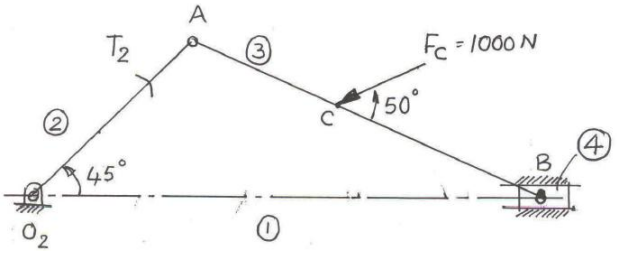
Internal Assessment Test V – Feb 2022

Sub:	Dynamics of Machinery					Code:	18ME53
Date:	08/ 02 / 2022	Duration:	90 mins	Max Marks:	50	Sem: V	Branch: MECH

Note: Answer **all** questions.

		Marks	OBE CO	OBE RBT
1	State the conditions for the equilibrium of following systems: Two force member ii) Three force member iii) Member with two force and torque	**10**	CO1	L1
2	Determine torque T_2 to keep the mechanism in equilibrium shown in fig (a). AC = 70 mm, AB = 150 mm, O_2A = 40 mm	**20**	CO1	L3



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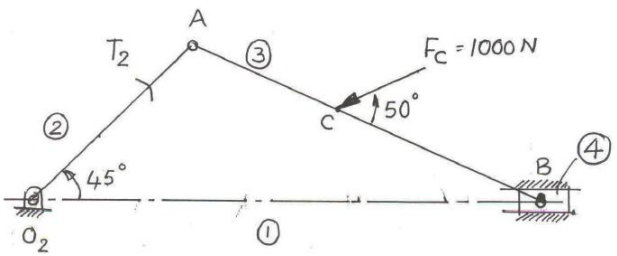
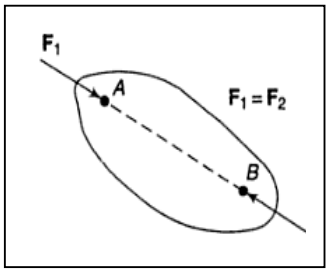


3	A shaft carries four rotating masses P, Q, R & S in order, along with the axis. The mass center is at 160mm, 180mm, 200mm & 120mm respectively for P, Q, R & S from axis. The masses Q, R & S are 40kg, 30kg & 50kg respectively. The planes contain Q & R are 300mm apart. The angular position of R & S are 90° and 210°respectively, w.r.t. Q measured in same sense. If the shaft and masses are to be in complete dynamic balance. Determine: i) Mass and angular position of P ii)Positions of planes P & S.	**20**	CO2	L3

3	A shaft carries four rotating masses P, Q, R & S in order, along with the axis. The mass center is at 160mm, 180mm, 200mm & 120mm respectively for P, Q, R & S from axis. The masses Q, R & S are 40kg, 30kg & 50kg respectively. The planes contain Q & R are 300mm apart. The angular position of R & S are 90° and 210°respectively, w.r.t. Q measured in same sense. If the shaft and masses are to be in complete dynamic balance. Determine: i) Mass and angular position of P ii)Positions of planes P & S.	**20**	CO2	L3

Equilibrium of Two Force Members



A member under the action of two forces will be in equilibrium if

- The forces are of the same magnitude,
- The forces act along the same line, and the forces are in opposite directions

Equilibrium of Three Force Members

A member under the action of three forces will be in equilibrium if

- The resultant of the forces is zero, and
- The lines of action of the forces intersect at a point (known as *point of concurrency).*

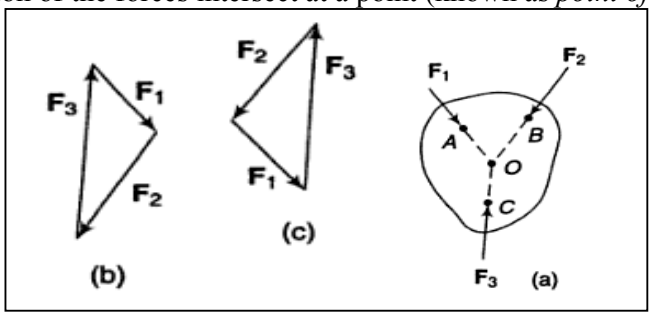


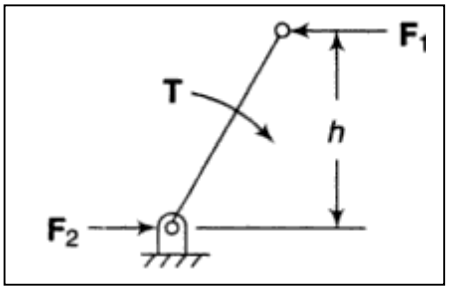
Figure (a) indicates an example for the three force member and (b) and (c) indicates the force polygon to check for the static equilibrium.

