Edexcel GCSE

Mathematics

Higher Tier

Number: Proportion

Information for students

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 23 questions in this selection.

Advice for students

Show all stages in any calculations.
Work steadily through the paper. Do not spend too long on one question.
If you cannot answer a question, leave it and attempt the next one.
Return at the end to those you have left out.

Information for teachers

The questions in this document are taken from the 2009 GCSE Exam Wizard and include questions from examinations set between January 2003 and June 2009 from specifications 1387, 1388, 2540, 2544, 1380 and 2381.

Questions are those tagged as assessing "Proportion" though they might assess other areas of the specification as well. Questions are those tagged as "Higher" so could have (though not necessarily) appeared on either an Intermediate or Higher tier paper.

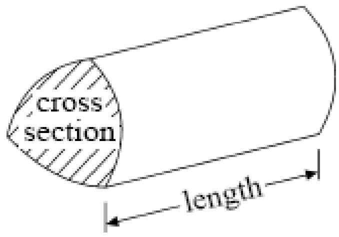
GCSE Mathematics

Formulae: Higher Tier

You must not write on this formulae page.

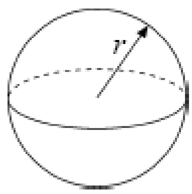
Anything you write on this formulae page will gain NO credit.

Volume of prism = area of cross section × length



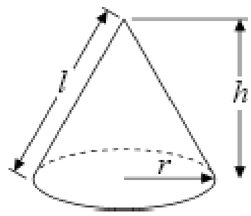
Volume of sphere $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$

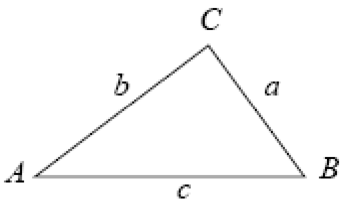


Volume of cone $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl



In any triangle ABC



Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle = $\frac{1}{2}ab \sin C$

The Quadratic Equation

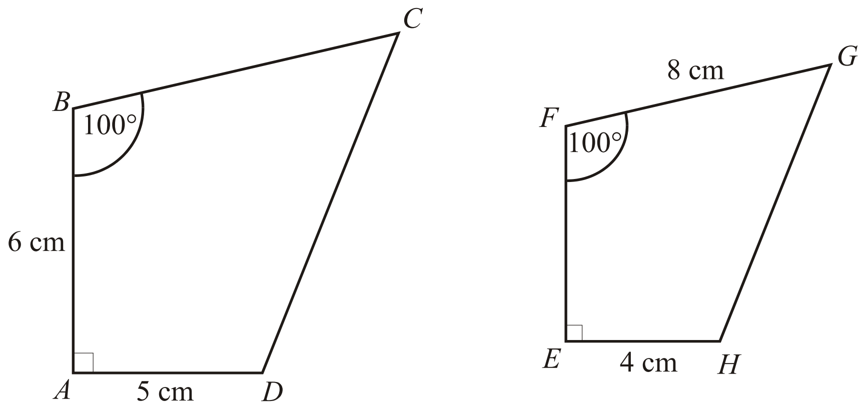
The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

1.

Diagrams **NOT** accurately drawn



Shapes *ABCD* and *EFGH* are mathematically similar.

(i) Calculate the length of *BC*.

BC = ………………… cm

(ii) Calculate the length of *EF*.

EF = ………………… cm

(Total 5 marks)

2. A company bought a van that had a value of £12 000
Each year the value of the van depreciates by 25%.

(a) Work out the value of the van at the end of three years.

£ ....

(3)

The company bought a new truck.
Each year the value of the truck depreciates by 20%.
The value of the new truck can be multiplied by a single number to find its value at the end of four years.

(b) Find this single number as a decimal.

....

(2)
(Total 5 marks)

3. The shutter speed, S, of a camera varies inversely as the square of the aperture setting, f.

When $f = 8$, $S = 125$

(a) Find a formula for S in terms of f.

....

(3)

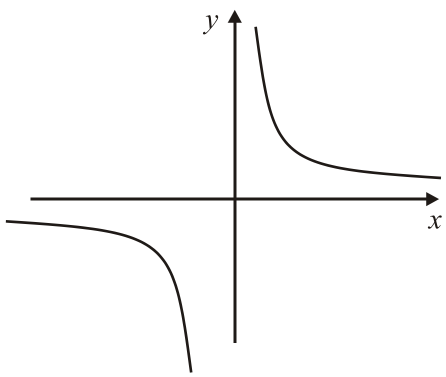
(b) Hence, or otherwise, calculate the value of S when $f = 4$

$S =$ ....

