Name:

Exam Style Questions

Direct Proportion
Inverse Proportion

Corbettmaths

Equipment needed: Calculator and Pen

Guidance

1. Read each question carefully before you begin answering it.
2. Check your answers seem right.
3. Always show your workings

Video Tutorial

www.corbettmaths.com/contents

Videos 254, 255

Answers and Video Solutions

1. y is directly proportional to x.

$y = 30$ when $x = 2.5$

Work out the value of y when $x = 4$

$y \propto x$

$y = kx$

$30 = k \times 2.5$

$k = 12$

$y = kx$

$y = 12x$

when $x = 4$

$y = 12 \times 4$

$y = 48$

y = 48

(3)

2. y is directly proportional to the square of x.
When y = 24, x = 2

Find the value of y when x = 4.

$y \propto x^2$

$y = kx^2$

$24 = k \times 2^2$

$24 = k \times 4$

$k = 6$

$y = 6x^2$

when $x = 4$

$y = 6 \times 4^2$

$y = 96$

y = 96

(3)

3. The cost of a circular table is directly proportional to the square of the radius.
A circular table with a radius of 40cm cost £50

What is the cost of a circular table with a radius of 60cm?

$C \propto r^2$

$C = kr^2$

$50 = k \times 40^2$

$50 = k \times 1600$

$k = \frac{1}{32}$ (or 0.03125)

$C = \frac{1}{32} r^2$

$C = \frac{1}{32} \times 60^2$

$C = 112.50$

£ 112.50

(3)

4. The time taken, t seconds, that it takes a water heater to boil water is inversely proportional to the power, p watts, of the water heater.

When P = 2000W, T = 252 seconds.

Find the time it takes to boil water when P = 800W

$t \propto \frac{1}{p}$

$t = \frac{k}{p}$

$252 = \frac{k}{2000}$

$k = 504000$

$t = \frac{504000}{p}$

$t = \frac{504000}{800}$

$t = 630$

630 seconds

(3)

5. H varies directly to the cube of c.
When H = 40, c = 2

(a) Express H in terms of c.

$H \propto c^3$

$H = kc^3$

$40 = k \times 2^3$

$40 = k \times 8$

$k = 5$

H = $5c^3$
(3)

(b) Find the value of H when c = 5

$H = 5 \times 5^3$

$H = 625$

H = 625
(1)

(c) Find the value of c when H = 5000

$5000 = 5c^3$

$1000 = c^3$

$c = 10$

c = 10
(1)

6. The force, F newtons, exerted by a magnet on a metal object is inversely proportional to the square of the distance d cm.

When d = 2 cm, F = 50 N

(a) Express F in terms of d.

$F \propto \frac{1}{d^2}$

$F = \frac{k}{d^2}$

$50 = \frac{k}{2^2}$

$50 = \frac{k}{4}$

$k = 200$

F = $\frac{200}{d^2}$

(3)

(b) Find the force when the distance between the magnet and metal object is 10cm

$F = \frac{200}{10^2}$

$F = 2$

F = 2 N

(1)

(c) Find the distance between the magnet and metal object when the force is 8N

$8 = \frac{200}{d^2}$

$8d^2 = 200$

$d^2 = 25$

d = 5 cm

(1)

(d) Explain what happens to F when d is halved.

÷2 { d = 5 cm F = 8N ×4
d = 10 cm F = 2N

When the distance is halved, the force is 4 times bigger.

(1)

7. The table shows a set of values for x and y.

y is directly proportional to the square root of x.

x	16	
y	9	54

Complete the table.

$y \propto \sqrt{x}$

$y = k\sqrt{x}$

$9 = k \times \sqrt{16}$

$9 = 4k$

$k = 2.25$

$y = 2.25\sqrt{x}$

$54 = 2.25\sqrt{x}$

$\sqrt{x} = 24$

$x = 576$

(4)

8. A and B are positive numbers.
A is inversely proportional to B.
When A = 4, B = 36

Find the value of A when B = A

$A \propto \frac{1}{B}$

$A = \frac{k}{B}$

$4 = \frac{k}{36}$

$k = 144$

$A = \frac{144}{B}$

$A = \frac{144}{A}$

$A^2 = 144$

$A = 12$

A = 12

(4)

9. C is directly proportional to the square root of y.
When C = 12.8, y = 16

(a) Express C in terms of y.

$C \propto \sqrt{y}$

$C = k\sqrt{y}$

$12.8 = k \times 4$

$k = 3.2$

$C = 3.2\sqrt{y}$

C = $3.2\sqrt{y}$ **(3)**

(b) Find C when y = 400

$C = 3.2 \times \sqrt{400}$

$= 3.2 \times 20$

$= 64$

C = 64 **(1)**

10. The time taken, t, for passengers to be checked-in for a flight is inversely proportional to the square of the number of staff, s, working.

It takes 30 minutes passengers to be checked-in when 10 staff are working.

(a) Find an equation connecting t and s.