Member with two forces and a torque

A member under the action of two forces and an applied torque will be in equilibrium if

- The forces are equal in magnitude, parallel in direction and opposite in sense and
- The forces form a couple which is equal and opposite to the applied torque.

Figure shows a member acted upon by two equal forces $\mathbf{F_1}$, and $\mathbf{F_2}$ and an applied torque **T** for equilibrium,



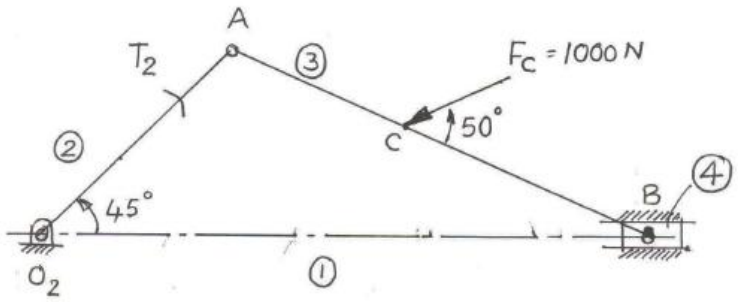
$$T = F_1 h = F_2 h$$

Where *T, F_1 and F_2 are the magnitudes of* ***T, F_1 and*** $\mathbf{F_2}$ respectively.

T is clockwise whereas the couple formed by $\mathbf{F_1}$, and $\mathbf{F_2}$ is counter-clockwise.

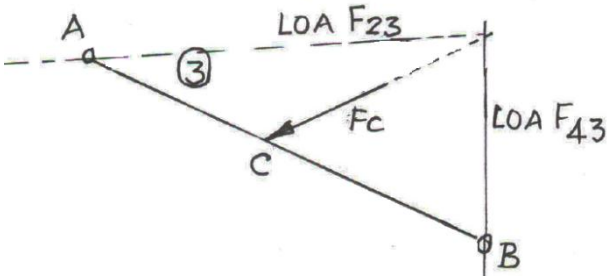
2 ***Problem***

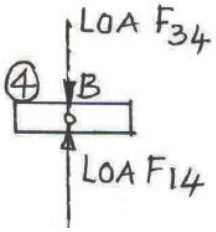
Determine T_2 to keep the mechanism in equilibrium



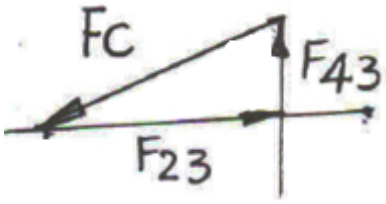
AC=70mm,
AB=150mm,
O_2A= 40mm

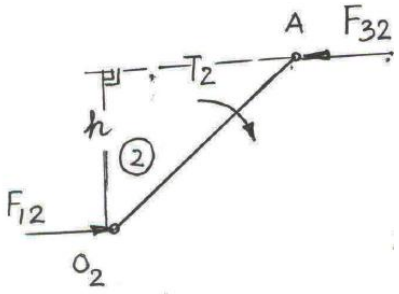
Solution:





Force Polygon





$T_2 = F_{32} * h = F_{12} * h$

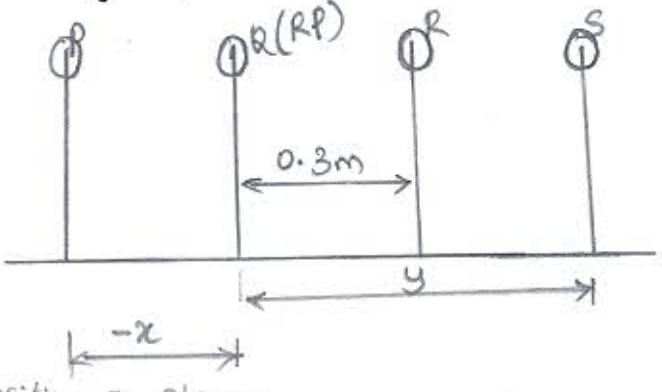
F_{32} and F_{12} form a CCW couple and hence T_2 acts clock wise.

