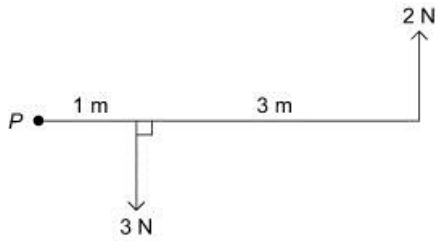
Moments 4B

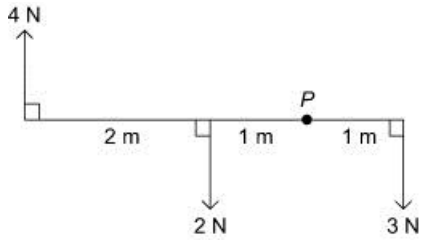
For each question in this exercise, clockwise is assumed to be the positive direction.

1 a



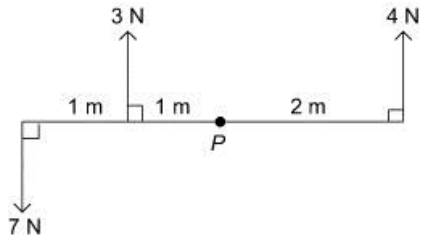
Moment of 3 N force
$= 3 \times 1 = 3$ Nm clockwise
Moment of 2 N force
$= (1+3) \times 2 = 8$ Nm anticlockwise
Resultant moment $= 8 - 3$
$= 5$ Nm anticlockwise

b



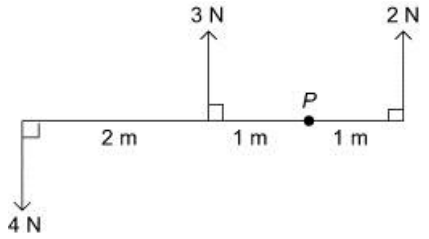
Moment of 4 N force
$= 4 \times (2+1) = 12$ Nm clockwise
Moment of 2 N force
$= 2 \times 1 = 2$ Nm anticlockwise
Moment of 3 N force
$= 3 \times 1 = 3$ Nm clockwise
Resultant moment $= 12 - 2 + 3 = 13$ Nm clockwise

c



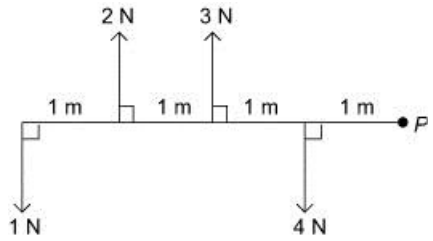
Moment of 7 N force
$= 7 \times (1+1) = 14$ Nm anticlockwise
Moment of 3 N force
$= 3 \times 1 = 3$ Nm clockwise
Moment of 4 N force
$= 4 \times 2 = 8$ Nm anticlockwise
Resultant moment $= -14 + 3 - 8 = -19$ Nm
The resultant moment is 19 Nm anticlockwise.

1 d



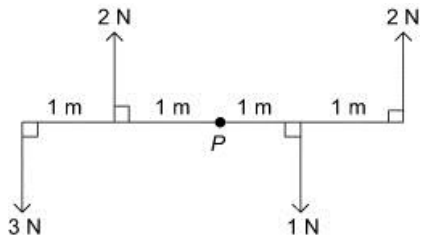
Moment of 4 N force
$= 4 \times (2+1) = 12$ Nm anticlockwise
Moment of 3 N force
$= 3 \times 1 = 3$ Nm clockwise
Moment of 2 N force
$= 2 \times 1 = 2$ Nm anticlockwise
Resultant moment $= -12 + 3 - 2 = -11$ Nm
The resultant moment is 11 Nm anticlockwise.

e



Moment of 1 N force
$= 1 \times (1+1+1+1) = 4$ Nm anticlockwise
Moment of 2 N force
$= 2 \times (1+1+1) = 6$ Nm clockwise
Moment of 3 N force
$= 3 \times (1+1) = 6$ Nm clockwise
Moment of 4 N force
$= 4 \times 1 = 4$ Nm anticlockwise
Resultant moment $= -4 + 6 + 6 - 4 = 4$ Nm clockwise

