

Matrices - worksheet

Addition and subtraction

Use the following matrices in questions 1 to 6.

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 4 & 6 & 5 \end{pmatrix} \quad B = \begin{pmatrix} 2 \\ 4 \\ 6 \end{pmatrix} \quad C = \begin{pmatrix} 2 & 4 & 5 \\ 1 & 0 & 6 \end{pmatrix} \quad D = \begin{pmatrix} 4 & 1 \\ 0 & 5 \\ 7 & 8 \end{pmatrix} \quad E = \begin{pmatrix} 3 & 1 & 4 \\ 5 & 1 & 6 \end{pmatrix} \quad F = \begin{pmatrix} 5 & 4 & 1 \end{pmatrix}$$

$$G = \begin{pmatrix} 4 & 6 \\ 0 & 0 \\ 1 & 4 \end{pmatrix} \quad H = \begin{pmatrix} 5 & 4 & 2 \\ 0 & 1 & 0 \\ 6 & 5 & 3 \end{pmatrix} \quad J = \begin{pmatrix} 2 & 4 & 6 \end{pmatrix} \quad K = \begin{pmatrix} 5 \\ 2 \\ 7 \end{pmatrix} \quad L = \begin{pmatrix} 2 & 4 & 2 \\ 1 & 1 & 3 \\ 5 & 6 & 1 \end{pmatrix} \quad M = \begin{pmatrix} 2 & 5 & 1 \\ 1 & 3 & 4 \end{pmatrix}$$

1 Write the type and order of matrices A to H (not J to M).

Work out the answers in questions 2 and 3 if possible, or else write 'impossible'.

2 (a) $A + H$ (b) $A + C$ (c) $C + E$ (d) $A + F$ (e) $F + J$ (f) $D + G$

3 (a) $A - H$ (b) $C - E$ (c) $B - F$ (d) $F - J$ (e) $D - G$ (f) $B - K$

***4** Write the type and order of matrices J to M .

***5** State which of the following have no meaning. *Do not work out* the possible ones

(a) $C + M$ (b) $A + L$ (c) $M + J$ (d) $F + K$ (e) $M + E$ (f) $B + J$

***6** Work out, if possible: (a) $C - M$ (b) $A - L$ (c) $M - A$ (d) $H - L$.

7 $A = \begin{pmatrix} 2 & -2 \\ -1 & 0 \end{pmatrix} \quad B = \begin{pmatrix} -4 & -2 \\ 1 & 3 \end{pmatrix} \quad C = \begin{pmatrix} -6 & 4 \\ 2 & -3 \end{pmatrix} \quad D = \begin{pmatrix} 5 & 2 \\ -3 & 4 \end{pmatrix}$

Find:

(a) $A + B$ (b) $C + D$ (c) $A - B$ (d) $B - C$ (e) $A - D$ (f) $B - D$.

8 $M = \begin{pmatrix} 1 & -3 \\ 2 & 2 \end{pmatrix} \quad N = \begin{pmatrix} -2 & 0 \\ 2 & 1 \end{pmatrix} \quad P = \begin{pmatrix} 6 & -3 \\ 0 & 1 \end{pmatrix}$

Find:

(a) $M + N$ (b) $M - N$ (c) $N - P$ (d) $P - M$ (e) $M + N + P$
(f) $M + N - P$ (g) $M - N - P$ (h) $M - P - N$ (i) $M + M$ (j) $M + M + M$

9 $A = \begin{pmatrix} -2.4 & 4.7 \\ 3.6 & -5.3 \end{pmatrix}; \quad B = \begin{pmatrix} 1.8 & -4.6 \\ -3.7 & -2.8 \end{pmatrix}; \quad C = \begin{pmatrix} 4.2 & -1.4 \\ -9.6 & 3.7 \end{pmatrix}.$

Work out in your head:

(a) $2A$ (b) $3B$ (c) $4C$ (d) $A - C$ (e) $C - A$ (f) $A - B$
(g) $B - C$ (h) $C - B$.

Multiplication by a constant

Find:

(a) $4 \begin{pmatrix} \frac{1}{4} & \frac{1}{2} & 1 \\ 2 & 0 & \frac{3}{4} \end{pmatrix}$ (b) $5 \begin{pmatrix} 0 & \frac{1}{5} & -1 \\ \frac{2}{5} & 2 & 1 \end{pmatrix}$ (c) $4 \begin{pmatrix} -\frac{1}{2} & 1 & -2 \\ 0 & -\frac{1}{4} & -1 \end{pmatrix}$ (d) $8 \begin{pmatrix} -\frac{1}{2} & -4 & \frac{1}{4} \\ 2 & -\frac{3}{4} & 0 \end{pmatrix}$
(e) $2 \begin{pmatrix} -1.2 & 3.4 & -1.4 \\ 0.5 & 6.1 & -3.2 \end{pmatrix}$ (f) $10 \begin{pmatrix} 0.04 & 0.3 & 0.5 \\ 3.04 & 4.6 & 0.4 \end{pmatrix}.$