PROBLEMS

Mar 2001
Dec 2011 (P) A Shaft carries four rotating masses P, Q, R & S inorder along the axis. The mass centre is at 160 mm, 180mm, 200mm & 120mm respectively. for P, Q, R, S from axis. The masses Q, R & S are 40kg, 30kg & 50 kg resp. The planes containing Q & R are 300mm apart. The angular positions of R & S are 90° & 210° respectively. w.r.t Q measured in same sense. If the shaft is masses are to be in complete dynamic balance. Determine

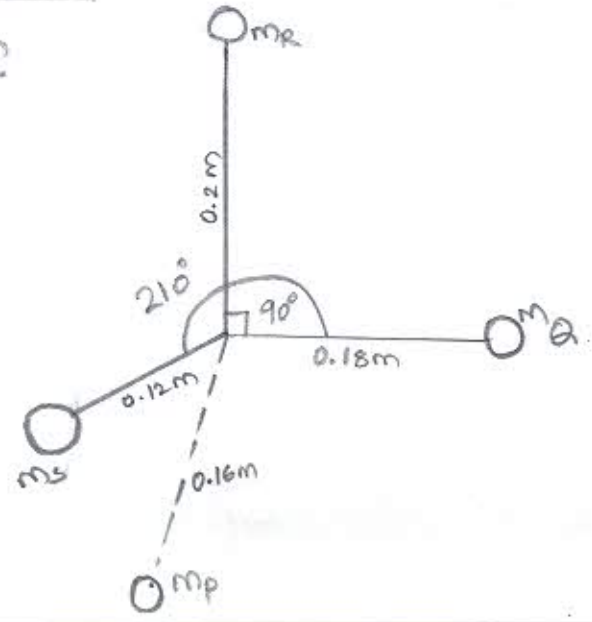
i) Mass & angular position of P
ii) Positions of planes P & S.

Sol



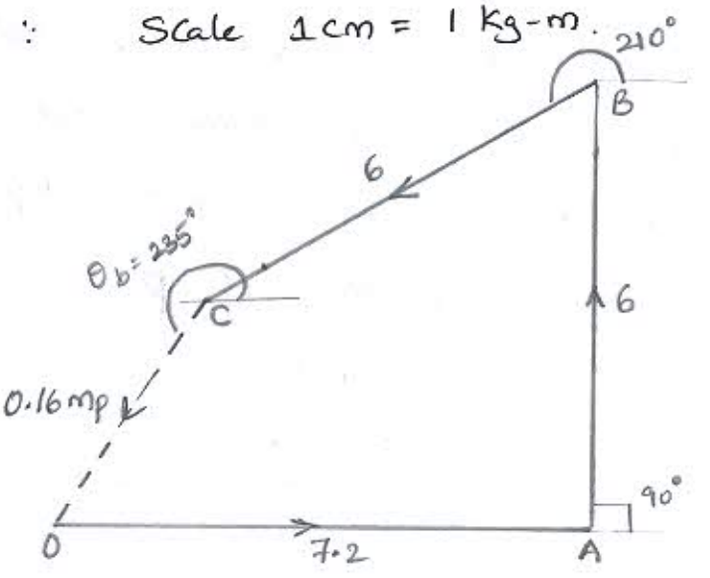
Position of planes.

Space diagram



Planes	Masses m (Kg)	Radius of rotation r (m)	Centrifugal force $\div \omega^2$ mr (Kg-m)	Distance from R.P 'l' (m)	Couple $\div \omega^2$ mrl Kg-m^2
P	m_p	0.16	0.16 m_p	$-x$	$-0.16 m_p . x$
Q	40	0.18	7.2	0	0
R	30	0.2	6	0.3	1.8
S	50	0.12	6	y	6y

Force Polygon : Scale 1 cm = 1 Kg-m.