$t \propto \frac{1}{s^2}$

$t = \frac{k}{s^2}$

$30 = \frac{k}{10^2}$

$30 = \frac{k}{100}$

$k = 3000$

$t = \frac{3000}{s^2}$ **(3)**

(b) What is the minimum number of staff that must be working so that the time taken is under 60 minutes?

$60 = \frac{3000}{s^2}$

$60s^2 = 3000$

$s^2 = 50$

$s = \sqrt{50}$ $s = 7.0710...$

$s = \sqrt{50}$

8 **(3)**

11. The cost of a trip is directly proportional to the square root of the distance.

The cost is £495 when the distance is 324 miles.

Find a formula connecting the cost, C, and the distance d.

$C \propto \sqrt{d}$

$C = k \times \sqrt{d}$

$495 = k \times \sqrt{324}$

$495 = k \times 18$

$k = 27.5$

$C = 27.5\sqrt{d}$

.....

(3)

12. w is inversely proportional to y^2

$w = 54$ when $y = c$

Find the value of w when $y = 3c$

$w \propto \frac{1}{y^2}$

$w = \frac{k}{y^2}$

$54 = \frac{k}{c^2}$

$k = 54c^2$

$w = \frac{54c^2}{y^2}$

$w = \frac{54c^2}{(3c)^2}$

$w = \frac{54c^2}{9c^2}$

$w = 6$

6

.....

(3)

13. a is directly proportional to $\sqrt{c}$

w is inversely proportional to a^3

When c = 49, a = 35
When a = 2, w = 16

Find the value of w when c = 4

$a \propto \sqrt{c}$

$a = k\sqrt{c}$

$35 = k\sqrt{49}$

$35 = k \times 7$

$k = 5$

$a = 5\sqrt{c}$

$w \propto \frac{1}{a^3}$

$w = \frac{k}{a^3}$

$16 = \frac{k}{2^3}$

$16 = \frac{k}{8}$

$k = 128$

$w = \frac{128}{a^3}$

when $c = 4$

$a = 5 \times \sqrt{4}$

$a = 10$

when $a = 10$

$w = \frac{128}{10^3}$

$= 0.128$

w = 0.128

(6)

14. The number of days, D, to complete research is inversely proportional to the number of researchers, R, who are working.

The research takes 125 days to complete is 16 people work on it.

Find how many people are needed to complete the research in 40 days.

$D \propto \frac{1}{R}$

$D = \frac{k}{R}$

$125 = \frac{k}{16}$

$k = 2000$

$D = \frac{2000}{R}$

$40 = \frac{2000}{R}$

$40R = 2000$

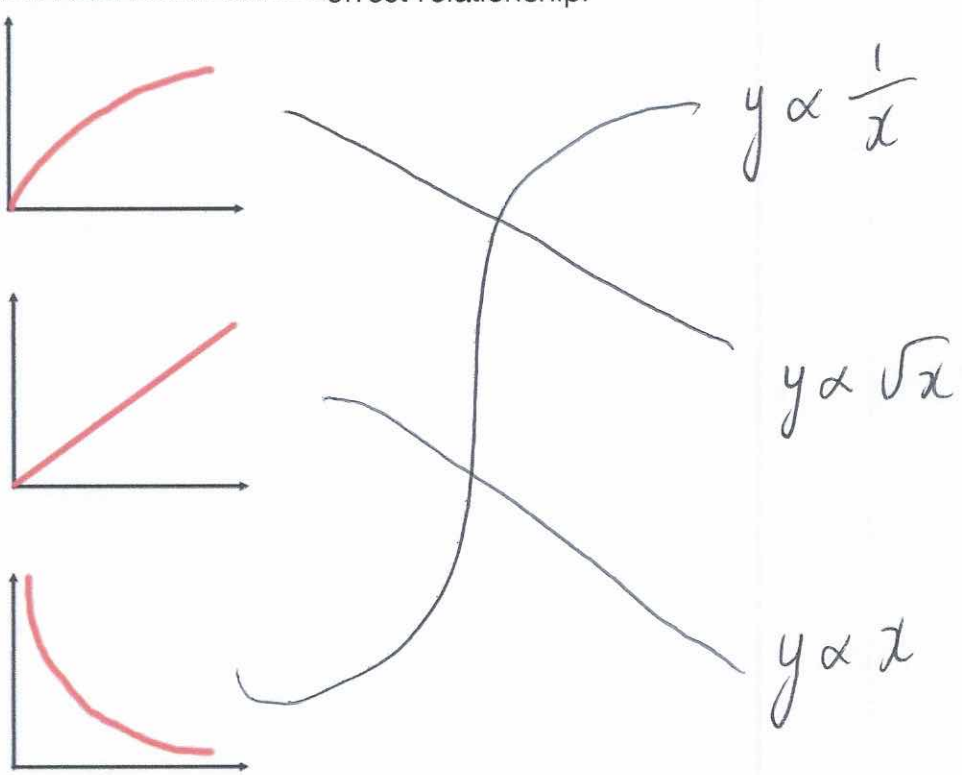
$R = 50$

50

.....

