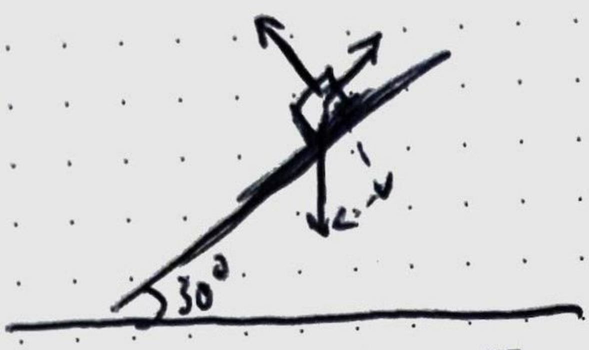
Q1.



$$N = mg\cos(30) = \frac{\sqrt{3}}{2} mg \ N$$
$$F_r = mg\sin(30) = \frac{1}{2} mg \ N$$

Q2:

$$\frac{1.2}{4} = 0.3 \text{ hours}$$

Q3: Proof by induction.

let $P(n) = \overrightarrow{A_1A_2} + \overrightarrow{A_2A_3} + \cdots + \overrightarrow{A_nA_1}$

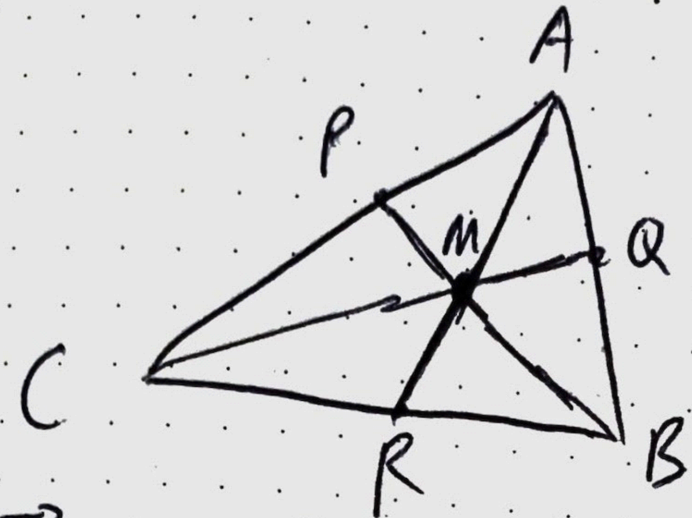
$P(1) = \overrightarrow{A_1A_1} = 0$ True

let $P(k) = \overrightarrow{A_1A_2} + \overrightarrow{A_2A_3} + \cdots + \overrightarrow{A_kA_1} = 0$

$$\begin{aligned} P(k+1) &= \overrightarrow{A_1A_2} + \cdots + \overrightarrow{A_kA_{k+1}} + \overrightarrow{A_{k+1}A_1} \\ &= P(k) - \overrightarrow{A_kA_1} + \overrightarrow{A_kA_{k+1}} + \overrightarrow{A_{k+1}A_1} \\ &= P(k) + \overrightarrow{A_1A_k} + \overrightarrow{A_kA_{k+1}} + \overrightarrow{A_{k+1}A_1} \\ &= P(k) + 0 \\ &= 0 \end{aligned}$$

Q.E.D.

Q5:



$$\vec{AR} = \frac{1}{2}(\vec{AB} + \vec{AC})$$
$$\vec{BP} = \frac{1}{2}(\vec{BA} + \vec{BC})$$
$$\vec{CQ} = \frac{1}{2}(\vec{CA} + \vec{CB})$$

$\therefore$ $\vec{AR} + \vec{BP} + \vec{CQ} = 0$

as $\vec{MA} = \frac{2}{3} RA$

$\vec{MB} = \frac{2}{3} \vec{PB}$

$\vec{MC} = \frac{2}{3} \vec{QC}$

$\therefore$ $\vec{MA} + \vec{MB} + \vec{MC} = -\frac{2}{3}(\vec{AR} + \vec{BP} + \vec{CQ})$

$= 0$

Q.E.D.

Q4. $\vec{OA} = \vec{OM} + \vec{MA}$

$\vec{OB} = \vec{OM} + \vec{MB}$

$\vec{OC} = \vec{OM} + \vec{MC}$

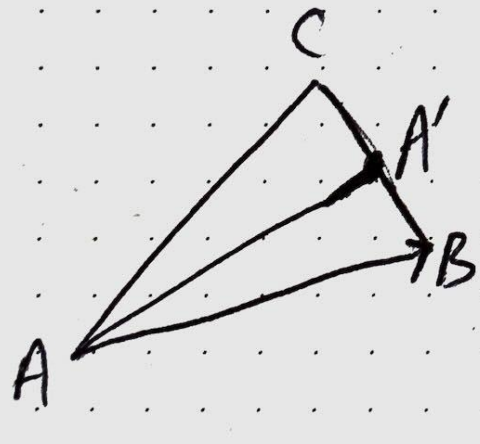
$\therefore \vec{OA} + \vec{OB} + \vec{OC} = 3\vec{OM} + \vec{MA} + \vec{MB} + \vec{MC}$

As $\vec{MA} + \vec{MB} + \vec{MC} = 0$

$\therefore 3\vec{OM} = \vec{OA} + \vec{OB} + \vec{OC}$

$\therefore \vec{OM} = \frac{1}{3}(\vec{OA} + \vec{OB} + \vec{OC})$

Q7:



$AA' = \vec{AB} + \vec{BA'}$

$= \vec{AB} + \frac{1}{2}\vec{BC}$

$= \vec{AB} + \frac{1}{2}(\vec{AC} - \vec{AB})$

$= \frac{1}{2}\vec{AB} + \frac{1}{2}\vec{AC}$

$= \frac{1}{2}(\vec{AB} + \vec{AC})$

Q.E.D.