Find:

(a) $\frac{1}{2} \begin{pmatrix} -6 & 7 & 5 \\ -9 & 3 & 2 \end{pmatrix}$ (b) $0.25 \begin{pmatrix} 4 & 3 & -8 \\ 6 & 7 & 0 \end{pmatrix}$ (c) $0.75 \begin{pmatrix} 8 & 6 & -4 \\ 2 & 0 & 1 \end{pmatrix}$
(d) $-6 \begin{pmatrix} -4 & -3 & 0 \\ 2 & 1 & -2 \end{pmatrix}$ (e) $-\frac{1}{2} \begin{pmatrix} -4 & 8 & -6 \\ 0 & -1 & 1 \end{pmatrix}$ (f) $-\frac{1}{4} \begin{pmatrix} 8 & -6 & 5 \\ -7 & 2 & 3 \end{pmatrix}.$

$A = \begin{pmatrix} 2 & 3 \\ -1 & 2 \end{pmatrix} \quad B = \begin{pmatrix} 4 & -3 \\ -2 & 0 \end{pmatrix} \quad C = \begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$ Find:
(a) $2B + C$ (b) $3(A + B)$ (c) $3A + 3B$ (d) $4(A - B)$
(e) $2(A + B - C).$

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Multiplication

Multiply:

(a) $\begin{pmatrix} 4 & 5 \\ 6 & 2 \end{pmatrix} \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ (b) $\begin{pmatrix} 5 & 0 \\ 8 & 6 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}$ (c) $\begin{pmatrix} 6 & 3 \\ 4 & 5 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ (d) $\begin{pmatrix} 4 & 5 \\ 3 & 0 \end{pmatrix} \begin{pmatrix} 0 \\ 4 \end{pmatrix}$

Multiply:

(a) $\begin{pmatrix} -4 & 3 \\ 2 & 6 \end{pmatrix} \begin{pmatrix} -4 \\ 2 \end{pmatrix}$ (b) $\begin{pmatrix} -1 & -3 \\ 2 & -4 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}$ (c) $\begin{pmatrix} -5 & 3 \\ 0 & 3 \end{pmatrix} \begin{pmatrix} -4 \\ 2 \end{pmatrix}$

Multiply:

(a) $\begin{pmatrix} 5 & -1 & 3 \\ 6 & 2 & -4 \end{pmatrix} \begin{pmatrix} 5 \\ -4 \\ 3 \end{pmatrix}$ (b) $\begin{pmatrix} 1 & -4 & 7 \\ -2 & 1 & -5 \\ 6 & 1 & -4 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix}$

Find the values of the letters if:

(a) $3 \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 6 & 12 \\ -9 & 0 \end{pmatrix}$ (b) $k \begin{pmatrix} 4 & 2 \\ 0 & -2 \end{pmatrix} = \begin{pmatrix} 12 & 6 \\ 0 & -6 \end{pmatrix}$
 (c) $k \begin{pmatrix} 6 & 8 \\ 0 & 4 \end{pmatrix} = \begin{pmatrix} 9 & 12 \\ 0 & 6 \end{pmatrix}$ (d) $4 \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 7 & 9 \\ -6 & 2 \end{pmatrix}$
 (e) $a \begin{pmatrix} a & 2a \\ 2b & -3a \end{pmatrix} = \begin{pmatrix} 16 & c \\ 64 & 2d \end{pmatrix}$ (f) $-\frac{1}{2} \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} \frac{1}{8} & -\frac{1}{4} \\ \frac{1}{3} & -\frac{1}{5} \end{pmatrix}$
 (g) $\begin{pmatrix} a & 3 \\ 2 & b \end{pmatrix} \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 8 \\ 8 \end{pmatrix}$ (h) $\begin{pmatrix} s & t \\ s & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 11 \\ 6 \end{pmatrix}$ (i) $\begin{pmatrix} u & u \\ v & 1 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \end{pmatrix} = \begin{pmatrix} 20 \\ 0 \end{pmatrix}$

Multiply:

(a) $\begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 2 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 2 & 3 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 2 & 2 \end{pmatrix}$ (c) $\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} \begin{pmatrix} 2 & 3 \\ 0 & 1 \end{pmatrix}$

Multiply:

