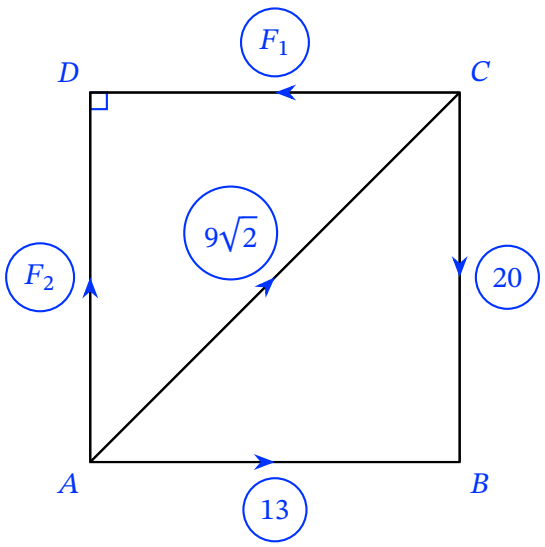
Worksheet: Equivalent System of Forces to a Couple

Q1: $ABCD$ is a square, where the five forces, measured in newtons, are acting on it as shown in the figure. If the system of forces is equivalent to a couple, determine F_1 and F_2.

Question Video



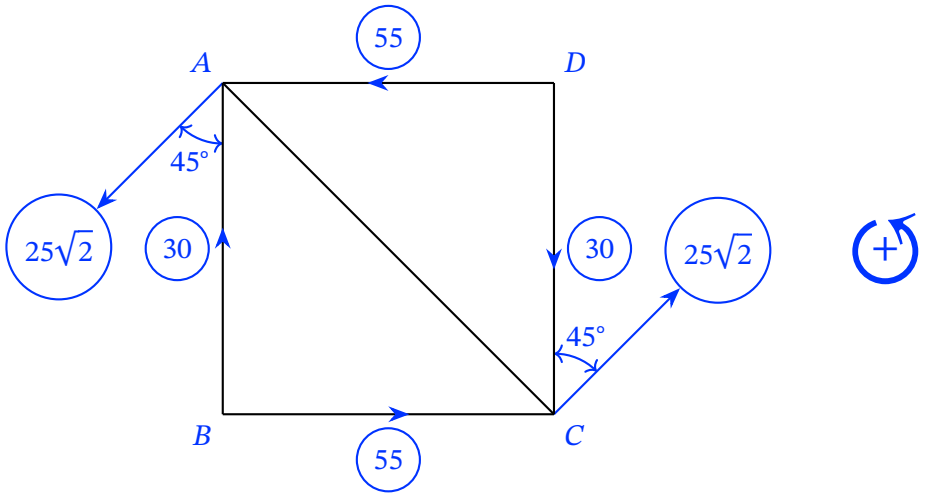
A $F_1 = 13$ N, $F_2 = 20$ N

B $F_1 = 22$ N, $F_2 = 29$ N

C $F_1 = 4$ N, $F_2 = 11$ N

D $F_1 = 22$ N, $F_2 = 11$ N

Q2: $ABCD$ is a square having a side length of 85 cm. Forces of magnitudes 30, 55, 30, and 55 newtons are acting along the square's sides, and two equal forces of magnitude $25\sqrt{2}$ newtons, are acting at A and C in the directions shown in the figure. Find the couple equivalent to the system.



A $-2{,}125$ N·cm

B $2{,}125$ N·cm

C $-6{,}375$ N·cm

D $6{,}375$ N·cm

E $11{,}475$ N·cm

Q3: $ABCD$ is a square having a side length of 50 cm. Forces of magnitudes 30, 60, 160, and 10 newtons are acting at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, and $\overrightarrow{DA}$, respectively, while two forces of magnitudes $40\sqrt{2}$ and $90\sqrt{2}$ newtons are acting at $\overrightarrow{AC}$ and $\overrightarrow{DB}$, respectively. If the system is equivalent to a couple, find its moment considering the positive direction is $DCBA$.

