IAT_2 - Dynamics of Machines

Instructions

Numerical on Static Force - 14 Marks
Numerical on determining resultant motion - 6 Marks.
Numerical on Balancing of rotating masses - 20 marks
Upload solved numerical.

Balancing of single rotating mass by balancing masses in same plane and in different planes cannot take place. *

- ○ True
- ◉ False

Which of the following is true for centrifugal force causing unbalance? *

- ◉ Direction changes with rotation
- ○ Magnitude changes with rotation
- ○ Direction and magnitude both change with rotation
- ○ Direction and magnitude both remain unchanged with rotation

What is not the effect of unbalanced forces? *

- ○ Load on bearings
- ○ Dangerous vibrations
- ○ Stresses in various members
- ◉ Violation of conservation of mass principle

The static balancing is satisfactory for low speed rotors but with increasing speeds, dynamic balancing becomes necessary. This is because, the *

- ○ unbalanced couples are caused only at higher speeds
- ○ unbalanced forces are not dangerous at higher speeds
- ◉ effects of unbalances are proportional to the square of the speed
- ○ effects of unbalances are directly proportional to the speed

Let the disturbing mass be 100 kg and the radius of rotation be 20 cm and the rotation speed be 50 rad/s, then calculate the centrifugal force in kN. *

- ○ 25
- ◉ 50
- ○ 25000
- ○ 50000

The time interval after which the motion is repeated itself is known as _____ . *

- (●) time period
- ( ) cycle
- ( ) frequency
- ( ) isolation

In a spring-mass system, which of the following force is not considered? *

- ( ) Spring force
- (●) Damping force
- ( ) Accelerating force
- ( ) A and B

If the unbalanced system is not set right then. *

- (●) Static forces develop
- ( ) Dynamic forces develop
- ( ) Tangential forces develop
- ( ) Radial forces develop

A body is subjected to two harmonic motions. Determine the resultant motion. *

$$x_1 = 15\sin(\omega t + \frac{\pi}{6});\ x_2 = 8\cos\left(\omega t + \frac{\pi}{6}\right).$$

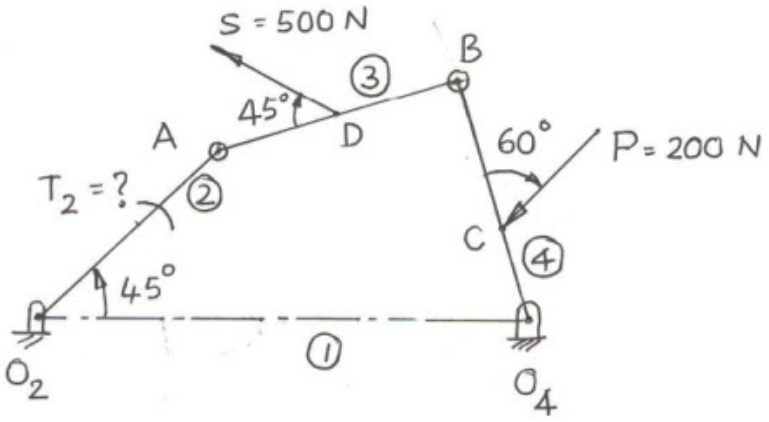
- (●) X = 17 sin (wt + 58°)
- ( ) x = 20 sin (wt + 58°)
- ( ) x = 17 sin (wt + 70°)
- ( ) x = 20 sin (wt + 70°)

A harmonic motion has an amplitude of 20 m and a period of 15.5 sec. Determine the maximum velocity *

- ( ) 0.60
- (●) 0.84
- ( ) 0.95
- ( ) 0.54

Determine the torque required to keep the given mechanism in equilibrium. *

$O_2A = 30mm, \quad = AB = O_4B, O_2O_4 = 60mm, \quad AO_2O_4 = 60°, BC = 19mm, AD = 15mm.$



