Edexcel GCSE

Mathematics

Higher Tier

Number:

Approximation and estimation

Information for students

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 17 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 “Approximation and estimation” 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.

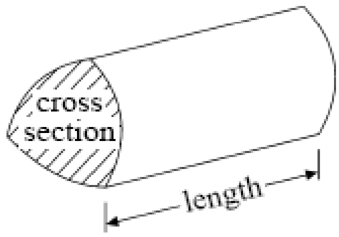
GCSE Mathematics

Formulae: Higher Tier

You must not write on this formulae page.

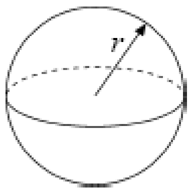
Anything you write on this formulae page will gain NO credit.

Volume of prism = area of cross section × length



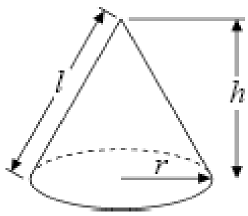
Volume of sphere $\frac{4}{3}\pi r^3$

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

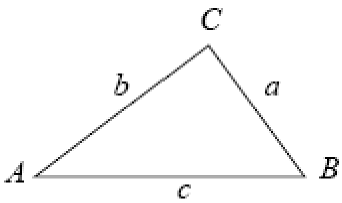


Volume of cone $\frac{1}{3}\pi r^2 h$

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 = $\frac{1}{2}ab \sin C$

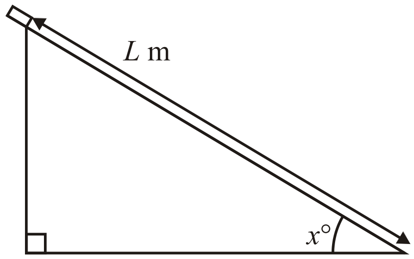
The Quadratic Equation

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.



Elliot did an experiment to find the value of g m/s^2, the acceleration due to gravity.
He measured the time, T seconds, that a block took to slide L m down a smooth slope of angle x°.

He then used the formula $$g = \frac{2L}{T^2 \sin x°}$$

to calculate an estimate for g.

T = 1.3 correct to 1 decimal place.
L = 4.50 correct to 2 decimal places.
x = 30 correct to the nearest integer.

(a) Calculate the lower bound and the upper bound for the value of g.
Give your answers correct to 3 decimal places.

Lower bound ....

Upper bound ....

(4)

(b) Use your answers to part (a) to write down the value of g to a suitable degree of accuracy. Explain your reasoning.

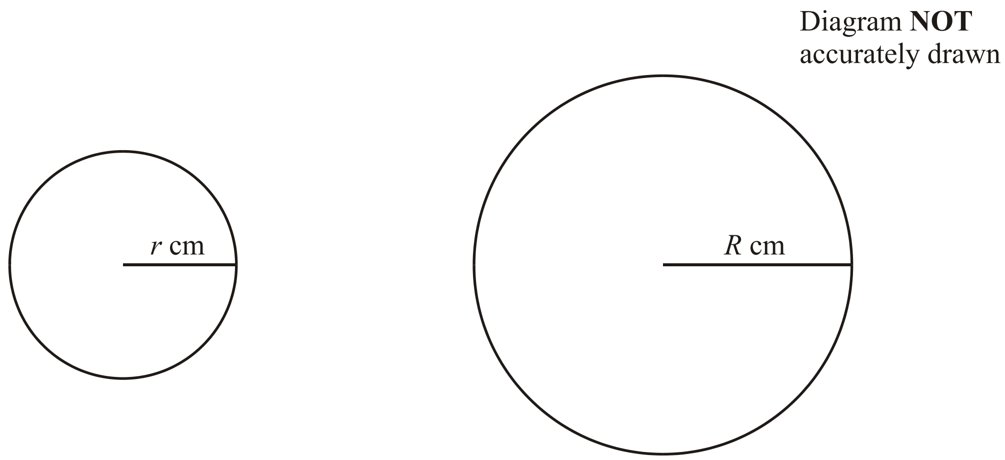
....

....

....