(5)

15. Match each graph to the correct relationship.



(3)

16. x and y and positive numbers.
y is inversely proportional to the square of x.

b = 0.5

x	2	4	b
y	30	a	480

a = 7.5

Find the values of a and b.

$y \propto \frac{1}{x^2}$

$y = \frac{k}{x^2}$

$30 = \frac{k}{2^2}$

$30 = \frac{k}{4}$

$k = 120$

$y = \frac{120}{x^2}$

$480 = \frac{120}{b^2}$

$480b^2 = 120$

$b^2 = \frac{1}{4}$

$b = \frac{1}{2}$

$y = \frac{120}{x^2}$

$y = \frac{120}{4^2}$

$y = \frac{120}{16}$

$y = 7.5$

(4)

17. A and B are positive numbers.
A is inversely proportional to the cube of B.

When $A = \frac{10}{27}$, $B = 30$

Find the value of A when B = A

$A \propto \frac{1}{B^3}$

$A = \frac{k}{B^3}$

$\frac{10}{27} = \frac{k}{30^3}$

$\frac{10}{27} = \frac{k}{27000}$

$k = 10000$

$A = \frac{10000}{B^3}$

$A = \frac{10000}{A^3}$

$A^4 = 10000$

$A = 10$

(5)

18. w is inversely proportional to the square root of y
w is directly proportional to z cubed.

$w : y : z = 3 : 2 : 5$ when y = 4

Work out $w : z$ when y = 256

$y = 4$

w : y : z
3 : 2 : 5
6 : 4 : 10

$w = 6$

$z = 10$

$w \propto \frac{1}{\sqrt{y}}$

$w = \frac{k}{\sqrt{y}}$

$6 = \frac{k}{\sqrt{4}}$

$6 = \frac{k}{2}$

$k = 12$

$w = \frac{12}{\sqrt{y}}$

$y = 256$

$w = \frac{12}{\sqrt{256}}$

$w = \frac{3}{4}$

$w \propto z^3$

$w = k \times z^3$

$6 = k \times 10^3$

$6 = 1000k$

$k = 0.006$

$w = 0.006z^3$

$\frac{3}{4} = 0.006z^3$

$125 = z^3$

$z = 5$

3 : 20

(5)

w : z

×4 $\frac{3}{4}$: 5 ×4

3 : 20

19. w is directly proportional to x cubed.

Find the percentage increase in w when x is increased by 10%

$w \propto x^3$

$w = k x^3$

$1.1^3 = 1.331$

33.1 %

(3)

20. A is directly proportional to the cube root of B.

B is increased by 75%

Work out the percentage increase in A.

$A \propto \sqrt[3]{B}$

$A = k \times \sqrt[3]{B}$

$\sqrt[3]{1.75} = 1.2050711...$

20.5 %

(3)

21. x is directly proportional to w^2
When $x = 50$, $w = 5$

y is directly proportional to x^3
When $x = 3$, $y = 4$

Find a formula for y in terms of w
Give your answer in its simplest form.

$x \propto w^2$

$x = kw^2$

$50 = k \times 5^2$

$50 = k \times 25$

$k = 2$

$x = 2w^2$

$y \propto x^3$

$y = kx^3$

$4 = k \times 27$

$k = \frac{4}{27}$

$y = \frac{4}{27} x^3$

$y = \frac{4}{27} (2w^2)^3$

$y = \frac{4}{27} (8w^6)$

$y = \frac{32}{27} w^6$

(4)

22. w is directly proportional to c squared.

When w = 16, c = 2

Find the value of c when $w = 28c - 49$

$w \propto c^2$

$w = kc^2$

$16 = k \times 2^2$

$k = 4$

$w = 4c^2$

$28c - 49 = 4c^2$

$4c^2 - 28c + 49 = 0$

$(2c - 7)(2c - 7) = 0$

$c = \frac{7}{2}$

or $c = 3.5$

$c = 3.5$

(4)

23. W is directly proportional to the square of x.
where W and x are both positive.
When the value of x is increased by 2, the value of W is three times larger.

Find the exact value of x.

$W \propto x^2$

$W = kx^2$

$k(x+2)^2 = 3kx^2$

$(x+2)^2 = 3x^2$

$x^2 + 4x + 4 = 3x^2$

$0 = 2x^2 - 4x - 4$

$0 = x^2 - 2x - 2$

Completing the square

$(x-1)^2 - 1 - 2 = 0$

$(x-1)^2 - 3 = 0$

$(x-1)^2 = 3$

$x - 1 = \pm\sqrt{3}$

$x = 1 \pm \sqrt{3}$

$x = 1 + \sqrt{3}$

Quadratic formula

$a = 1 \quad b = -2 \quad c = -2$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \dfrac{2 \pm \sqrt{4 - (-8)}}{2}$

$x = \dfrac{2 \pm \sqrt{12}}{2}$

$x = \dfrac{2 \pm 2\sqrt{3}}{2}$

$x = 1 \pm \sqrt{3}$

$x = 1 + \sqrt{3}$

(6)