- (●) 11500 N-mm
- ( ) 9000 N-mm
- ( ) 13500 N-mm
- ( ) 14500 N-mm

A shaft carriers four masses A, B, C and D, 200,300, 240 and 360 kg respectively, revolving at radii 90,70, 100 and 120 mm respectively. The distance from the plane A are 270 mm, 420mm and 720 mm respectively. Angles between the crank A & B is 45°, B & C is 75°, C & D is 130°. Balancing masses are placed 120 mm and 100 mm from D & A respectively. the distance between them being 500 mm. Find the balancing masses if they are placed at a radius of 100 mm. *

- (●) Balancing Masses are 404 & 408 Kg
- ( ) Balancing Masses are 390 & 408 Kg
- ( ) Balancing Masses are 404 & 435 Kg
- ( ) Balancing Masses are 390 & 435 Kg

1) mass = 100Kg

$r = 20cm = 0.2m$

$\omega = 50$ rad/s.

$F_C = m\omega^2 r$

$= 100 \times 0.2 \times 50^2$

$F_C = 100 \times 0.2 \times 50^2 = 50,000N$

$\therefore F_C = \underline{50KN}$

2)

Sol.

Plane	Mass (M) Kg.	Radius (r) (m)	Force $\times \omega^2$	Dist from ref. Plane	Couple $\times \omega^2$
A	200	0.09	18	-0.1	-1.8
L	ML	0.1	$0.1M_L$	0	0
B	300	0.07	21	0.17	3.57
C	240	0.1	24	0.32	7.68
M	M_M	0.1	$0.1M_M$	0.5	$0.05M_M$
D.	360	0.12	43.2	0.62	26.784

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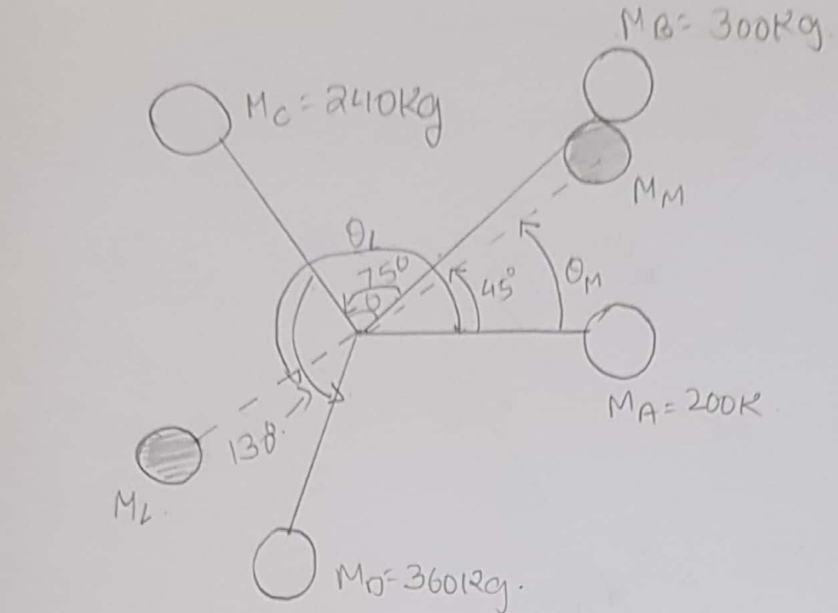
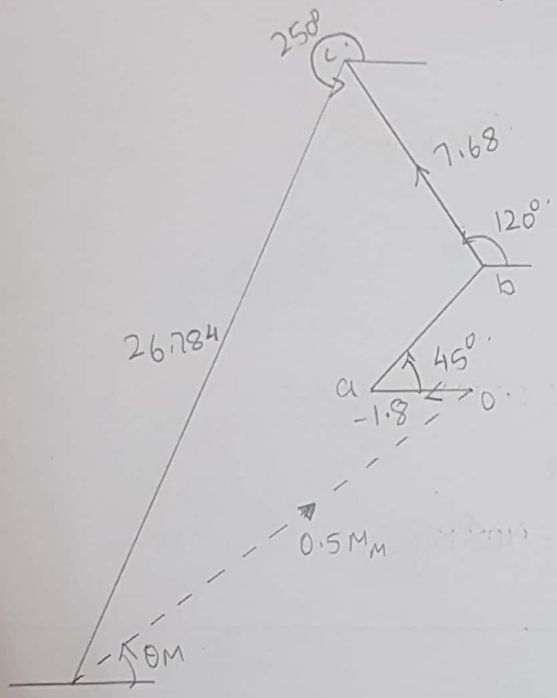
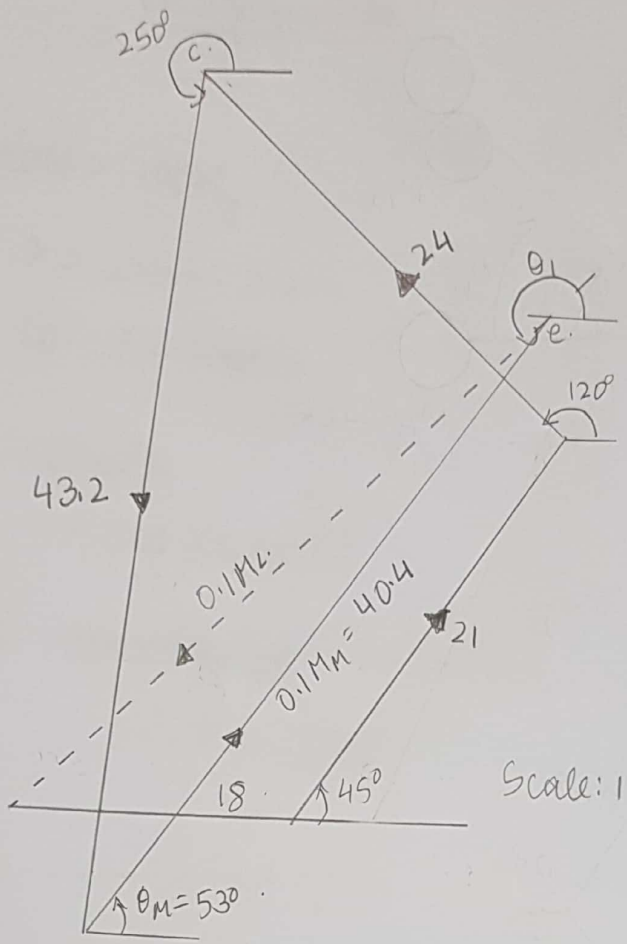