(1)
(Total 5 marks)

2.



The diagram represents two metal spheres of different sizes.

The radius of the smaller sphere is r cm.
The radius of the larger sphere is R cm.

$r = 1.7$ correct to 1 decimal place.

$R = 31.0$ correct to 3 significant figures.

(a) Write down the upper and lower bounds of r and R.

Upper bound of r = ……………………………….

Lower bound of r = ……………………………….

Upper bound of R = ……………………………….

Lower bound of R = ……………………………….

(2)

(b) Find the smallest possible value of $R - r$.

…………………………….

(1)

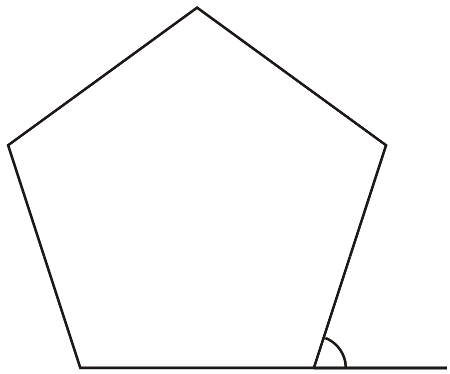
The larger sphere of radius R cm was melted down and used to make smaller spheres of radius r cm.

(c) Calculate the smallest possible number of spheres that could be made.

....

(4)
(Total 7 marks)

3.



(a) Work out the size of an exterior angle of a regular pentagon.

..........................°

(2)

The area of the pentagon is 8560 mm^2.

(b) Change 8560 mm^2 to cm^2.

.... cm^2

(2)

Each side of another regular pentagon has a length of 101 mm, correct to the nearest millimetre.

(c) (i) Write down the **least** possible length of each side.

.... mm

(ii) Write down the **greatest** possible length of each side.

.... mm

(2)

(Total 6 marks)

4. Martin won the 400 metre race in the school sports with a time of 1 minute.
The distance was correct to the nearest centimetre.
The time was correct to the nearest tenth of a second.

(a) Work out the upper bound and the lower bound of Martin's speed in km/h.
Give your answers correct to 5 significant figures.

Upper bound .... km/h

Lower bound .... km/h

(5)

(b) Write down an appropriate value for Martin's speed in km/h.
Explain your answer.

....

....

(1)

The table shows the number of people in each age group who watched the school sports.

Age group	0 – 16	17 – 29	30 – 44	45 – 59	60 +
Number of people	177	111	86	82	21

Martin did a survey of these people.
He used a stratified sample of exactly 50 people according to age group.

(c) Work out the number of people from each age group that should have been in his sample
of 50.
Complete the table.

Age group	0 – 16	17 – 29	30 – 44	45 – 59	60 +	Total
Number of people in sample						

(3)
(Total 9 marks)

5. The time period, T seconds, of a pendulum is calculated using the formula

$$T = 6.283 \times \sqrt{\frac{L}{g}}$$

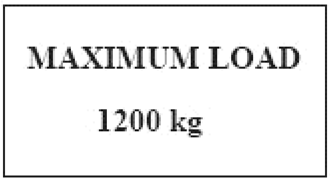
where L metres is the length of the pendulum and g m/s^2 is the acceleration due to gravity.

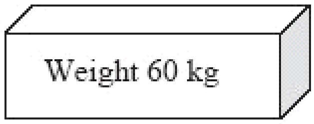
L = 1.36 correct to 2 decimal places.
g = 9.8 correct to 1 decimal place.

Find the difference between the lower bound of T and the upper bound of T.

....
(Total 5 marks)

6.





Peter transports metal bars in his van.

The van has a safety notice “Maximum Load 1200 kg”.

Each metal bar has a label “Weight 60 kg”.

For safety reasons Peter assumes that

1200 is rounded correct to 2 significant figures

and 60 is rounded correct to 1 significant figure.