A $-6{,}500$ N·cm

B $-9{,}000$ N·cm

C 3,000 N·cm

D 9,000 N·cm

Q4: ABC is a triangle, where $BC = 48$ cm, and three forces of magnitudes 13, 13, and 24 newtons are acting along $\overrightarrow{CA}$, $\overrightarrow{AB}$, and $\overrightarrow{BC}$ respectively. If the system of forces is equivalent to a couple, determine the magnitude of its moment.

A 240 N·cm

B 120 N·cm

C 480 N·cm

D 960 N·cm

Q5: In a triangle ABC, $AB = BC = 32$ cm and $m\angle B = 120°$. Forces of magnitudes 2, 2, and $2\sqrt{3}$ newtons are acting at $\overrightarrow{AB}$, $\overrightarrow{BC}$, and $\overrightarrow{CA}$, respectively. If the system is equivalent to a couple, find the magnitude of its moment considering the positive direction is ABC.

A $32\sqrt{3}$ N·cm

B 64 N·cm

C 32 N·cm

D $64\sqrt{3}$ N·cm

Q6: ABC is a triangle, where $AB = 8$ cm, $BC = 3$ cm, and $m\angle B = 60°$, and forces of magnitudes 64 N, 24 N, and 56 N are acting along $\overrightarrow{AB}$, $\overrightarrow{BC}$, and $\overrightarrow{CA}$ respectively. If the system of forces is equivalent to a couple, determine the magnitude of its moment.

A $48\sqrt{3}$ N·cm

B 96 N·cm

C 48 N·cm

D $96\sqrt{3}$ N·cm

Q7: $ABCD$ is a square of side length 60 cm, where $E \in \overrightarrow{CB}$ and $F \in \overrightarrow{CD}$, such that $CE = CF = 180$ cm. Forces of magnitudes 75, 5, 40, 40, and $35\sqrt{2}$ g-wt are acting at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, $\overrightarrow{DA}$, and $\overrightarrow{EF}$, respectively. If the system is equivalent to a couple, find its moment considering the positive direction is $DCBA$.

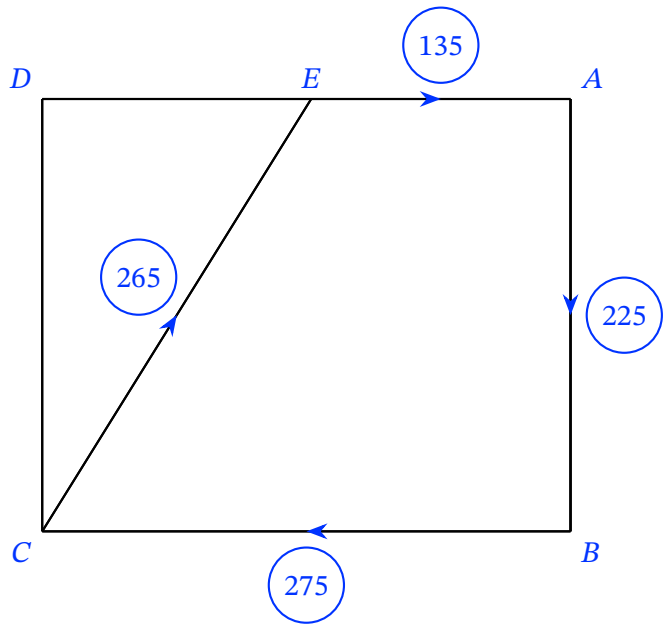
A -600 g-wt$\cdot$cm

B 7,350 g-wt$\cdot$cm

C $-7{,}950$ g-wt$\cdot$cm

D $-1{,}050$ g-wt$\cdot$cm

Q8: $ABCD$ is a rectangle, in which $AB = 45$ cm, $BC = 55$ cm, and $DE = 28$ cm. Forces of magnitudes 225, 275, 265, and 135newtons act along $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CE}$, and $\overrightarrow{EA}$, respectively. If the system of forces is equivalent to a couple, Determine the magnitude of the moment of the forces.



