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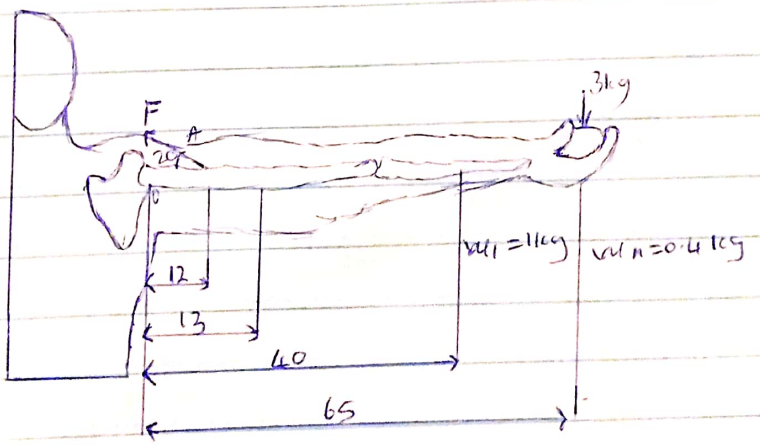
15/ENG01/022
Bio Engineering Assignment

① A man is holding a 3kg weight in his hand with the entire arm flexed horizontally. A tensile force in the deltoid muscle prevents the arm from rotating about the shoulder joint this force acts at an angle 20° angle. Determine the force exerted by the deltoid muscle on the upper arm at A and the X and Y components of the reaction force at the shoulder joint. The weight of the upper arm lower arm and the hand are 2 kg, 1kg and 0.4 kg respectively and are acting at parts shown in Fig 2.67 the dimensions are in cm.



Taking moment about part O

$\Sigma M_O = 0$

$12 F \sin 20 = 13 W_u + 40 W_l + 65 (W_h + W_g)$

$12 F \sin 20 = 13 \times 2 + 40 \times 1 + 65 \times (3 + 0.4)$

$12 F \times 0.3420 = 26 + 40 + 221$

$4.104 F = 287$

$F = 69.93 kg$

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∴ Force exerted on the deltoid muscle at A is

$F = 69.93\,kg \times 9.81$

$= 656\,N$

Equilibrium of forces along the y axis $\Sigma F_y = 0$

$F \sin 20 - W_a - W_c - W_n = 0$

∴ Y component of the force at the deltoid joint

$= F \sin 20$

$= 69.9 \times \sin 20$

$= 23.91\,kg$

X component of the force at the deltoid joint

$= F \cos 20$; $\Sigma x - F \cos 20 = 0$

$= 69.9 \times \cos 20$

$= 65.6\,N$

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A person is performing arm flexion extension exercise with a 10kg weight is indicated in the figure below. The brachialis muscle group is the major participant in this exercise. Determine F of the brachialis muscle and J at the elbow joint reaction at point J for the forearm position. Take the dimensions shown to locate the effective points of application of the two muscle groups these points are 20 cm directly above J and 5cm directly to the right of J. Consider that the 1.5kg fore arm weight acts at point C

solution

C - 1.5kg

Palm weight - 10kg

$\tan\theta = 5/20$

$\theta = \tan^{-1}(5/20)$

$\theta = 14.04^\circ$

Taking moment about E

$\Sigma M_E = 0$

$F\cos(14.04) \times (5 \times 0.01) = [(15 \times 0.01 \times C] + [(35 \times 0.01 \times$

$C\ 10 \times 9.81)]$

$F \times 0.049 = (0.015 \times 1.5 \times 9.81) + 34.335$

$0.049F = 2.207 + 34.335$

$F = 36.542 \div 0.049$

$F = 745.76N$

$= 76.6kg$

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Consider force along the x axis

$$\Sigma F_x = 0$$

$$\Sigma x - F \sin 14.04^\circ = 0$$

$$\Sigma x = 74.6 \sin(14.04)$$

$$\Sigma x = 18.09 \text{ kg}$$

Consider force along the Y axis

$$\Sigma F_Y = 0$$

$$F \cos(14.04) - 1.5 - 10 = 0$$

$$74.6 \cos(14.04) - 1.5 - 10 = 0$$

$$72.37 - 1.5 - 10$$

$$\Sigma F_Y = 60.87 \text{ kg}$$

The resultant force of E

$$E = \sqrt{(\Sigma x^2 + \Sigma y^2)}$$

$$E^2 = 18.09^2 + 60.87^2$$

$$= 327.25 + 3705.16$$

$$= 4032.41$$

$$E = \sqrt{4032.41}$$

$$E = 63.50 \text{ kg}$$

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