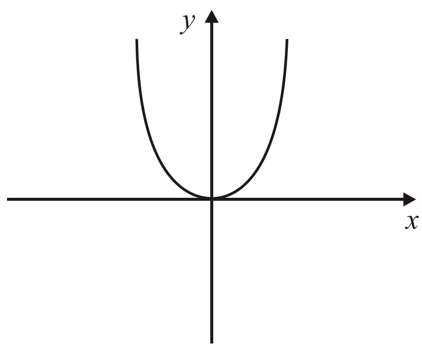
(1)

(Total 4 marks)

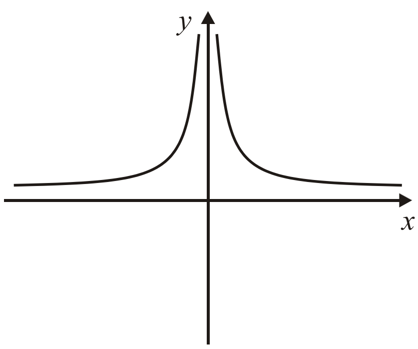
4.



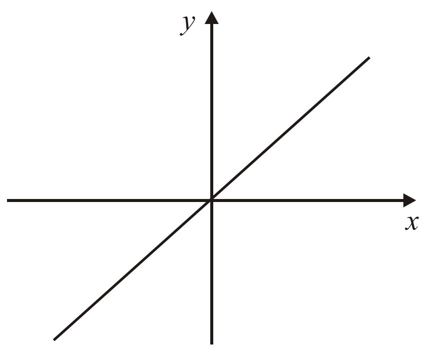
Graph **A**



Graph **B**



Graph **C**



Graph **D**

The graphs of y against x represent four different types of proportionality.

Write down the letter of the graph which represents the type of proportionality.

Type of proportionality	**Graph letter**
y is directly proportional to x	....
y is inversely proportional to x	....
y is proportional to the square of x	....
y is inversely proportional to the square of x	....

(Total 2 marks)

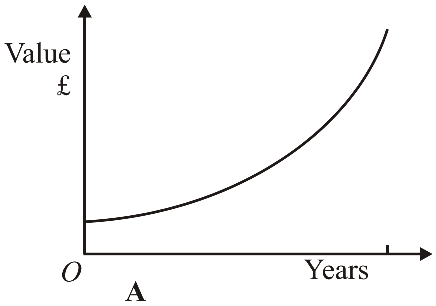
5. Nicola invests £8000 for 3 years at 5% per annum **compound** interest.

(a) Calculate the value of her investment at the end of 3 years.

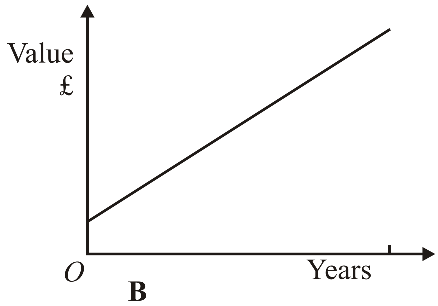
£................................

(3)

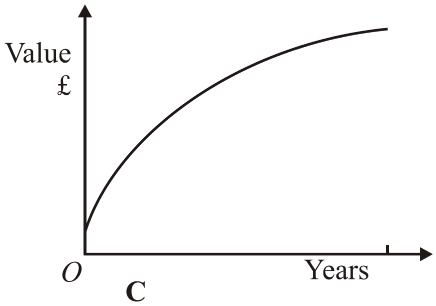
Jim invests a sum of money for 30 years at 4% per annum **compound** interest.



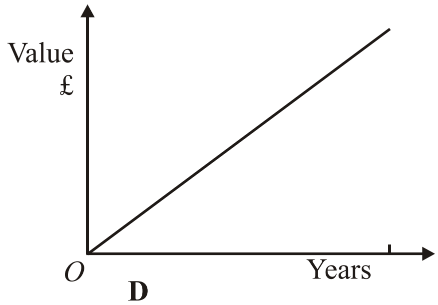
A



B



C



D

(b) Write down the letter of the graph which best shows how the value of Jim's investment changes over the 30 years.

....

(1)

Hannah invested an amount of money in an account paying 5% per annum **compound** interest.

After 1 year the value of her investment was £3885

(c) Work out the amount of money that Hannah invested.

£................................

(3)
(Total 7 marks)

6.

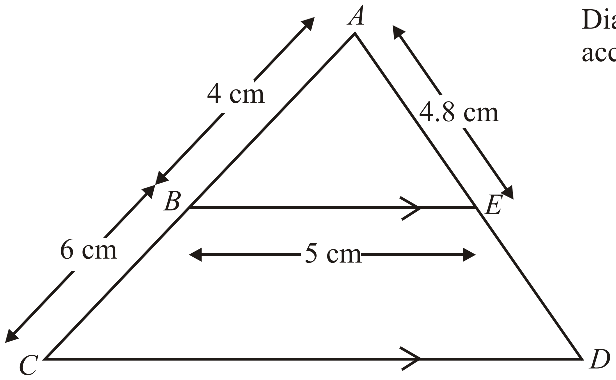


Diagram **NOT** accurately drawn

BE is parallel to *CD*.
ABC and *AED* are straight lines.
AB = 4 cm, *BC* = 6 cm, *BE* = 5 cm, *AE* = 4.8 cm.