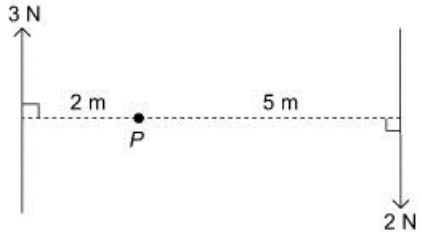
f



Moment of 3 N force
$= 3 \times (1+1) = 6$ Nm anticlockwise
Moment of 2 N force to the left of P
$= 2 \times 1 = 2$ Nm clockwise
Moment of 1 N force
$= 1 \times 1 = 1$ Nm clockwise

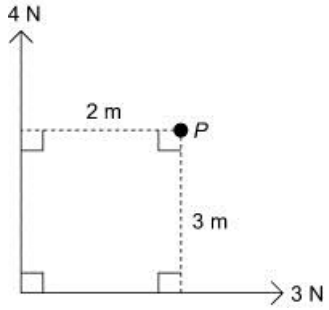
1 f Moment of 2 N force to the right of P
$= 2\times(1+1) = 4$ Nm anticlockwise
Resultant moment $= -6+2+1-4 = -7$ Nm
The resultant moment is 7 Nm anticlockwise.

2 a



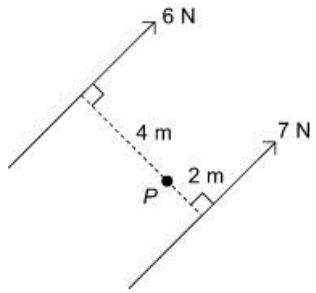
Moment of 3 N force
$= 3\times 2 = 6$ Nm clockwise
Moment of 2 N force
$= 2\times 5 = 10$ Nm clockwise
Resultant moment $= 6+10 = 16$ Nm clockwise

b



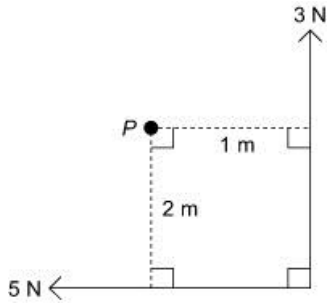
Moment of 4 N force
$= 4\times 2 = 8$ Nm clockwise
Moment of 3 N force
$= 3\times 3 = 9$ Nm anticlockwise
Resultant moment $= 8-9 = -1$ Nm
The resultant moment is 1 Nm anticlockwise.

c



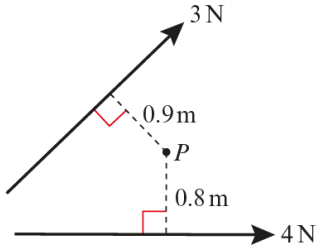
Moment of 6 N force
$= 6\times 4 = 24$ Nm clockwise
Moment of 7 N force
$= 7\times 2 = 14$ Nm anticlockwise
Resultant moment $= 24-14 = 10$ Nm clockwise

2 d



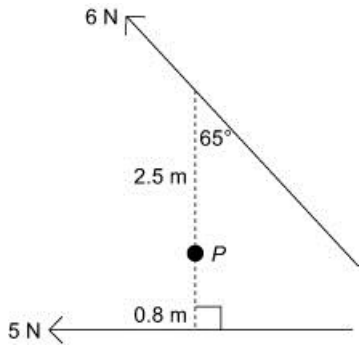
Moment of 3 N force
$= 3 \times 1 = 3$ Nm anticlockwise
Moment of 5 N force
$= 5 \times 2 = 10$ Nm clockwise
Resultant moment $= -3 + 10 = 7$ Nm clockwise

e



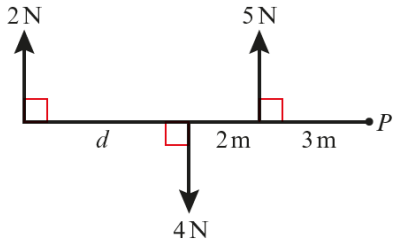
Moment of 3 N force
$= 3 \times 0.9 = 2.7$ Nm clockwise
Moment of 4 N force
$= 4 \times 0.8 = 3.2$ Nm anticlockwise
Resultant moment $= 2.7 - 3.2 = -0.5$ Nm
The resultant moment is 0.5 Nm anticlockwise.

f



Moment of 6 N force
$= 6 \times (2.5 \times \sin 65°) = 13.59$ Nm anticlockwise
Moment of 5 N force
$= 5 \times 0.8 = 4$ Nm clockwise
Resultant moment $= -13.59 + 4 = -9.59$ Nm
The resultant moment is 9.59 Nm anticlockwise.