(a) $\begin{pmatrix} 2 & -1 \\ -2.1 & 4.1 \end{pmatrix} \begin{pmatrix} 1.5 & -1.2 \\ -2.1 & 4.1 \end{pmatrix}$ (b) $\begin{pmatrix} 2.5 & 1.1 \\ 4 & 8 \\ 6 & 3 \end{pmatrix} \begin{pmatrix} 4 & 8 \\ 6 & 3 \end{pmatrix}$ (c) $\begin{pmatrix} 2 & 2 \\ 2 & 8 \end{pmatrix} \begin{pmatrix} \frac{1}{2} & -\frac{1}{4} \\ 2 & 8 \end{pmatrix}$

State the value of the letters if:

(a) $\begin{pmatrix} -2 & 3 \\ -2 & n \end{pmatrix} \begin{pmatrix} m & 3 \\ -2 & n \end{pmatrix} = \begin{pmatrix} -14 & 9 \\ -6 & 5 \end{pmatrix}$ (b) $\begin{pmatrix} m & 2 \\ -6 & 5 \end{pmatrix} \begin{pmatrix} -4 & n \\ -6 & 5 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -6 & 5 \end{pmatrix}$
 (c) $\begin{pmatrix} 2 & p & 3 \\ -1 & q & -4 \\ 2 & -5 & r \\ -4 & 6 & 2 \end{pmatrix} = \begin{pmatrix} -22 & 44 & -14 \end{pmatrix}$
 (d) $\begin{pmatrix} p & 3 & -2 \\ 1 & 5 & r \\ -8 & q & r \\ -4 & -2 & r \end{pmatrix} = \begin{pmatrix} -16 & 1 & 16 \end{pmatrix}$
 (e) $\begin{pmatrix} a & b & c \\ a & b & b \\ c & a & c \\ b & b & b \end{pmatrix} = \begin{pmatrix} 2bc & b & 4c \end{pmatrix}$

Multiply:

(a) $\begin{pmatrix} 2 & 3 \\ 1 & 4 \end{pmatrix} \begin{pmatrix} 3 & 2 \\ 1 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 4 & 3 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$ (c) $\begin{pmatrix} 2 & 2 \\ 0 & 4 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 4 & 0 \end{pmatrix}$
 (d) $\begin{pmatrix} 2 & 3 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 2 & 1 \end{pmatrix}$ (e) $\begin{pmatrix} 3 & 1 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 0 & 3 \end{pmatrix}$ (f) $\begin{pmatrix} 2 & 1 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 3 & 2 \end{pmatrix}$

Example $\begin{pmatrix} 2 & 3 \\ 1 & 5 \end{pmatrix} \begin{pmatrix} x & 0 \\ 0 & y \end{pmatrix} = \begin{pmatrix} 2x & 3y \\ x & 5y \end{pmatrix}$

Find:

(a) $\begin{pmatrix} 3 & 4 \\ 2 & 5 \end{pmatrix} \begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}$ (b) $\begin{pmatrix} 2 & 4 \\ 1 & 5 \end{pmatrix} \begin{pmatrix} 0 & d \\ c & 0 \end{pmatrix}$ (c) $\begin{pmatrix} e & 0 \\ 0 & f \end{pmatrix} \begin{pmatrix} 3 & 4 \\ 2 & 5 \end{pmatrix}$

Find the value of each letter if:

(a) $\begin{pmatrix} 3 & 4 \\ 2 & 5 \end{pmatrix} \begin{pmatrix} m & 0 \\ 0 & n \end{pmatrix} = \begin{pmatrix} 9 & 8 \\ p & q \end{pmatrix}$ (b) $\begin{pmatrix} 3 & 5 \\ 2 & 3 \end{pmatrix} \begin{pmatrix} p & 0 \\ 0 & q \end{pmatrix} = \begin{pmatrix} r & 10 \\ 8 & s \end{pmatrix}$
 (c) $\begin{pmatrix} 2 & 4 \\ 3 & 5 \end{pmatrix} \begin{pmatrix} 0 & c \\ b & 0 \end{pmatrix} = \begin{pmatrix} 8 & f \\ e & -6 \end{pmatrix}$ (d) $\begin{pmatrix} 2 & 3 \\ 4 & 5 \end{pmatrix} \begin{pmatrix} a & 2 \\ 3 & c \end{pmatrix} = \begin{pmatrix} 15 & 16 \\ b & d \end{pmatrix}$
 (e) $\begin{pmatrix} 3 & 2 \\ -4 & 2 \end{pmatrix} \begin{pmatrix} a & 3 \\ a & b \end{pmatrix} = \begin{pmatrix} -10 & 3 \\ 4 & c \end{pmatrix}$ (f) $\begin{pmatrix} 3 & 2 \\ 1 & a \end{pmatrix} \begin{pmatrix} a & c \\ a & c \end{pmatrix} = \begin{pmatrix} 5 & 0 \\ b & d \end{pmatrix}$