(a) Calculate the length of *CD*.

.... cm
(2)

(b) Calculate the length of *ED*.

.... cm

(2)

(Total 4 marks)

7. In a factory, chemical reactions are carried out in spherical containers.

The time, T minutes, the chemical reaction takes is directly proportional to the square of the radius, R cm, of the spherical container.

When $R = 120$, $T = 32$

Find the value of T when $R = 150$

T = ...

(Total 4 marks)

8. d is directly proportional to the square of t.

$d = 80$ when $t = 4$

(a) Express d in terms of t.

……………………

(3)

(b) Work out the value of d when $t = 7$

d = …………………

(1)

(c) Work out the positive value of t when $d = 45$

t = …………………

(2)

(Total 6 marks)

9. The distance, D, travelled by a particle is directly proportional to the square of the time, t, taken.

When $t = 40$, $D = 30$

(a) Find a formula for D in terms of t.

$D =$ ....

(3)

(b) Calculate the value of D when $t = 64$

....

(1)

(c) Calculate the value of t when $D = 12$
Give your answer correct to 3 significant figures.

....

(2)
(Total 6 marks)

10. The time, T seconds, it takes a water heater to boil some water is directly proportional to the mass of water, m kg, in the water heater.

When $m = 250$, $T = 600$

(a) Find T when $m = 400$

$T =$ ....

(3)

The time, T seconds, it takes a water heater to boil a constant mass of water is inversely proportional to the power, P watts, of the water heater.

When $P = 1400$, $T = 360$

(b) Find the value of T when $P = 900$

$T =$.....................................

(3)
(Total 6 marks)

11. A ball falls vertically after being dropped.
The ball falls a distance d metres in a time of t seconds.
d is directly proportional to the square of t.

The ball falls 20 metres in a time of 2 seconds.

(a) Find a formula for d in terms of t.

d = ...

(3)

(b) Calculate the distance the ball falls in 3 seconds.

.... m

(1)

(c) Calculate the time the ball takes to fall 605 m.

.... seconds

(3)

(Total 7 marks)

12. The diagram shows two quadrilaterals that are mathematically **similar**.

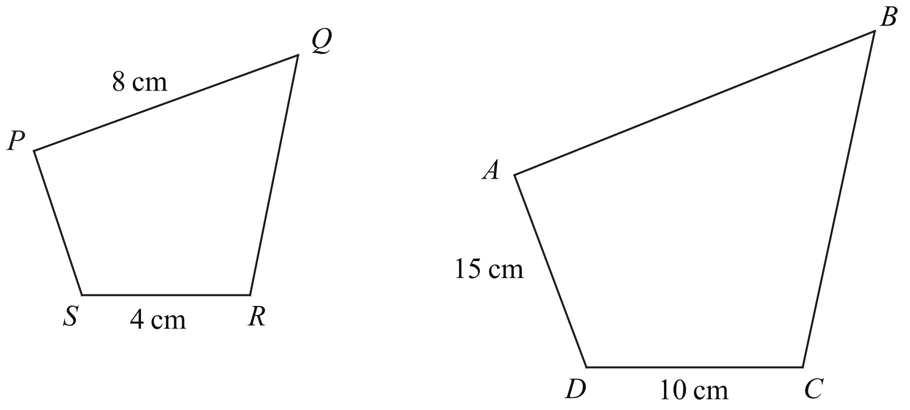


Diagram **NOT** accurately drawn

In quadrilateral $PQRS$, $PQ = 8$ cm, $SR = 4$ cm.
In quadrilateral $ABCD$, $AD = 15$ cm, $DC = 10$ cm.
Angle PSR = angle ADC.
Angle SPQ = angle DAB.

(a) Calculate the length of AB.

.... cm
(2)

(b) Calculate the length of *PS*.

.... cm

(2)

(Total 4 marks)

13. In a spring, the tension (T newtons) is directly proportional to its extension (x cm).

When the tension is 150 newtons, the extension is 6 cm.

(a) Find a formula for T in terms of x.

T = ...

(3)

(b) Calculate the tension, in newtons, when the extension is 15 cm.

.... newtons

(1)

(c) Calculate the extension, in cm, when the tension is 600 newtons.

.... cm

(1)

(Total 5 marks)

14. *f* is inversely proportional to *d*.

When $d = 50$, $f = 256$

Find the value of *f* when $d = 80$

$f =$ ....

(Total 3 marks)

15. *q* is inversely proportional to the square of *t*.

When $t = 4$, $q = 8.5$

(a) Find a formula for *q* in terms of *t*.

$q =$ ....

(3)

(b) Calculate the value of q when $t = 5$

....

(1)

(Total 4 marks)

16. D is proportional to S^2.

$D = 900$ when $S = 20$

Calculate the value of D when $S = 25$

$D =$ ....

(Total 4 marks)

17. M is directly proportional to L^3.

When $L = 2$, $M = 160$

Find the value of M when $L = 3$

....

(Total 4 marks)

18. Julie buys 19 identical calculators.
The total cost is £143.64

Work out the total cost of 31 of these calculators.