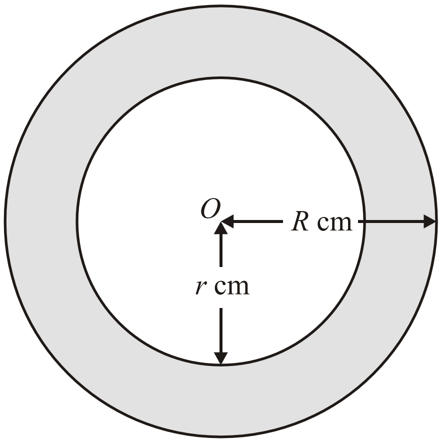
Calculate the greatest number of bars that Peter can **safely** put into the van if his assumptions are correct.

....

(Total 4 marks)

7. The diagram shows two circles.

Diagram **NOT** accurately drawn



O is the centre of both circles.
The radius of the outer circle is *R* cm.
The radius of the inner circle is *r* cm.
R = 15.8 correct to 1 decimal place.
r = 14.2 correct to 1 decimal place.

(a) John says that the minimum possible diameter of the inner circle is 28.35 cm.
Explain why John is wrong.

....

....

....

(2)

The upper bound for the area, in cm^2, of the shaded region is $k\pi$.

(b) Find the **exact** value of *k*.

k = ...

(4)
(Total 6 marks)

8. The length of a rectangle is 6.7 cm, correct to 2 significant figures.

(a) For the length of the rectangle write down

(i) the upper bound,

.....................................cm

(ii) the lower bound.

.....................................cm

(2)

The area of the rectangle is 26.9 cm^2, correct to 3 significant figures.

(b) (i) Calculate the upper bound for the width of the rectangle.
Write down all the figures on your calculator display.

.....................................cm

(ii) Calculate the lower bound for the width of the rectangle.
Write down all the figures on your calculator display.

.....................................cm

(3)

(c) (i) Write down the width of the rectangle to an appropriate degree of accuracy.

.....................................cm

(ii) Give a reason for your answer.

....
.

(2)
(Total 7 marks)

9. Kelly runs a distance of 100 metres in a time of 10.52 seconds.

The distance of 100 metres was measured to the nearest metre.
The time of 10.52 seconds was measured to the nearest hundredth of a second.

(a) Write down the upper bound for the distance of 100 metres.

.... metres

(1)

(b) Write down the lower bound for the time of 10.52 seconds.

.... seconds

(1)

(c) Calculate the upper bound for Kelly's average speed.
Write down all the figures on your calculator display.

.... metres per second

(2)

(d) Calculate the lower bound for Kelly's average speed.
Write down all the figures on your calculator display.

.... metres per second

(2)
(Total 6 marks)

10. A clay bowl is in the shape of a hollow hemisphere.

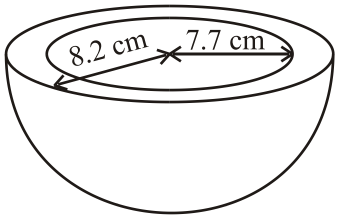


Diagram **NOT** accurately drawn

The external radius of the bowl is 8.2 cm.
The internal radius of the bowl is 7.7 cm.
Both measurements are correct to the nearest 0.1 cm.

The upper bound for the volume of clay is $k\pi$ cm^3.
Find the exact value of k.

k = ………………………..

(Total 4 marks)

11. A field is in the shape of a rectangle.

The length of the field is 340 m, to the nearest metre.
The width of the field is 117 m, to the nearest metre.

Calculate the upper bound for the perimeter of the field.

.... m
(Total 2 marks)

12. Correct to 2 significant figures, the area of a rectangle is 470 cm^2.
Correct to 2 significant figures, the length of the rectangle is 23 cm.

Calculate the upper bound for the width of the rectangle.

…………………………. cm
(Total 3 marks)

13.

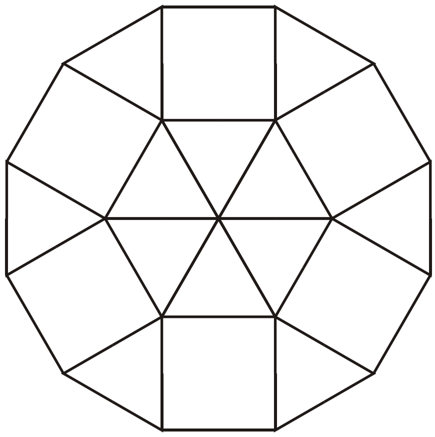


Diagram **NOT** accurately drawn

This 12-sided window is made up of squares and equilateral triangles.
The perimeter of the window is 15.6 m.