OC = 3.6 cm

$0.16 m_p$ = OC x Scale

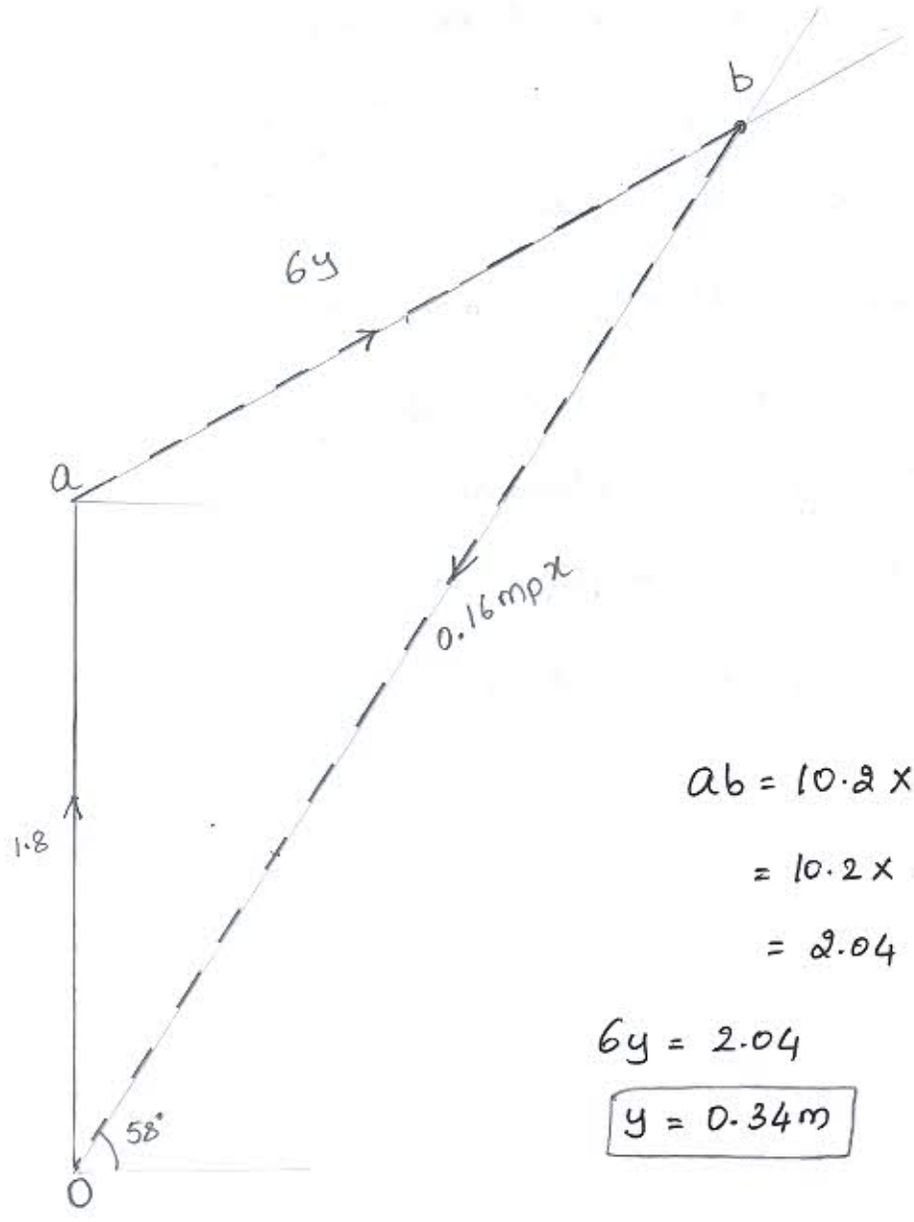
$0.16 m_p = 3.6$

$m_p = 22.5$ Kg-m

$\theta = 235°$

Couple polygon

Scale 1 cm = 0.2 kg·m²



$ab = 10.2 \times \text{scale}$

$= 10.2 \times 0.2$

$= 2.04$

$6y = 2.04$

$\boxed{y = 0.34\,m}$

$-0.16mpx = ob \times \text{Scale}$

$-0.16 \times 22.5 \times x = 16.6 \times 0.2$

$x = \dfrac{-3.32}{-0.16 \times 22.5}$

$\boxed{x = -0.92\,m}$