A 990 N·cm

B 738 N·cm

C 9,225 N·cm

D 18,450 N·cm

Q9: $ABCD$ is a rectangle in which $AB = 12$ cm, $BC = 6$ cm and O is midpoint of $\overline{AB}$. Forces of magnitudes 7 N, 2 N, 6 N, 18 N, $3\sqrt{5}$ N, and $10\sqrt{2}$ N are acting along $\overrightarrow{CB}$, $\overrightarrow{AB}$, $\overrightarrow{DA}$, $\overrightarrow{CD}$, $\overrightarrow{AC}$, and $\overrightarrow{OC}$ respectively. If this system of forces is equivalent to a couple, find the norm of its moment.

A 60 N·cm

B 84 N·cm

C 72 N·cm

D 24 N·cm

Q10: In a trapezium $ABCD$, $m\angle A = m\angle B = 90°$, $AD = 27$ cm, $AB = 35$ cm, and $BC = 39$ cm. Given that forces of magnitudes 54, 70, 78, and 74 newtons are acting along $\overrightarrow{DA}$, $\overrightarrow{AB}$, $\overrightarrow{BC}$, and $\overrightarrow{CD}$, respectively, and that the system of forces is equivalent to a couple, find the magnitude of the moment of the forces.

A 9,240 N·cm

B 4,620 N·cm

C 2,310 N·cm

D 1,155 N·cm

Q11: $ABCDE$ is a regular pentagon whose side length is 16 cm. Five forces, each of magnitude 11 N, are acting at $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, $\overrightarrow{DE}$, and $\overrightarrow{EA}$, respectively. If the system is equivalent to a couple, find the magnitude of its moment, considering the positive direction is $ABCDE$, rounded to two decimal places.

A 626.87 N·cm

B 342.10 N·cm

C 42.53 N·cm

D 605.61 N·cm

Q12: $EABCD$ is a pentagon in which $m\angle E = m\angle B = m\angle C = 90°$, $EA = 24$ cm, $AB = CD = 19$ cm, and $BC = 26$ cm. Forces of magnitudes 72 N, 57 N, 78 N, 57 N, and 30 N are acting along $\overrightarrow{EA}$, $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, and $\overrightarrow{DE}$ respectively. If this system is equivalent to a couple, find its moment norm.

A 1,842 N·cm

B 2,202 N·cm

C 3,684 N·cm

D 4,404 N·cm

Q13: $ABCDEO$ is a regular hexagon of side length 8 cm, and forces of magnitudes 2, 13, and 11 newtons are acting at $\overrightarrow{AB}$, $\overrightarrow{CO}$, and $\overrightarrow{ED}$ respectively. If the system is equivalent to a couple, determine the magnitude of the moment of the forces.

A $36\ \text{N}\cdot\text{cm}$

B $52\ \text{N}\cdot\text{cm}$

C $36\sqrt{3}\ \text{N}\cdot\text{cm}$

D $52\sqrt{3}\ \text{N}\cdot\text{cm}$

Q14: $ABCDHO$ is a regular hexagon whose side length is 7 cm. Forces of magnitudes of 9, 8, 10, 9, 8, and 10 newtons are acting along $\overrightarrow{BA}$, $\overrightarrow{AO}$, $\overrightarrow{HO}$, $\overrightarrow{HD}$, $\overrightarrow{DC}$, and $\overrightarrow{BC}$ respectively. Find the magnitude of the moment of the couple that is equivalent to the system.

A $49\sqrt{3}\ \text{N}\cdot\text{cm}$

B $98\ \text{N}\cdot\text{cm}$

C $378\ \text{N}\cdot\text{cm}$

D $63\sqrt{3}\ \text{N}\cdot\text{cm}$

Q15: If $ABCDEO$ is a regular hexagon having a side length of 6 cm, where forces of magnitudes 20 N, 20 N, 13 N, 13 N, and $20\sqrt{3}$ newtons are acting along $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CO}$, $\overrightarrow{ED}$, and $\overrightarrow{CA}$, respectively, and the system is equivalent to a couple, find its moment norm.