Calculate the area of the window.
Give your answer correct to 3 significant figures.

.... m^2
(Total 6 marks)

14. Work out $\dfrac{\sqrt{2.56 + \sin 57^\circ}}{8.765 - 6.78}$

(a) Write down all the figures on your calculator display.

…………………….

(2)

(b) Give your answer to part (a) to an appropriate degree of accuracy.

…………………….

(1)
(Total 3 marks)

15. The length of a rectangle is 6.7 cm, correct to 2 significant figures.

(a) For the length of the rectangle write down

(i) the upper bound,

…………………….cm

(ii) the lower bound.

…………………….cm

(2)

The area of the rectangle is 26.9 cm^2, correct to 3 significant figures.

(b) (i) Calculate the upper bound for the width of the rectangle.
Write down all the figures on your calculator display.

…………………….cm

(ii) Calculate the lower bound for the width of the rectangle.
Write down all the figures on your calculator display.

…………………….cm

(3)

(c) Write down the width of the rectangle to an appropriate degree of accuracy.

…………………….cm

(1)
(Total 6 marks)

16. Use your calculator to work out the value of $\sqrt{7.08^2 - 6.57^2}$

(a) Write down all the figures on your calculator display.

....
(2)

(b) Write your answer to part (a) correct to 2 significant figures.

....
(1)
(Total 3 marks)

17. What is 23 860.868 written correct to two significant figures?

24 000	24	2 386.86	23 860.87	23 000
A	**B**	**C**	**D**	**E**

(Total 1 mark)

01. (a) 9.719
11.710 4

$$g_L = \frac{2 \times 4.495}{1.35^2 \times \sin 30.5}$$

$$g_u = \frac{2 \times 4.505}{1.25^2 \times \sin 29.5}$$

B2 for any 4 of 4.505, 1.25, 29.5, 4.495, 1.35, 30.5 seen
(B1 for any two or three seen)
B1 for 11.710 – 11.7103
B1 cao 9.719 – 9.71904

(b) 10 1

Round, until lower and upper bounds agree
B1 for 10 + reason " they agree to this level of accuracy"

[5]

02. (a) 1.75
1.65
31.05
30.95 2
B2 all correct
Or B1 for 2 or 3 correct

(b) 29.2 1

"30.95" – 1.75
B1 ft on values in (a)

(c) 5531 4

Minimum volume of bigger sphere = $\frac{4}{3} \times \pi \times$ "30.95^3" = …..

Maximum volume of smaller sphere = $\frac{4}{3} \times \pi \times$ "1.75^3" =

M1 for correct substitution of his/her "30.95" or "1.75" into $\frac{4\pi}{3}r^3$
A1 for either 124122 – 124201 or 22.4379 – 22.4542
M1 (dep) for his/her min big vol ÷ his/her max little vol
A1 cao

[7]

03. (a) 72 2

360 ÷ 5

M1 for 360 ÷ 5 oe
A1 for 72

(b) 85.6 2

8560 ÷ (10 × 10)

M1 for 8560 ÷ (10 × 10) oe
A1 for 85.6

(c) (i) 100.5 2

Least length = 100.5

B1 for 100.5

(ii) 101.5

Greatest length = 101.5

B1 for 101.5 or 101.499 or better

[6]

04. (a) 24.020
23.980 5

400.005 ÷ 59.95 = 6.672310
6.672310 ÷ 1000 × 3600 = 24.02032
399.995 ÷ 60.05 = 6.661032
6.661032 ÷ 1000 × 3600 = 23.97972

B1 for 400.005 or 59.95 seen oe
M1 for "400.005" ÷ "59.95" where "400.005" $\in$ [400.005,400.5] and "59.95" $\in$ [59.5,59.95] oe
B1 for 399.995 or 60.05 seen oe
M1 for "399.995" ÷ "60.05" where "399.995" $\in$ [399.5,399.95] and "60.05" $\in$ [60.05,60.5] oe
A1 23.979-23.980 and 24.020-24.0204

