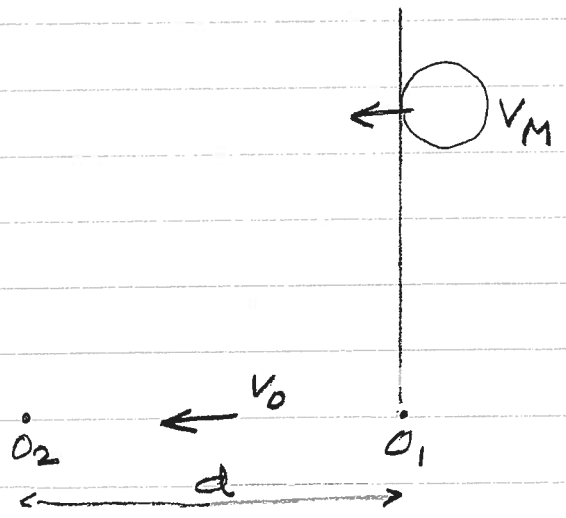
To access speed of moon we need two observers to go out at mid-night on a full moon night and observe a star such that the moon intercepts the light from the star. Star is very far so light from it is a parallel beam. Both observers on same latitude so both have same velocity V_0 due to Earth's rotation.

The picture is



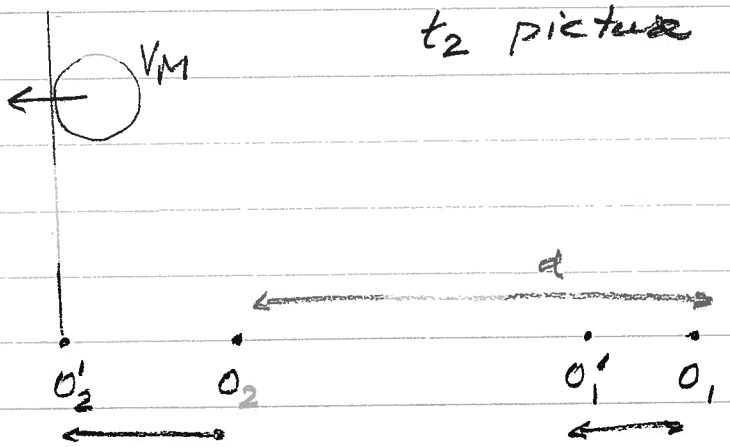
At time t_1 moon intercepts light from star as seen by O_1

Picture at t_1



At time t_2 moon intercepts light as seen by O_2.

t_2 picture



$O_2'O_2 = O_1'O_1$ = distance travelled by observer due to motion of Earth

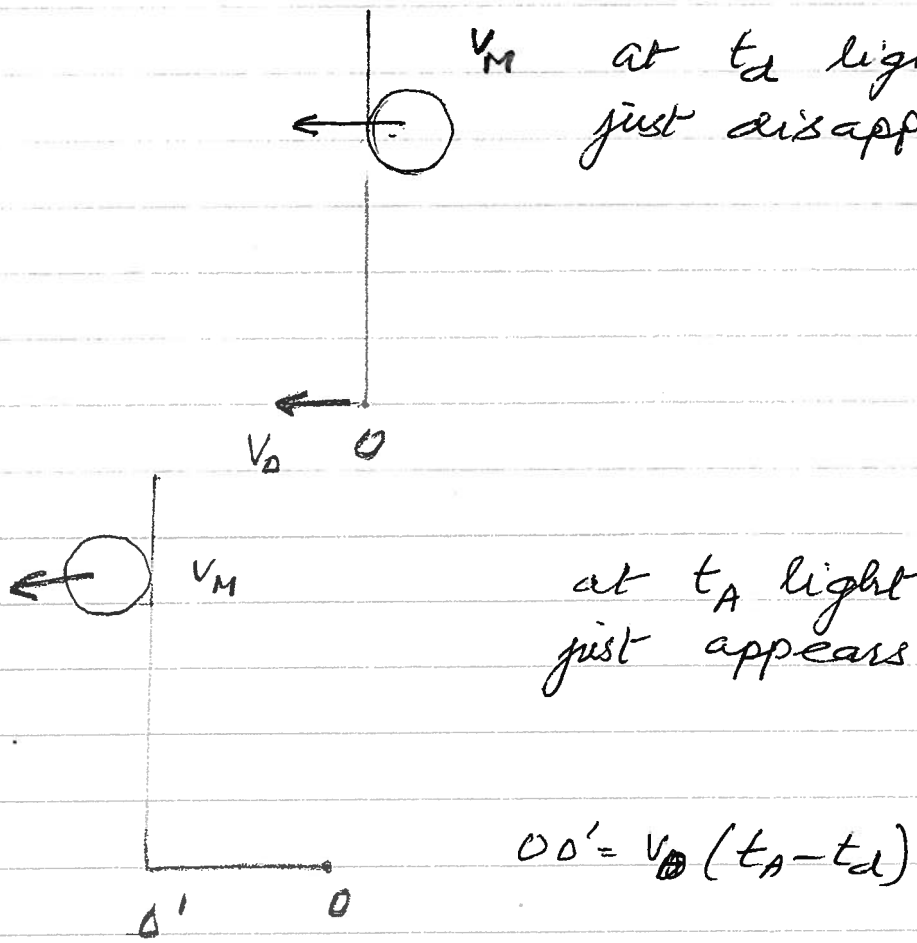
Hence

$$V_M(t_2 - t_1) = d + V_0(t_2 - t_1)$$

speed of moon $V_M = \dfrac{d}{t_2 - t_1} + V_0.$

Once we know V_M a single observer can "measure" diameter of moon

Again, concentrate on light from a star being intercepted by moon.



Distance Moved by moon = $d_M + V_0(t_A - t_d)$

where d_M = diameter of moon

$$V_M (t_A - t_d) = d_M + V_0 (t_A - t_d).$$

$$d_M = (V_M - V_0)(t_A - t_d)$$

which will allow us to measure d_M