A $99\sqrt{3}$ N·cm

B $21\sqrt{3}$ N·cm

C 99 N·cm

D 21 N·cm

Q16: $ABCD$ is a trapezium, where $m\angle A = m\angle B = 90°$, $AB = 24$ cm, $AD = 11$ cm and $BC = 18$ cm. E and O are the midpoints of $\overline{AB}$ and $\overline{BC}$ respectively. Forces of magnitude 77 N, 175 N, 220 N, and 10 N are acting along $\overrightarrow{AD}$, $\overrightarrow{DC}$, $\overrightarrow{CA}$, and $\overrightarrow{EO}$, respectively. If the system of forces is equivalent to a couple, determine the magnitude of the moment of the forces.

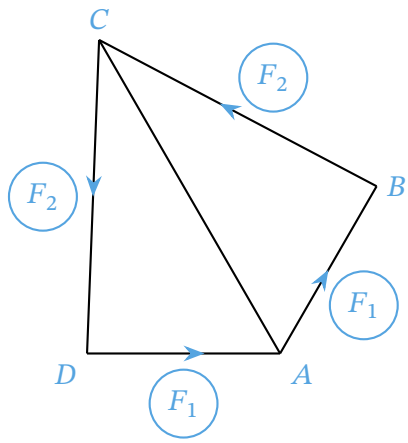
A 1,848 N·cm

B 924 N·cm

C 1,776 N·cm

D 1,920 N·cm

Q17: $ABCD$ is a quadrilateral in which $AB = AD = 8$ cm, $BC = CD = 13$ cm, and $m\angle BAD = 120°$. Forces act on the directed line segments $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, and $\overrightarrow{DA}$. If the system is reduced to a couple having a moment of $42\sqrt{3}$ N·cm in the direction of $ABCD$, find the magnitude of F_1 and F_2.



A $F_1 = \frac{80}{7}$ N, $F_2 = \frac{130}{7}$ N

B $F_1 = \frac{80}{7}$ N, $F_2 = \frac{91}{20}$ N

C $F_1 = \frac{14}{5}$ N, $F_2 = \frac{130}{7}$ N

D $F_1 = \frac{14}{5}$ N, $F_2 = \frac{91}{20}$ N

Q18: $ABCD$ is a trapezium in which $\overline{AD} \parallel \overline{BC}$, $\overline{AB}$ is perpendicular to them, E is the projection of D on $\overline{BC}$, $BC = 16$ cm, $AB = 12$ cm, and $AD = 11$ cm. Forces of magnitudes 5, $\frac{11}{4}$, $\frac{13}{4}$, 10, and 10 newtons are acting along $\overrightarrow{CA}$, $\overrightarrow{AD}$, $\overrightarrow{DC}$, $\overrightarrow{ED}$, and $\overrightarrow{AB}$ respectively. If the system is equivalent to a couple, find the magnitude of the couple moment.

A 143 N·cm

B 126.5 N·cm

C 77 N·cm

D 93.5 N·cm

Q19: $ABCD$ is an isosceles trapezium in which $AD \parallel BC$, $AD = 15$ cm, $AB = DC = 17$ cm, and $BC = 31$ cm. Forces having magnitudes of 51, 79, 51, and 31 newtons are acting in the directions of $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$, and $\overrightarrow{DA}$, respectively. If the system is equivalent to a couple, find the magnitude of its moment considering the positive direction is $DCBA$.

A 1,593 N·cm

B 2,046 N·cm

C 2,052 N·cm

D 1,860 N·cm

Q20: $ABCD$ is a rectangle, where $AB = x$ cm, $BC = 2x$ cm, and E and O are the midpoints of $\overline{AD}$ and $\overline{BC}$, respectively. Forces of magnitudes 8 N, 8 N, $31\sqrt{2}$ N, and $23\sqrt{2}$ N are acting along $\overrightarrow{EA}$, $\overrightarrow{AB}$, $\overrightarrow{BE}$, and $\overrightarrow{DO}$, respectively. Given that this system of forces is equivalent to a couple, determine the magnitude of its moment in terms of x, giving your answer in N·cm.

A $15x$ N·cm

B $8x$ N·cm

C $23x$ N·cm

D $31x$ N·cm

Q21: The sides of an equilateral triangle ABC, taken the same way round, completely represent three forces with a drawing scale of 4 cm to 8 N. If the length of a side of the triangle is 24 cm, find the magnitude of the resulting couple, giving an exact answer in N·cm.