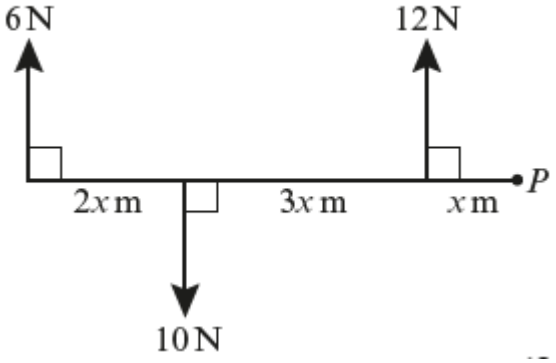
3 Moment of 2 N force about P
$= 2 \times (5 + d)$ Nm clockwise
Moment of 5 N force about P
$= 5 \times 3 = 15$ Nm clockwise
Moment of 4 N force about P
$= 4 \times (2 + 3) = 20$ Nm anticlockwise
Resultant moment = 17 Nm clockwise so:



$$2(5+d)+15-20=17$$
$$5+2d=17$$
$$2d=12$$
$$d=6$$

The distance d is 6 m.

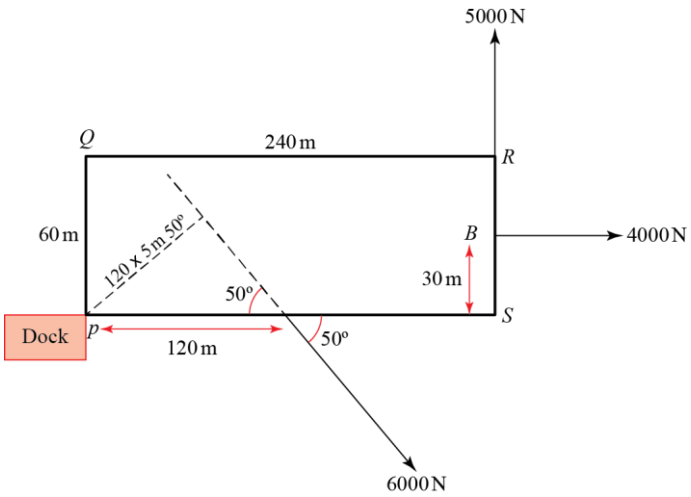
4 Moment of 6 N force about P
$= 6 \times (2 + 3 + 1)x = 36x$ Nm clockwise.
Moment of 12 N force about P
$= 12x$ Nm clockwise.
Moment of 10 N force about P
$= 10 \times (3 + 1)x = 40x$ Nm anticlockwise.
Resultant moment = 12.8 Nm clockwise so:



$$36x+12x-40x=12.8$$
$$8x=12.8$$
$$x=1.6$$

The distance x is 1.6 m.

5 $AP = 240 \div 2 = 120$ m
$BS = 60 \div 2 = 30$ m
Moment of tug at A about P
$= 6000 \times 120\sin 50 = 551\,552$ Nm clockwise.
Moment of tug at B about P
$= 4000 \times 30 = 120\,000$ Nm clockwise.
Moment of tug at R about P
$= 5000 \times 240 = 1\,200\,000$ Nm anticlockwise.
Resultant moment
$= 551\,552 + 120\,000 - 1\,200\,000 = -528\,448$
The ship rotates anticlockwise and the resultant moment about P is 528 448 Nm.



6 If drawbridge is rising, clockwise moment > anticlockwise moment
Let the length of the drawbridge be x

$$6000 \times x \sin\theta > 8000 \times \frac{1}{2} x \cos\theta$$
$$6000\sin\theta > 4000\cos\theta$$
$$\frac{\sin\theta}{\cos\theta} > \frac{4000}{6000}$$
$$\tan\theta > \frac{2}{3}$$