

10.54

Given: $m = 6 \text{ kg}$, $\vec{r}(t_0) = 1\text{m}\hat{i} - 2\text{m}\hat{j} + 4\text{m}\hat{k}$

$$\vec{v}(t_0) = 3\text{m/s}\hat{i} + 4\text{m/s}\hat{j} - 7\text{m/s}\hat{k}$$

$$\vec{a}(t_0) = 5\text{m/s}^2\hat{i} + 11\text{m/s}^2\hat{j} - 9\text{m/s}^2\hat{k}$$

a) $\Sigma \vec{F} = m\vec{a} = 6\text{kg}(5\text{m/s}^2\hat{i} + 11\text{m/s}^2\hat{j} - 9\text{m/s}^2\hat{k})$
 $= \boxed{30\text{ N}\hat{i} + 66\text{ N}\hat{j} - 54\text{ N}\hat{k}}$

b) $\Sigma \vec{M}_0 = \vec{r} \times \vec{F}$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 4 \\ 30 & 66 & -54 \end{vmatrix} = \hat{i}(108 - 264) - \hat{j}(-54 - 120) + \hat{k}(66 + 60)$$
$$= \boxed{-156\text{ Nm}\hat{i} + 174\text{ Nm}\hat{j} + 126\text{ Nm}\hat{k}}$$

c) Power $P = \vec{F} \cdot \vec{v}$

$$= (30\text{ N}\hat{i} + 66\text{ N}\hat{j} - 54\text{ N}\hat{k}) \cdot (3\text{ m/s}\hat{i} + 4\text{ m/s}\hat{j} - 7\text{ m/s}\hat{k})$$

$$= 30(3) + 66(4) + (-54)(-7) = \boxed{732 \text{ W}}$$