θ_M = 53° wrt A (C.C.W)

$0.5M_M$ = od x scale.

$M_M = \frac{10.1 \times 2}{0.05 \times 1} = \underline{404 Kg}$.

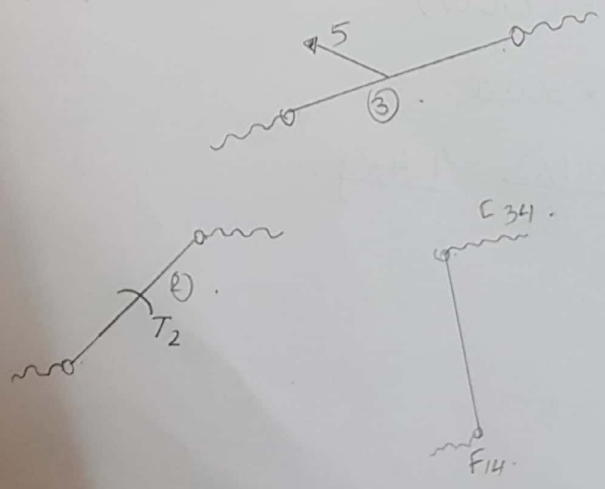


$\theta_L = 221°$ wrt A (C.C.W)

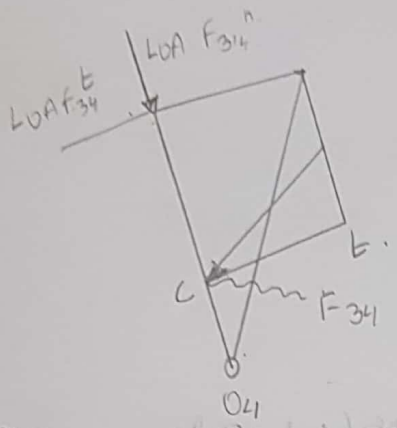
$0.1M_L$ = oe x Scale.

$\therefore M_L = \frac{10.2 \times 4}{0.1} = 408\,Kg$.

