Perfect Squares

$(a \pm b)^2 = a^2 \pm 2ab + b^2$ * Learn

Exercise 2.14

1 a Express $(a+b)^2$ as $(a+b)(a+b)$. Hence, show that $(a+b)^2 = a^2 + 2ab + b^2$.
b Express $(a-b)^2$ as $(a-b)(a-b)$. Hence, show that $(a-b)^2 = a^2 - 2ab + b^2$.

2 Use the perfect square identities to expand:
a $(p+q)^2$ b $(m+n)^2$ c $(x-y)^2$ d $(c-d)^2$

3 Expand these perfect squares.
a $(x+3)^2$ b $(m+5)^2$ c $(k-2)^2$ d $(y-7)^2$
e $(u+4)^2$ f $(t-1)^2$ g $(c-11)^2$ h $(b+9)^2$
i $(e-6)^2$ j $(p+10)^2$ k $(w+8)^2$ l $(n-12)^2$

4 Expand:
a $(5+a)^2$ b $(3-j)^2$ c $(11+y)^2$ d $(1-h)^2$

Consolidation

5 Use a calculator to expand each of these.
a $(a+13)^2$ b $(q-17)^2$ c $(22+r)^2$ d $(18-v)^2$

6 Expand each of these perfect squares.
a $(y+0.2)^2$ b $(f-0.7)^2$ c $(s+0.5)^2$ d $(p-1.2)^2$

7 Expand each perfect square.
a $(2x+3)^2$ b $(3a+5)^2$ c $(4k-1)^2$ d $(5h-2)^2$
e $(3u+4)^2$ f $(6d-7)^2$ g $(2c-11)^2$ h $(4w+9)^2$
i $(8g-1)^2$ j $(7p+2)^2$ k $(10y+3)^2$ l $(12f-5)^2$
m $(6+5e)^2$ n $(9-2v)^2$ o $(5-8b)^2$ p $(7+12q)^2$

8 Expand:
a $(ab+c)^2$ b $(p-qr)^2$ c $(rs+st)^2$ d $(3ef-4gh)^2$

9 Expand and simplify:
a $2(p+5)^2$ b $-3(a-4)^2$ c $x(2x+7)^2$ d $5t(3t-2u)^2$

10 Complete each of these perfect squares.
a $(x+3)^2 = x^2 + 6x + \_\_\_$
b $(m-5)^2 = m^2 - 10m + \_\_\_$
c $(c+4)^2 = c^2 + \_\_\_ + 16$
d $(w-7)^2 = w^2 - \_\_\_ + 49$
e $(k+\_\_\_)^2 = k^2 + \_\_\_ + 36$
f $(\_\_\_ - 10)^2 = y^2 - \_\_\_ + 100$
g $(\_\_\_)^2 = u^2 - \_\_\_ + 4$
h $(\_\_\_)^2 = a^2 + \_\_\_ + 81$
i $(\_\_\_)^2 = n^2 + 2n + \_\_\_$
j $(\_\_\_)^2 = t^2 + 24t + \_\_\_$
k $(\_\_\_)^2 = p^2 - 16p + \_\_\_$
l $(\_\_\_)^2 = z^2 - 22z + \_\_\_$

11 Complete each of these perfect squares.
a $(3m+4)^2 = 9m^2 + 24m + \_\_\_$
b $(2e-7)^2 = 4e^2 - 28e + \_\_\_$
c $(2q+3)^2 = 4q^2 + \_\_\_ + 9$
d $(3h-8)^2 = 9h^2 - \_\_\_ + 64$
e $(\_\_\_ + 1)^2 = 25s^2 + 10s + \_\_\_$
f $(4k + \_\_\_)^2 = \_\_\_ + 40k + 25$
g $(\_\_\_)^2 = 4g^2 + 44g + 121$
h $(\_\_\_)^2 = 36a^2 - 60a + 25$
i $(\_\_\_)^2 = 16j^2 - \_\_\_ + 81$
j $(\_\_\_)^2 = 121r^2 + \_\_\_ + 144$
k $(\_\_\_)^2 = \_\_\_ + 36b + 4$
l $(\_\_\_)^2 = 49y^2 - 42y + \_\_\_$

12 State whether each expression is a perfect square.
a $a^2 + 9$ b $(b-2)^2$ c $x^2 + 28x + 196$ d $c^2 + 10c - 25$
e $n^2 - 4n + 16$ f $m^2 + n^2$ g $k^4 + 12k^2 + 36$ h x^2y^2
i $z^2 - 25$ j $4x^2 + 6x + 9$ k $49 - 14u + u^2$ l $e^2 + f^2 + 2ef$

13 Expand:
a $\left(z + \frac{1}{3}\right)^2$ b $\left(c - \frac{4}{5}\right)^2$ c $\left(a + \frac{1}{a}\right)^2$ d $\left(t - \frac{1}{t}\right)^2$

14 Simplify:
a $\sqrt{y^2 + 20y + 100}$ b $\sqrt{g^2 - 16g + 64}$ c $\sqrt{9j^2 - 42j + 49}$

15 Evaluate:
a 101^2 by first expressing it as $(100+1)^2$ b 99^2 by first expressing it as $(100-1)^2$

16 Use the expansions for perfect squares to evaluate each of the following.
a 35^2 b 107^2 c 49^2 d 28^2

17 Expand $\left(x + \frac{1}{x}\right)^2$. Hence, evaluate $\left(2\frac{1}{2}\right)^2$ and $\left(3\frac{1}{3}\right)^2$.

Further applications

18 a Show that $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$ using the distributive law.
b Hence, expand each of the following.
i $(p+q+3)^2$ ii $(x-y-4)^2$ iii $(2f+3g+4h)^2$

19 Complete each of these perfect squares.
a $(\_\_\_)^2 = \_\_\_ + 30c + 25$
b $(\_\_\_)^2 = \_\_\_ + 56w + 16$
c $(\_\_\_)^2 = \_\_\_ - 110t + 121$
d $(\_\_\_)^2 = \_\_\_ - 168r + 49$