£ ....

(Total 3 marks)

19. r is inversely proportional to t.
$r = 12$ when $t = 0.2$

Calculate the value of r when $t = 4$.

……………………………
(Total 3 marks)

20. y is inversely proportional to x^2.

Given that $y = 2.5$ when $x = 24$,

(i) find an expression for y in terms of x

y = ...

(ii) find the value of y when $x = 20$

y = ...

(iii) find a value of x when $y = 1.6$

x = ...

(Total 6 marks)

21. The weight of a piece of wire is directly proportional to its length.

A piece of wire is 25 cm long and has a weight of 6 grams.
Another piece of the same wire is 30 cm long.

Calculate the weight of the 30 cm piece of wire.

…………………. grams
(Total 2 marks)

22. p is inversely proportional to m.
$p = 48$ when $m = 9$

Calculate the value of p when $m = 12$

....
(Total 2 marks)

23. P is inversely proportional to d^2.

$P = 10\ 000$ when $d = 0.4$

Find the value of P when $d = 0.8$

$P =$ ....

(Total 3 marks)

01. (i) 10 5

$8 \times \frac{5}{4}$

B1 for sight of $\frac{5}{4}$ *or* $\frac{4}{5}$ *or 2 or* $\frac{1}{2}$ *oe*
M1 for 8 × 1.25 oe
A1 cao

(ii) 4.8

$6 \times \frac{4}{5}$

M1 for 6 × 0.8 oe
A1 cao

[5]

02. (a) £5062.50 — 3

£12000 × 0.25 = £3000; £12000 – £3000 = £9000
£9000 × 0.25 = £2250; £9000 – £2250 = £6750
£6750 × 0.25 = £1687.50; £6750 – £1687.50 =

M1 for 12000 × 0.75 (= 9000) oe or £3000 or £23437.50 seen
M1 (dep) for at least two further depreciation calculations (complete steps)
A1 cao
***OR** M2 for $12000 \times (0.75)^3$ or 5062.50 seen*
(M1 for $12000 \times (0.75)^n$, n = 2 or 4)

(b) 0.4096 — 2

0.8 × 0.8 × 0.8 × 0.8 (oe)

M1 0.8^4 (oe)
A1 cao

[5]

03. (a) $S = \frac{8000}{f^2}$ — 3

$S = \frac{k}{f^2}$; $125 = \frac{k}{8^2}$; $k = 8000$

M1 for $S = \frac{k}{f^2}$
M1 for $125 = \frac{k}{8^2}$
A1 cao
These marks can be awarded if the full formula appears in part (b), rather than in part (a).
[SC: $S = \frac{125}{64}f^2$ M1 M0 A0, $S = 1.95(3125)f^2$ M1 M0 A0 $S = \frac{1000}{f}$ M1 M0 A0]

(b) 500 — 1

B1 cao

[4]

04. D
A
B
C 2

B2 for all correct
(B1 for any 2 correct)

[2]

05. (a) £ 9261 3

8000×1.05^3
8000, 8400, 8820, 9261, (9724.05)

M1 for $\frac{5}{100} \times 8000$ *or* $\frac{105}{100} \times 8000$ *oe or any one of the following seen: 400, 8400, 1200, 9200*
M1 (dep) complete method for 3 yrs compound interest
A1 cao
SC B2 for £ 1261 without working
OR
M1 for 8000×1.05^n *oe*
M1 for $n = 3$
A1 cao

(b) A 1

B1 cao

(c) £ 3700 3

3885 – 105 × 100

B1 for sight of 105 or 1.05
M1 for 3885 – 105 × 1 00
A1 cao

[7]

06. (a) 12.5 — 2

$\frac{CD}{5} = \frac{10}{4}$

B1 for sight of $\frac{10}{4}$ *or* $\frac{4}{10}$ *or 2.5 or 0.4 or 1.25 oe*
B1cao for 12.5

(b) 7.2 — 2

$4.8 \times 2.5 - 4.8$

M1 for 4.8 × "2.5" or sight of 12
A1 cao

[4]

07. 50 — 4

$T = kR^2$
$K = 32 - 120^2 = 0.\ 00222$
$T = 0.00222 \times 150^2$

M1 for $T = kR^2$ *for* $32 = k \times 120^2$
A1 for $32 = k \times 120^2$
M1 for $T = \text{'}\frac{32}{120^2}\text{'} \times 150^2$
A1 cao 50

[4]

08. (a) $d = 5t^2$ — 3

$d = kt^2$
$80 = k \times 4^2$

M1 for $d = kt^2$ *or* $d \propto t^2$
M1 sub d = 80 and t = 4 into their equation
A1 for $d = 5t^2$ *oe (cao)*

(b) 245 — 1

B1 ft from (a) using "k"

(c) 3 — 2

$45 = 5t^2$

M1 ft from (a) for substituting d = 45 into their equation
A1 for 3 cao (condone inclusion of – 3)

[6]