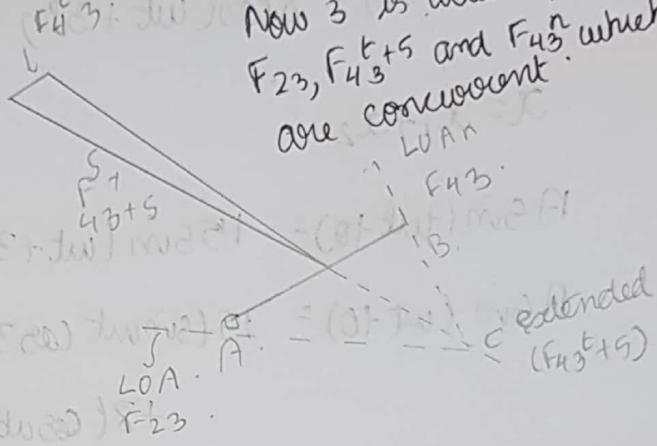
3).



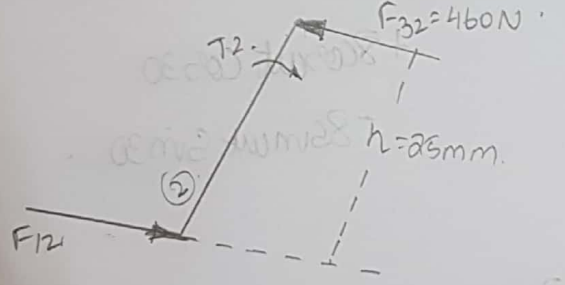
None of the links are acted upon by only 2 forces. Therefore links cant be analyzed individually



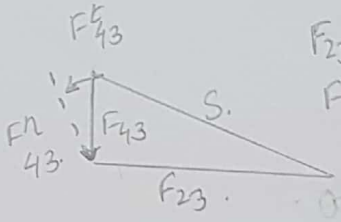
(Also, taking moments almost O_4, F_{34}^t can be found out)



Now 3 is acted upon by F_{23}, F_{43}^t+5 and F_{43}^n which are concurrent



$T_2 = 460 \times 25 = 11500 N\text{-}mm$ (CW)



$F_{23}=460N$
$F_{43}=160N$

Force triangle for ③

Vector Scale = 1cm = 100N.

7). let Resultant

be $x = A\sin(\omega t + \theta)$.

we have.

$$x_1 = 15\sin(\omega t + 30^\circ)$$

$$x_2 = 8\cos(\omega t + 30^\circ)$$

$$x = x_1 + x_2.$$

$$A\sin(\omega t + \theta) = 15\sin(\omega t + 30^\circ) + 8\cos(\omega t + 30^\circ)$$

$$A\sin(\omega t + \theta) = 15(\sin\omega t \cos 30^\circ + \cos\omega t \sin 30^\circ) + 8(\cos\omega t \cdot \cos 30 - \sin\omega t + \sin 30)$$

$$A(\sin\omega t\cos\theta + \cos\omega t\sin\theta) = 15\sin\omega t\cos 30 + 15\cos\omega t \sin 30 + 8\cos\omega t\cos 30 - 8\sin\omega t \sin 30.$$

$A\sin\omega t \cdot \cos\theta$ +
$A\cos\omega t \sin\theta$

$$= \sin\omega t(15\cos 30 - 8\sin 30) + \cos\omega t(15\sin 30 + 8\cos 30)$$

$\sin\omega t(A\cdot\cos\theta)$ +
$\cos\omega t(A\cdot\sin\theta)$

$$= 8.990\sin\omega t + 14.42\cos\omega t.$$

Equating coefficient

$$A\cos\theta = 8.990$$

$$A\sin\theta = 14.42.$$

Sq and adding both eq we get.

$$A^2(\cos^2\theta + \sin^2\theta) = 288.7565$$

$$A = 16.99 \simeq 17.$$

Now

$$A\sin\theta = 14.42 \quad \text{(Dividing both)}$$

$$A\cos\theta = 8.990$$

$$\tan\theta = 1.6040$$

$$\theta = 58.05$$

So,

$$x = 17\sin(\omega t + 58.05^\circ).$$