(b) 24.0 because to 1dp the answers are the same 1
B1cao for 24.0 with reason

(c) 18
12
9
9
2 3

177 × 50/477 = 18.553 → 19 → 18
111 × 50/477 = 11.635 → 12
86 × 50/477 = 9.0147 → 9
82 × 50/477 = 8.595 → 9
21 × 50/477 = 2.201 → 2

M1 for $\frac{50}{"477"} \times 177$ *or 111 or 86 or 82 or 21*
A1 for all integers or better answers, at least 3 correct
A1 cao

[9]

05. 0.021 5

$T_{ub} = 6.283\sqrt{\frac{1.365}{9.75}} = 2.351$

$T_{lb} = 6.283\sqrt{\frac{1.355}{9.85}} = 2.330$

B1 for either 1.365 or 1.355 seen
B1 for either 9.75 or 9.85 seen
M1 for a correct expression for either max T or min T.
$1.36 < L_{max} \le 1.37$, $1.35 \le L_{min} < 1.36$
$9.8 < g_{max} \le 9.9$, $9.7 \le g_{min} < 9.8$
A1 for either $6.283\sqrt{\frac{1.365}{9.75}}$ *(= 2.351)*
or $6.283\sqrt{\frac{1.355}{9.85}}$ *(= 2.330)*
A1 for 0.02 – 0.021 cwo

[5]

06. 17 4

Lower bound of 1200 is 1150
Upper bound of 60 is 65
1150 ÷ 65

B1 for 1150 or 1250 seen
B1 for 65 or 55 seen
M1 (Lower bound of load) ÷ (Upper bound of weight)
Where 1150 ≤ LB load < 1200 and
60 < UB Weight ≤ 65
A1 for 17 requires fully correct working
OR
B1 for 1150 or 1250 seen
B1 for 65 or 55 seen
M1 (upper bound of load) ÷ (lower bound of weight)
Where 1200 ‹ UB load ≤ 1250 and 55 ≤ LB weight < 60
A1 for 22 requires fully correct working
OR
M2 1200 ÷ 55
A1 21.8
A1 21 requires fully correct working
OR
M2 1200 ÷ 65
A1 18.4(6)
A1 18 requires fully correct working

[4]

07. (a) 'minimum possible diameter is twice minimum possible radius' oe
minimum possible diameter = 2 × 14.15 = 28.3 cm 2

M1 for 'minimum possible diameter is twice minimum possible radius' or 2 × 14.15 seen
A1 for 28.3 cao

(b) **upper bound**, in cm, for radius of outer circle is 15.85
lower bound, in cm, for radius of inner circle is 14.15

area, in cm^2, of shaded region
$= \pi R^2 - \pi r^2$
$= \pi(15.85)^2 - \pi(14.15)^2$
$= 51\pi$
$k = 51$ 4

B1 for 15.85 or 789.2(3...) seen
B1 for 14.15 or 629.0(1...) seen
M1 for using $\pi R^2 - \pi r^2$
A1 cao (accept final answer left as 51π)

[6]

08.	(a)	(i)	6.75 *B1 cao*	1
		(ii)	6.65 *B1 cao*	1
	(b)	(i)	26.95 ÷ 6.65 4.05263 *M1 for "26.95" ÷ "6.65" where 26.9 < "26.95" ≤ 26.95 and* *6.65 ≤ "6.65" < 6.7* *A1 for 4.05263 (....)*	3
		(ii)	26.85 ÷ 6.75 3.97778 *If M1 not earned in (i), then M1 for '26.85'÷'6.75' where 26.85 ≤ '26.85' < 26.9 and 6.7 < '6.75' ≤ 6.75* *A1 for 3.9777 (.....)*	
	(c)	(i)	4 *B1 cao*	2
		(ii)	bounds agree to 1sf *B1 for appropriate reason for 4*	

[7]