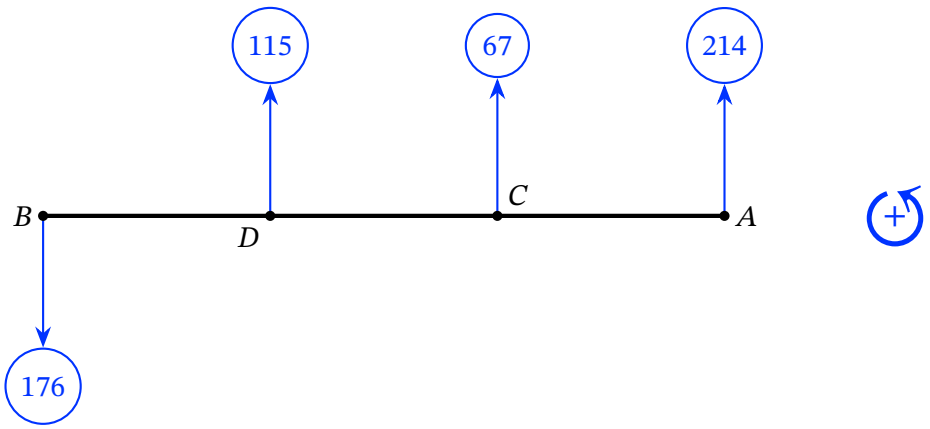
A $576\sqrt{3}$ N·cm

B 288 N·cm

C 576 N·cm

D $288\sqrt{3}$ N·cm

Q22: AB is a rod having a length of 105 cm and negligible weight. Forces of magnitudes 214 N, 67 N, 115 N, and 176 N are acting on the rod as shown in the figure. Given that C and D are the points of trisection of AB, determine the algebraic sum of the moments of these forces about the point A.



A 12,775 N·cm

B 12,110 N·cm

C 8,085 N·cm

D 7,871 N·cm

E −4,235 N·cm

Q23: Three forces $\overrightarrow{AB}$, $\overrightarrow{BC}$ and $\overrightarrow{CA}$ are represented by the sides of a right-angled triangle ABC where B is a right-angle. 1 cm on the triangle represents 40 N of force, and $AB = 19$ cm and $BC = 40$ cm. Find the magnitude of the resulting couple.

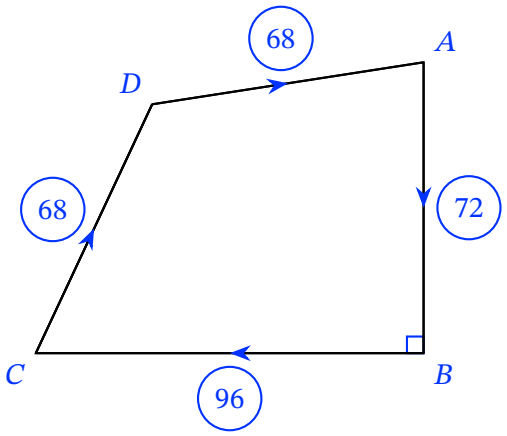
A 15,200 N·cm

B 30,400 N·cm

C 9.5 N·cm

D 19 N·cm

Q24: $ABCD$ is a quadrilateral, where $AB = 18$ cm, $BC = 24$ cm, $CD = DA = 17$ cm, and $m\angle ABC = 90°$. Given that four forces, measured in newtons, are acting on the quadrilateral as shown in the given figure, determine the magnitude of the moment of the equivalent couple.



A 2,952 N·cm

B 1,476 N·cm

C 1,344 N·cm

D 2,688 N·cm

Q25: Three forces of magnitudes 15, 10, and 15 newtons are acting along $\overrightarrow{AB}, \overrightarrow{BC}$, and $\overrightarrow{CA}$ respectively. Given that $AB = AC = 36\,\text{cm}$ and $BC = 24\,\text{cm}$, determine the magnitude of the resultant couple rounded to the nearest hundredth.

A 339.41 N·cm

B 169.71 N·cm

C 360.00 N·cm

D 678.82 N·cm