09. (a) $D = kt^2$

$30 = k(40)^2$

$k = 30/1600$ (= 0.01875)

$D = \frac{30}{1600}t^2$ — 3

M1 for $D = kt^2$ seen or implied ($k \neq 1$)
M1(dep) for substitution or sight of $k = 30/40^2$ oe
A1 for $D\ \frac{30}{1600}t^2$ oe
$k = 0.018(75)$ truncated or rounded

(b) $\frac{30}{1600} \times 64^2$

76.8 — 1

M1 for 'k' × 64^2 ($k \neq 1$) seen

(c) ($t^2 =$) 12 ÷ (30/1600)

$t = \sqrt{640} = 25.298...$

25.3 — 2

M1 for 12 ÷ 'k'($k \neq 1$)
A1 for 24.4 to 25.9 (ignore –25.3)

[6]

10. (a) $T = kM$

$k = \frac{600}{250}$

$T = \frac{600}{250} \times 400$

960 3

M1 for T = km or $\frac{600}{250} = \frac{T}{400}$ *oe*

M1 for (k=) $\frac{600}{250}$ *(=2.4) or (T =)* $400 \times \frac{600}{250}$

A1 cao

(b) $T = \frac{K}{P}$

$T = \frac{1400 \times 360}{900}$

560 3

M1 for $T = \frac{K}{P}$ *or* $\frac{T}{1400} = \frac{360}{900}$ *oe*

M1 for (K =) 1400 × 360 or 360 = $\frac{K}{1400}$ *or (K=) 504000 or*

(T =) $\frac{360 \times 1400}{900}$ *oe*

A1 cao

[6]

11. (a) $d = kt^2$ 3

$20 = k \times 2^2$

$d = 5t^2$

M1 for $d = kt^2$ *(accept any* $\mathbf{k} \neq 0, 1$*)*

M1 (dep) for $20 = k \times 2^2$

A1 for $d = 5t^2$

(b) 45 1

B1 for 45 cao

(c) $605 = 5t^2$ 3

$\sqrt{\frac{605}{5}}$

$= 11$

M1 for $605 = \text{“5”}\ t^2\ (\text{“5”} \neq 1)$

M1 for $\sqrt{\frac{605}{\text{"5"}}}$

A1 for 11 cao

[7]

12. (a) $8 \times \frac{10}{4} = 20$ 2

M1 $\frac{10}{4}$ or $\frac{4}{10}$ or 0.4 or 2.5 oe seen

A1 cao

NB ratios get M0 unless of the form 1:n

or

M1 $\frac{8}{4}$, $\frac{4}{8}$ oe seen

A1 cao

(b) $15 \times \frac{4}{10}$

6 2

M1 $15 \times \frac{4}{10}$ oe

A1 cao

[4]

13. (a) $T = kx$; $150 = 6k$; $k = 25$

$T = 25x$ 3

M1 for $T = kx$, k algebraic

M1 subs $T = 150$ and $x = 6$ into $T = kx^n$ ($n \neq 0$)

A1 for $T = 25x$ oe

SC B1 $T \propto 25x$ oe

(b) $T = 25 \times 15 =$
375 — 1
B1 ft on k, k ≠ 1

(c) $600 = 25x$; $x = 600 \div 25 = = 24$ — 1
B1 ft on k, k ≠ 1

[5]

14. $f = \frac{k}{d}$

$= 160$

$256 = \frac{k}{50}$

$k = 12800$

$f = \frac{'12800'}{80}$ — 3

M1 $f = \frac{k}{d}$

M1 $256 = \frac{k}{50}$ *(also implies first M1)*

A1 cao

or

M1 $50 \times 256 = f \times 80$

M1 $f = \frac{'12800'}{80}$

A1 cao

[3]

15. (a) $q = \frac{k}{t^2}$; $8.5 = \frac{k}{4^2}$

$k = 8.5 \times 4^2$; $k = 136$

$q = \frac{136}{t^2}$ 3

M1 $q = \frac{k}{t^2}$, $(k \neq 1)$

M1 $8.5 = \frac{k}{4^2}$

A1 cao

NB $q = \frac{k}{t^2}$ *in the answer line followed by k*

being found correctly anywhere in (a) or (b) earns all 3 marks

(b) q = "136" ÷ 5^2 = "136" ÷ 25

5.44 1

B1 ft for $\frac{'136'}{25}$ *oe*

[4]

16. $D = kS^2$

$900 = k \times 20^2$

$k = \frac{900}{400}$

$D = \frac{900}{400} \times 25^2$

= 1406.25 4

M1 $D = kS^2$

M1 $900 = k \times 20^2$ *(can imply first M1)*

A1 $k = \frac{900}{20^2}$ *(= 2.25)*

A1 for 1406.25 or $\frac{5625}{4}$

[4]

17. $M = kL^3$

$k = \frac{M}{L^3} = \frac{160}{8} = 20$

When $L = 3$, $M = 20 \times 3^3$

540 — 4

M1 for $M \propto L^3$ or $M = kL^3$
A1 $k = 20$
M1 for '20' $\times 3^3$
A1 for 540 cao