09. (a) 100.5 1

B1 cao

(b) 10.515 1

B1 cao

(c) $\frac{100.5}{10.515} = 9.5577746$ 2

M1 for greatest distance divided by least time
Where 100 < greatest distance ≤ 100.5, 10.51 ≤ least time < 10.52
A1 for 9.555 – 9.56

(d) $\frac{99.5}{10.525}$

9.45368.. 2

M1 for least distance divided by greatest time
Where 99.5 ≤ least distance < 100, 10.52 < greatest time ≤ 10.53
A1 for 9.45 – 9.455

[6]

10. 75.879

$\frac{1}{2} \times \frac{4}{3}\pi \times 8.25^3 - \frac{1}{2} \times \frac{4}{3}\pi \times 7.65^3$

$= (374.34375 - 98.46475)\pi$

$= 75.879\pi$ 4

B1 for 8.25 or 7.65 seen
M1 for expression using r = 8.25 minus same expression using r = 7.65
M1 for $\frac{1}{2} \times \frac{4}{3}\pi \times R^3 - \frac{1}{2} \times \frac{4}{3}\pi \times r^3$ *used*
A1 cao

[4]

11. 916 2

$2 \times 340.5 + 2 \times 117.5$

M1 for sight of 340.5 or 117.5 OR 340.499… OR 117.499…
A1 cao for $915.996 \le ans \le 916$

[2]

12. 21.111… 3

$475 \div 22.5$

B1 for 475 or 22.5 seen
M1 for $\frac{A}{L}$ where $480 \ge A > 470$ and $22 \le L < 23$
A1 for 21.1(111…)

[3]

13. 18.9…. 6

Each side = $15.6 \div 12 = 1.3$

“1.3”^{2} “0.65”^{2} + h^2

$h = \sqrt{(1.3^2 - 0.65^2)} = \sqrt{1.2675}$

Area $\Delta = \frac{1}{2} \times$ “1.3” $\times$ “$\sqrt{1.2675}$“

= 0.73179…

$6\square + 12\Delta$ = “10.14” + “8.781…”

= 18.9215…

M1 for $15.6 \div 12$ (= 1.3)
M1 for “1.3”^{2} = “0.65”^{2} + h^2 or $\sin 60 = \frac{h}{"1.3"}$ oe
or (h^2 =) “1.3”^{2} – “0.65”^{2}
M1 (dep) for (h =) $\sqrt{(1.3^2 - 0.65^2)} = \sqrt{1.2675}$
or (h =) “1.3” × sin 60 (= 1.12583…)
M1 (dep) for area of triangle = ½ × “1.3” × “h”
M1 (indep) for 6 × “area of square” (= 10.14…) + 12 ×”area of triangle” (= 8.78…)
A1 for $18.9 \le ans \le 19.0$

[6]

14. (a) $\frac{\sqrt{3.39...}}{1.985} = \frac{1.84...}{1.985}$

0.9287… — 2

B2 for 0.9287(397....)
(B1 for sight of 3.39(....) ***or*** *1.84(....)* ***or*** *1.985)*

(b) 0.93 — 1

B1ft (indep) for writing "0.9287..." correct to 2, 3 or 4 sig figs

[3]

15. (a) (i) 6.75 — 1

B1 cao

(ii) 6.65 — 1

B1 cao

(b) (i) 26.95 ÷ 6.65

4.05263 — 3

M1 for "26.95" ÷ "6.65" where $26.9 <$ "26.95" ≤ 26.95 and $6.65 \leq$ "6.65" < 6.7
A1 for 4.05263 (....)
If M1 not earned in (i), then M1 for "26.85" ÷ "6.75" where $26.85 \leq$ "26.85" < 26.9 and $6.7 <$ "6.75" ≤ 6.75

(ii) 26.85 ÷ 6.75

3.97778

A1 for 3.9777 (.....)

(c) bounds agree to 1sf

4 — 1

B1 cao

[6]

16. (a) $50.1264 - 43.1649 = 6.9615$ 2

$\sqrt{6.9615} =$

2.638465….

