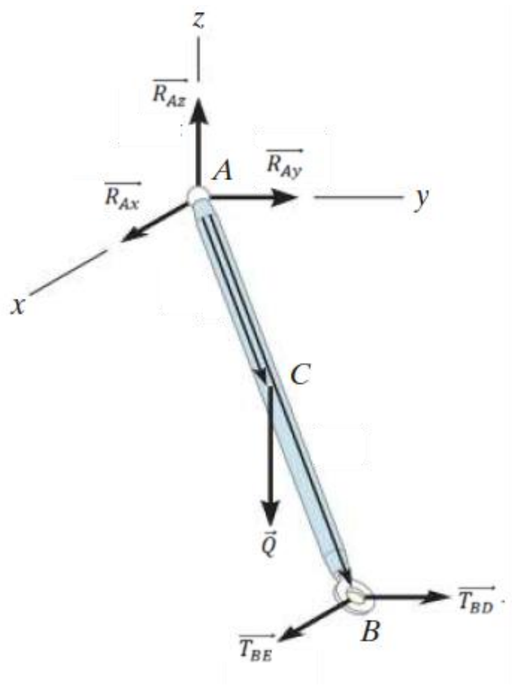
EF1 Correction- MR1

Exercise 1

Q	Answer	Pt
1	$\overrightarrow{F_1} = p\begin{pmatrix}1\\0\\0\end{pmatrix} = \begin{pmatrix}p\\0\\0\end{pmatrix}$; $\overrightarrow{F_2} = q\begin{pmatrix}1\\0\\0\end{pmatrix} = \begin{pmatrix}q\\0\\0\end{pmatrix}$; $\overrightarrow{F_3} = r\begin{pmatrix}0\\-1\\1\end{pmatrix} = \begin{pmatrix}0\\-r\\r\end{pmatrix}$	0,5 x 3
	$\vec{R} = \overrightarrow{F_1} + \overrightarrow{F_2} + \overrightarrow{F_3} = \begin{pmatrix}p\\0\\0\end{pmatrix} + \begin{pmatrix}q\\0\\0\end{pmatrix} + \begin{pmatrix}0\\-r\\r\end{pmatrix} = \begin{pmatrix}p+q\\-r\\r\end{pmatrix}$	0, 5
	$\overrightarrow{M_1} = \overrightarrow{OA} \times \overrightarrow{F_1} = \begin{pmatrix}0\\0\\0\end{pmatrix}$; $\overrightarrow{M_2} = \overrightarrow{OB} \times \overrightarrow{F_2} = \begin{pmatrix}0\\q\\-q\end{pmatrix}$; $\overrightarrow{M_3} = \overrightarrow{OC} \times \overrightarrow{F_3} = \begin{pmatrix}r\\-r\\-r\end{pmatrix}$	0,5 x 3
	$\overrightarrow{M_0} = \overrightarrow{M_1} + \overrightarrow{M_2} + \overrightarrow{M_3} = \begin{pmatrix}0\\0\\0\end{pmatrix} + \begin{pmatrix}0\\q\\-q\end{pmatrix} + \begin{pmatrix}r\\-r\\-r\end{pmatrix} = \begin{pmatrix}r\\q-r\\-q-r\end{pmatrix}$	0,5
	$[T]_0 = \begin{cases}(p+q)\vec{\imath} - r\vec{\jmath} + r\vec{k}\\ r\vec{\imath} + (q-r)\vec{\jmath} - (q+r)\vec{k}\end{cases}$	0,5
2	A **torsor** is zero if and only if both the resultant force vector and the resultant moment vector are zero vectors. From $\vec{R} = \vec{0}$ and $\overrightarrow{M_0} = \vec{0}$ we have :The necessary and sufficient condition for $[T]_0 = 0$ is that $r = p = q = 0$	01
3	$I = \vec{R} \cdot \overrightarrow{M_0} = r(p-q)$	0,5
4	$\vec{M} = \overrightarrow{M_0} - \overrightarrow{OP} \times \vec{R}$ The central axis is the set of points where $\vec{M}$ is parallel to $\vec{R}$, $\vec{M} = \lambda\vec{R}$ Given $p + q = 0$ and $r \neq 0$, we have: $\vec{M} = \begin{pmatrix}r - r(y+z)\\q - r + xr\\-q - r + xr\end{pmatrix}$ For the central axis, $\vec{M} = \lambda\vec{R}$: $\begin{pmatrix}r(1-(y+z))\\q-r+xr\\-q-r+xr\end{pmatrix} = \lambda\begin{pmatrix}p+q\\-r\\r\end{pmatrix} = \lambda\begin{pmatrix}0\\-r\\r\end{pmatrix}$ $1 - (y+z) = 0 \Longrightarrow y + z = +1$ and $-2r + 2xr = 0 \Rightarrow x = +1$ The equations of the central axis are: $x = +1$ and $y + z = 1$	02
5	A torsor is a sliding vector if the scalar invariant is zero, $I = \vec{R} \cdot \overrightarrow{M_0} = 0$ and resultant force vector is not zero, $\vec{R} \neq \vec{0}$ $I = r(p-q) = 0 \Longrightarrow r = 0$ or $p = q$ $\vec{R} \neq \vec{0} \Longrightarrow (r = 0\ and\ p + q \neq 0)\ or\ (p = q\ and\ r \neq 0)$	01
6	A torsor is a couple if $\vec{R} = \vec{0}$ and $\overrightarrow{M_0} \neq \vec{0}$ $\vec{R} = \vec{0} \Longrightarrow p = -q\ and\ r = 0$ $\overrightarrow{M_0} = \begin{pmatrix}r\\q-r\\-q-r\end{pmatrix} = \begin{pmatrix}0\\q\\-q\end{pmatrix} \neq \vec{0} \Longrightarrow q \neq 0$ The necessary and sufficient condition for $[T]_0$to be a couple is that: $r = 0\ and\ q \neq 0$	01

Exercise 2

	0,25 x 6
$\begin{cases} \sum \vec{F} = \vec{0} \\ \sum \overrightarrow{M_A}(\vec{F}) = \vec{0} \end{cases}$ $\begin{cases} \vec{Q} + \overrightarrow{T_{BE}} + \overrightarrow{T_{BD}} + \overrightarrow{R_A} = \vec{0} \\ \overrightarrow{M_A}(\vec{Q}) + \overrightarrow{M_A}(\overrightarrow{T_{BE}}) + \overrightarrow{M_A}(\overrightarrow{T_{BD}}) + \overrightarrow{M_A}(\overrightarrow{R_A}) = \vec{0} \end{cases}$	0,25 0,25
$\begin{cases} R_{Ax} + T_{BE} = 0 \\ R_{Ay} + T_{BD} = 0 \\ R_{Az} - Q = 0 \end{cases}$ And $\begin{cases} 2T_{BD} - 200 = 0 \\ -2T_{BE} + 100 = 0 \\ T_{BD} - 2T_{BE} = 0 \end{cases}$	01 x 6
$T_{BD} = 100N$ $T_{BE} = 50N$ $R_{Ax} = -50N$ $R_{Ay} = -100N$ $R_{Az} = 200N$ **Note** : the negative sign indicates that R_{Ax} and R_{Ay}, have a sense which is opposite to that shown on the free-body diagram.	0,5 x 5