[4]

18. $143.64 \div 19 = 7.56$

$7.56 \times 31 = 234.36$ — 3

M1 for $143.64 \div 19$ (or 7.56 seen) or 143.64×31 (or 4452.84 seen)
M1(dep) for '7.56' $\times$ 31 or '4452.84' $\div$ 19
or $143.64 + 12 \times$ '7.56'
A1 for 234.36 cao accept 234.36p

Alternative method:

M1 for $\frac{31}{19}$ (or 1.63(1…) seen)
M1 (dep) '1.63…' $\times$ 143.64
A1 for 234.36 cao accept 234.36p

[3]

19. 0.6 oe — 3

$(r = \frac{k}{t} \rightarrow)\ 12 = \frac{k}{0.2}$

$k = 12 \times 0.2$

$r = \frac{"k"}{4}$

M1 for $12 = \frac{k}{0.2}$
M1 (dep) for $r = \frac{"k"}{4}$
A1

[3]

20. (i) $y = \frac{1440}{x^2}$ 3

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

$k = 2.5 \times 24^2 = 1440$

M1 for either $y \propto \frac{1}{x^2}$ *or* $y = \frac{k}{x^2}$ *seen or implied* $k \neq 1$

M1 (dep) $2.5 = \frac{k}{24^2}$ *oe or* $k = 1440$

A1 for $y = \frac{1440}{x^2}$ *(accept equivalents)*

(ii) 3.6 1

$y = \frac{1440}{20^2}$

B1 ft [ft on $y = kn^n$*, n integer,* $n \neq 0$*]*

(iii) 30 2

$x = \sqrt{\frac{1440}{1.6}}$

M1 for $x^2 = \frac{\text{"1440"}}{1.6}$ *or better*

A1 cao for 30 or –30

SC: for $y = kx^2$ *MIMIAO BIMOAO*

SC: for $y = \frac{k}{\sqrt{x}}$ *MIMIAO BOMIAO*

[6]

21. 7.2 2

$\frac{30}{25} \times 6$

M1 for $\frac{30}{25} \times 6$

A1 cao

[SC: B1 candidate obtains the formula $m = \frac{150}{l}$ *and uses it to get m = 5]*

[2]

22. 36 2

$48 = \frac{k}{9}$

$48 \times 9 \div 12$

*M1 for $48 \times 9 \div 12$ oe **or** $48 \times 9 = m \times 12$*
A1 cao
SC: B1 for 64 as final answer

[2]

23. $P = \frac{k}{d^2}$

$k = Pd^2 = 10000 \times 0.4^2 = 1600$

when $d = 0.8$, $P = \frac{1600}{0.8^2}$

2500 3

M1 $P = \frac{k}{d^2}$ or $P \propto \frac{1}{d^2}$
M1 $k = 10000 \times 0.4^2$
A1 2500 cao
OR
M1 $\frac{x}{10000} = \frac{0.4^2}{0.8^2}$
M1 $\frac{0.4^2}{0.8^2} \times 10000$
A1 2500 cao

[3]

01. **Paper 3**

Few candidates had any understanding of the use of scale factors in this question, nor of how similarity is related to enlargement. In part (a), a few candidates obtained the correct answer due to the way in which the corresponding sides can be intuitively linked. In part (b), it was rare to see any success. It is all too common to see candidates relating the sides by addition and subtraction, rather than multiplication.

Paper 6

This was a slightly unusual question in that it did not deal with similar triangles. Because the two shapes were separate and both in the same orientation most candidates who knew anything about similarity or enlargement were able to gain marks for the question, usually from part (i) as a minimum. A variety of methods was used involving ratios such as *FG/EH* and *BC/AD*. Candidates found *EF* more difficult to establish as this usually involved the ratio 5 : 4

02. Mathematics A

Paper 4

There was a great variation across centres. A significant number treated this as a simple interest question, as evidenced by many answers of £3000 or £9000. As with previous numerical questions, there were many instances this year of candidates attempting this question using non-calculator methods. It is also disappointing that many candidates wrote their answers without consideration to money notation: missing off the trailing zero. This even applied to many of the brightest candidates. Part (b) was rarely attempted. Frequently 0.8 or 0.2 were seen on the answer line, earning no marks.

Paper 6

Part (a) was successfully answered – either by taking of successive 25% or (less commonly) by using the formula. Very few candidates thought that £3000 had to be taken off each year. Part (b) was less successfully done with many answers of 0.2 or 0.2^4.

Mathematics B Paper 17

The majority of candidates were able to accurately calculate 25% of £12000 and use this value appropriately to find the value after one year. Many continued to subtract £3000 for each subsequent year, although many candidates did proceed to compute a correct final value.
Part (b) was poorly done with only a small minority quoting 0.8^4 and even less evaluating this.