B2 for 2.638465… accept 2.6384….
(B1 for 6.9615)

(b) 2.6 1

B1 ft

[3]

17. A

[1]

01. Many candidates were able to get half marks by identifying the upper and lower bounds on the individual variables correctly. Very few went on to score full marks for the correct combinations of the individual upper and lower bounds.

02. Candidates benefited somewhat from the structure of the question. However, many candidates got the upper and lower bounds of *R* wrong, most often giving 30.5 and 31.5. Many got part (b) correct on follow-through.
In part (c), there was a great deal to unpack. The candidates had to choose the correct formula for the volume using their lower bound and then dividing by the volume using their upper bound and then rounding down. Most found it difficult to earn full marks.

03. Mathematics A Paper 3

In part (a), there seemed to be considerable confusion about whether interior or exterior angles sum to 360°. Many of those who worked out 360 ÷ 5 then spoilt their method by subtracting the result of this calculation from 180°. Less than 15% of candidates answered part (b) correctly as the majority chose to divide 8560 by 10. Even some of those candidates who divided by 100 did not obtain 85.6. In part (c) candidates had most success with the lower bound. The concept of upper bound was not well understood and the majority of candidates gave a number below 101.5, such as 101.4 or 101.49.

Mathematics B Paper 16

In part (a) many candidates correctly worked out 360/5 but then subtracted from 180, giving an answer of 108°, showing a lack of understanding of interior and exterior angles of a polygon. Only a quarter of the candidature gained full marks in this part. The success in part (b) showed a marked improvement on last year but still only a minority (16%) dividing by 100; the vast majority dividing by 10 to give 856 cm^2.
Part (c) 35% correctly identified the least value as 100.5mm, but only 12% gained the mark for the greatest possible length.

04. Mathematics A Paper 6

Parts (a) and (b) proved to be difficult for candidates to score full marks on because of the hard upper and lower bounds for the distance. Also for the conversion from metres per second to kilometres per hour was difficult. Nevertheless candidates were awarded marks if they had any two of the bounds correct and a further two method marks if they had carried out a division with the candidates own upper and lower bounds. Candidates were much more successful on part (c), where they generally succeeded in scoring at least two marks. Often the third mark was lost because of inappropriate rounding to give 19 for the first class interval instead of 18.
Some candidates confused 'stratified' with systematic and found 477/50 = 9.54 and so concluded that they had to select every 10^{th} person. This gives answers very close to the required stratified ones but deserves no marks.

Mathematics B Paper 19

The most common error in this question was to give the bounds as 400.5, 399.5, 60.5 and 59.5. Only a few candidates realised that, in order to obtain the upper bound, it was necessary to use the upper bound for the distance and the lower bound for the time. In part (b) the majority of candidates justified their answers by referring to the mean of the upper and lower bound rather than looking to see the accuracy to which their answers agreed. Part (c) was answered more successfully with many fully correct answers seen. A common error was to misread 177 as 117 and so obtain a total of 417. Some candidates failed to check that their total, once rounded, came to 50. Of those who did, many adjusted the value for the 45-59 age group rather than the 0-16 age group.

05. This question was relatively well answered. The numbers for upper and lower bounds were more accessible and most candidates were able to gain marks on these. The next key step was to evaluate the values of T. The upper bound of T is obtained from the upper bound of l divided by the lower bound of g. Many candidates were able to do this and go on to get the correct answer. Errors included using upper and lower bounds wrongly in the expression and to omit the evaluation of the square root. Candidates who used 6.2835 and 6.2825 appropriately were not penalised.

06. The intention of this question was to put a lower bound question in a practical context. The expected approach was to divide the lower bound of the allowed load by the upper bound of the weight and then round down (to 17). However, it was decided that an interpretation based on the upper bound of the load could be allowed. Consequently, the approach which divided the upper bound of the load by the lower bound of the weight and rounding down was also allowed. Which calculation was followed appears to depend on the interpretation of the word 'can' as one case 'is possible' and in the other case as 'is allowed to'.
Many candidates could not write down the appropriate correct bounded and of those that did many then calculated the upper bound of the load divided by the upper bound of the weight.

07. This question was generally done well by able candidates. Most had some appreciation of upper and lower bounds and could apply it in context. In part (a), candidates generally gave a clear method to find the minimum diameter. In part (b), many could apply $\pi R2^2 - nr^2$ to find the area, but some did not choose appropriate values for R and r. Common errors were $R = 15.8$, $r = 14.2=$ and $R = 15.85$, $r = 14.25$.

08. Most candidates were able to identify the correct upper and lower bounds. There were a few 6.74s for (i) and also a few 6 974. □□s. Responses to part (b) were not generally correct, the main error being that candidates used 26.9 rather than the upper and lower bounds of the 26.9. Of these candidates that did recognise this, most were successful in pairing up the correct upper and lower bounds in the quotient.

09. As a whole the question was poorly done. Candidates had some difficulty with part (b) because of the unusualness of the degree of accuracy.

In part (c), many candidates did not take the hint given in parts (a) and (b) and use those values to work out the answer to part (c). Some candidates did not have the correct formula for speed, distance and time and ended up with Kelly running at speeds in excess of 1000 metres per second.

10. Only the most able candidates obtained the correct answer to this demanding question. Many average candidates gained a mark for either a correct bound or for use of a correct formula. Common method errors included using the given values rather than the values for bounds or using 0.5cm as the radius of a hemisphere. Candidates also failed to divide the volume of the sphere by 2. Candidates seldom left □ in their calculation, preferring to evaluate the volume fully and then divide by □ in the final step. Unfortunately, the majority of those who did this lost the final accuracy mark.

11. Candidates were often able to demonstrate their understanding of upper bounds by giving the values 340.5 and/or 117.5 but then a number of candidates proceeded to find the area rather than the perimeter. Arithmetical errors often resulted in incorrect answers following a correct recognition of the necessary calculation.

12. It was common to find candidates carrying out a division before concerning themselves with bounds. Better candidates obtained a mark for a correct bound and quite often gained the method mark for an acceptable A/L. Those candidates who found more than one combination should be aware that it is up to them to convince the examiner which combination is appropriate. For example, two combinations one giving 21.11111 and the other giving 20.6666 then an answer of 21 on the answer line does not distinguish between the two combinations. In situations where a clear choice is given to the examiner then no marks can be awarded.

13. Just over 10% of candidates were able to give fully correct solutions to this question. Over 80% of candidates were able to score some marks generally for recognising that 15.6 needed to be divided by 12 and for adding together the area of six squares and twelve triangles. The most common error was to use 1.3 for both the base and height of the triangle (or assume incorrectly that the area of a triangle was half the area of a square) thus the most commonly seen answer to the question was 20.28 coming from this incorrect method. Some candidates used $\frac{1}{2}ab$ sinC to find the area of one triangle. This method does not form part of the modular stage 1 specification but was awarded marks as a fully correct method. Of those candidates who recognised the necessity to find the height of the triangle, most used Pythagoras's theorem. The common error was then to forget to take the square root following the relevant subtraction.

14. In part (a) the correct answer was seen from only approximately 60% of candidates. Of those who failed to gain the correct answer some, but not all candidates, were able to gain a method mark for demonstrating that at least part of the calculation had been carried out with due regard for the correct order of operations. A number of candidates showed no interim working so, when their final answer was wrong, were unable to pick up the available method mark. A common incorrect answer was 1.2285… which occurs when the square root of just 2.56 and not the complete numerator is taken. The majority of candidates were able to round their answer to part (a) correctly to gain a mark in part (b).

15. Part (a) was well answered although, as usual, candidates had more problems with the upper bound than the lower bound. Few candidates appreciated in part (b) that the area was given correct to 3 significant figures and so used the value given rather than the upper bound of the area in (bi) and the lower bound of the area in (bii).

16. Apart from the bevy of the usual calculator errors resulting in negative answers only 55% were successful in gaining 2 marks with a further 5% gaining one mark for a partial answer. Only 40% obtained the mark for writing their answer to 2 significant figures as they often went for 2 decimal places instead of 2 significant figures.

17. No Report available for this question.