03. Mathematics A Paper 6

This was a standard direct proportion question and the answers showed the range of understanding of the ideas. There were many correct solutions, but still, many candidates could not progress past the proportionality sign. Many candidates either failed to register or failed to understand the significance of ‘ square’ or ‘inversely’.

Mathematics B Paper 19

This question was poorly answered by the majority of candidates. Those candidates who were able to write down an initial equation correctly, went on to score full marks. The most common error was to assume direct proportion and to start with $S = \mathrm{k}f$.

04. This was a well understood question with 50% of candidates obtaining the correct solution and a further 30% gaining partial credit.

05. Paper 4

Even though the question clearly indicated that a compound approach was necessary, the majority of candidates demonstrated a simple interest approach, indicating their weakness in not understanding compound methods. Over 30% of candidates answered part (b) correctly, B and C being common incorrect answers. Many chose to show little working out. Most candidates treated part (c) as a normal percentage problem, and earned no marks as a result. Some credit was given to those who did realise the significance of 105. Trial and error methods appeared again in this question, where candidates attempted to work backwards. These methods were not successful.

Paper 6

Compound interest has almost become a fixture in Higher Tier examinations and this series was no different. The majority of candidates at this level tackled this part via the formula approach and calculated 8000×1.05^3 to achieve the correct answer of £ 9261. Other candidates calculated the interest step by step for each year and were also successful. Very few candidates thought this was a simple interest problem.
Part (b) involved identification of the graph which was the most representative of compound interest growth. This was well done.
Part (c) was a standard reverse percentage question where the method is to find 100% given that 105% = £ 3885. Many candidates were able to recognise the given problem as such and could go on to get the correct answer of £ 3700. Sadly, many candidates found 5% of £ 3885 and subtracted this off the £ 3885.

06. Paper 4

This question commonly appears on the Intermediate paper, yet this time is was very badly done, one of the worst attempted questions on the paper, with nearly 95% of candidates achieving no marks on either part. It was rare to see a correct scale factor. Most jumped straight into the incorrect method of adding and subtracting values between the two triangles.

Paper 6

Although these questions are standard the response to them was not as successful as we may have hoped. There was a great deal of confusion in what was the appropriate scale factor, especially in part (a), where the answer 7.5 was frequently seen. All the candidates who drew the two triangles themselves as separate shapes got the correct answers to both parts.

07. This question was a little more open ended than previous ones. Candidates were not instructed to find a formula, so had to decide what was the best method to achieve the answer. Most good candidates did use the formula approach and got the correct answer of 50. Some lost an accuracy mark through premature approximation. A few candidates were able to use the multiplier method successfully from $32 \times \frac{150^2}{120^2}$ they also were awarded full marks.
As ever, weaker candidates treated this as a problem of direct proportion and got no marks for 40.

08. Specification A

This question was not done well. Most candidates ignored 'square' in the question and produced answers involving only direct proportion.
In part (a), very few candidates started their answer with a suitable equation involving a constant of proportionality- this often appeared, if at all, at the end of a calculation. Some calculated a constant but did not combine this with the d and t^2 to produce a final equation. Many candidates were able to score a mark in part (b) and a mark in part (c) for a correct continuation using their equation from part (a).

Specification B

Candidates met with mixed success in this question. Those candidates who were able to write down a correct proportionality statement were generally able to go to score full marks. Too many candidates, however, misread the question and assumed that the quantities given were in direct proportion with each other. These candidates gained some marks but, as the question had been simplified, not full marks. Some inaccurate arithmetic was seen. A common error in part (a) was to give t in terms of d.

09. Many candidates ignored 'square' in the question and produced answers involving only direct proportion. In part (a), only the best candidates started their answer with a suitable equation involving a constant. Some found the constant correctly but did not combine this with the D and t^2 to produce a final equation. Many candidates unable to gain full credit in (a) often gained some credit in (b) and (c) for a correct method.

10. Specification A

Many candidates were able to score some marks in part (a). The most popular method was to use $T = km$ to find $k = \frac{600}{250}$. A common mistake here was to evaluate this as 2.5 or 2.2. For candidates attempting to compare ratios without the use of k, i.e. by $\frac{T}{400} = \frac{600}{250}$, poor presentation often led to rearrangement errors. Candidates were less successful in part (b). Less than half were able to make a start on this question, and those that could went on to make errors in calculation. Common errors included evaluating 360 × 1400 as 50400, dividing 504000 by 900, and starting the question as $T = \frac{P}{K}$. A few candidates attempted to answer this part as an inverse square relation.

Specification B

The arithmetic in this question caused problems for even very good candidates. Few candidates left their value for the constant in part (a) as a fraction and used this to multiply by 400 to obtain the answer. The incorrect evaluation of 600 ÷ 250 meant that many candidates lost the final accuracy mark. A significant number of those who evaluated this correctly as 2.4 then incorrectly evaluated 2.4 × 400 as 900. The same problems occurred in part (b) with incorrect multiplication or division resulting in candidates losing the final accuracy mark. In both parts, candidates able to show a fully correct method were able to gain 2 of the 3 available marks. Many candidates used direct proportion for both parts and it was common to see (b) written as T = P/k. It was disappointing to see most candidates doing long multiplication then a division sum to obtain their answer rather than cancelling down. Much incorrect cancelling was seen. For example, a numerator cancelled with a denominator across an = sign or cancelling of numbers which were to be multiplied.

11. The mean mark for this question was about 50% with the majority of the marks occupying zero or 7 (full marks). Most candidates who could start by formulating the model in the form $d = kt^2$ were able to go on and give a complete solution. A few got full marks for the first 2 parts but then spoilt things by changing $605 = 5t^2$ to $600 = t^2$.

12. **Higher Tier**

This was generally well answered. When working was shown it tended to be to display the use of a scale factor of $\frac{10}{4} = 2.5$ in both parts, where the availability of a calculator made part (b) fairly accessible.

Intermediate Tier

This was the worst question on the paper for which little working was shown, if any. The most common mistake was to add for the enlargement and to subtract for the reduction, giving answers of 14 and 9. An assumption of a factor of 2 in part (a) sometimes led to an incorrect answer of 7.5 in part (b).

13. This was a relatively straightforward question of its kind and many candidates were thus able to score all 5 marks. Some candidates were able to complete parts (b) and (c) even if they scored 0 for part (a). There were still some candidates who misuse the proportionality sign and write $T \propto kx$ throughout.

14. Candidates who started with the correct formula $f = \frac{k}{d}$ generally gained full marks. Many candidates treated the problem as if it were direct proportion and scored no marks. A few candidates used formulae involving d^2.

15. Proportionality laws are ubiquitous in science so it is not surprising that they get tested frequently at the higher level. Many candidates had the correct idea of writing the relationship as a formula involving a constant of proportionality k and then using the given information to find the value of *k*. After that, completing the question was straightforward, There were a few candidates who overlooked the word 'inverse' and changed the problem substantially. There were also many who answered the question for q directly proportional to t^2 or inversely proportional to *t*, or $\sqrt{t}$. Common wrong answers were $2t + 0.5$, $2.125t$ and $q = 34/t$

16. Very few pupils started from $D = kS^2$ with only 17% of candidates gaining full marks, but those who did generally got the correct answer. The most common answer seen was 1125 which was arrived at by a variety of incorrect methods.

17. There were an encouraging number of fully correct answers. A large number of candidates, however, took *M* to be proportional to *L* instead of L^3 which resulted in 240 being the most common incorrect answer. Those who managed to get as far as $k = 20$ usually managed to complete the question successfully but it was not uncommon to see $20 \times 3^3 = 20 \times 9 = 180$. Some candidates incorrectly evaluated 2^3 as 8.

18. **Specification A**

This was generally answered correctly, with most candidates using two steps, first dividing by 19 and then multiplying by 31. Sometimes candidates resorted to an unnecessarily complicated method no doubt taught for situations when calculators are prohibited, e.g. find the cost of one, then 20, then thirty, and then add 1 more. Finding the cost of 1, then 12, then adding on was also quite popular.

Unfortunately the more steps that were involved the more mistakes and rounding errors that appeared. However by far the greatest source of mark loss in this question, was in misreads and transcription errors, 13 used instead of 31 being the most common.

Specification B

A well answered question with the vast majority of candidates who were very comfortable using the unitary method. A few unorthodox approaches were also seen involving the idea of 19 + 12 or 38 – 7. A few candidates when for halving, presumably under the misapprehension that 19 + 8 + 4 gives 31 – which it does, but 8 is not half of 19. They got no marks.

19. The majority of candidates used direct proportion rather than inverse proportion as stated in the question. Thus, 240 was a common incorrect answer. Candidates should continue to be encouraged to read the question carefully, to note the word ‘inversely’ and start with an appropriate formula for *r* in terms of *k* and *t*.

20. Candidates attempting this question often failed to appreciate the meaning of the word ‘inverse’. $y = kx^2$ or $y = \frac{k}{\sqrt{x}}$ were common incorrect starting points for some candidates. Those candidates who started correctly with $y = \frac{k}{x^2}$ frequently went on to score full marks.

21. Premature approximation was very common which, in many cases, displayed a lack of understanding on how to deal with a recurring decimal at an intermediate stage of a calculation. Those candidates who wrote down the full expression to be evaluated before resorting to the calculator were generally more successful.

22. Just under half of all candidates were able to gain some credit for their answer to this question. Although a significant number of candidates used direct rather than inverse proportion to produce their solution. Those candidates who used inverse proportion were frequently let down by their arithmetic skills and many were unable to cope with 432 ÷ 12.

23. Most candidates did not have a clear idea of completing this unstructured question. The most successful approach came from candidates who started with $P = \frac{k}{d^2}$ and then went on to find the value of *k*. They usually completed the question to get the correct answer of 2500. A few candidates tried to deal with the squares directly without finding an algebraic formula. Many of these were just confused and completed the question by multiplying by 4 rather than dividing by 4 presumably from considering the problem as one of direct proportion.