M1.

144% or 1.44 seen

B1

$\sqrt{1.44}$ or 1.2

oe

M1

their 1.2 × 32

M1dep

38.4

A1

[4]

M2.

75 ÷ 50 or $\frac{3}{2}$ or 1.5 seen or implied

or 50 ÷ 75 or $\frac{2}{3}$ seen or implied

oe

M1

$(75 \div 50)^2$ or $\left(\frac{3}{2}\right)^2$ or 1.5^2 or 2.25 or $\frac{9}{4}$

or $(50 \div 75)^2$ or $\left(\frac{2}{3}\right)^2$ or $\frac{4}{9}$

oe

M1dep

6000 × 2.25 or 13 500
or 80 × 6000

oe

M1

their 13 500 ÷ 10 000
or 80 ÷ 10 000
or *their* 13 500 ÷ 10 000 × 80
or 80 × 6000 ÷ 10 000
or 6000 ÷ 10 000 × 2.25

oe

Dependent on previous M1

M1dep

108

Digits 108 seen M1M1M1M1A0

A1

Additional Guidance

$6000 \times \frac{3}{2} \times 80$

M1M0M1

720 000 implies $\frac{3}{2}$ and 6000×80 from $(6000 \times \frac{3}{2} \times 80)$

M1M0M1

9000 implies $\frac{3}{2}$

Ignore assumptions about the shape

M1

[5]

M3.

Alternative method 1

Volume original = $\frac{1}{3} \times \pi \times 8^2 \times 18$

(= 384π or [1190.4, 1206.6])

M1

Volume removed = $\frac{1}{3} \times \pi \times 2^2 \times 4.5$

(= 6π or [18.6, 18.855])

$\frac{1}{3} \times \pi \times (8^2 \times 18 - 2^2 \times 4.5)$ is M2

M1

378π or [1170, 1190])

A1

Alternative method 2

Volume original = $\frac{1}{3} \times \pi \times 8^2 \times 18$

(= 384π or [1190.4, 1206.6])

M1

Linear scale factor ¼ so volume scale factor $\frac{1}{64}$ so $\frac{63}{64}$

M1

378π or [1170, 1190])

A1

[3]

M4.

(a) 20 ÷ 32 or 0.625

32 ÷ 20 or 1.6

M1

their 0.625 × 24.8

24.8 ÷ their 1.6

M1dep

15.5

A1

Alternative method

24.8 ÷ 32 or 0.775

32 ÷ 24.8 or [1.29, 1.3]

M1

their 0.775 × 20

20 ÷ their [1.29, 1.3]

M1dep

15.5

A1

(b) $\left(\frac{37}{32}\right)^3$ or 1.15625^3 or $\frac{V_1}{37^3}=\frac{V_2}{32^3}$ *oe*

M1

[1.54, 1.55] or [154(%), 155(%)]

A1

[1.54, 1.55] and [54(%), 55(%)]
and decision
or
[154(%), 155(%)]
and decision
or
[1.54, 1.55] and 1.5(0)
and decision

Strand (iii)
ft their [1.54, 1.55] or their [154(%), 155(%)]
if M1 gained
SC1 $37^3 : 32^3$

Q1ft

Alternative method 1

$\left(\frac{32}{37}\right)^3$ or $(0.86486...)^3$ *oe*

M1

[0.64, 0.65]

A1

[0.64, 0.65] and [66(%), 67(%)]
and decision
or
[0.64, 0.65] and [0.66, 0.67]
and decision

Strand (iii)
ft their [0.64, 0.65] if M1 gained
SC1 $37^3 : 32^3$

Q1ft

Alternative method 2

$32^3 \times 1.5$ or 49 152
and
37^3 or 50 653
or

32^3 or 32 768
and
$37^3 \div 1.5$ or [33768, 33 769]
oe

M1

49 152 and 37^3 or 50 653
or
[33768, 33 769] and 32^3 or 32 768

A1

49 152 and 50 653
and decision
or
[33768, 33 769] and 32 768
and decision
Strand (iii)
ft their 49 152 and their 50 653
if M1 gained
or
ft their [33768, 33 769] and their 32 768
if M1 gained
SC1 $37^3 : 32^3$

Q1ft

Alternative method 3

$\frac{37^3 - 32^3}{32^3}$ or $\frac{50\,653 - 32\,768}{32\,768}$

oe

M1

[0.54, 0.55] or [54(%), 55(%)]

A1

[0.54, 0.55] and [54(%), 55(%)]
and decision
or
[54(%), 55(%)] and decision
or
[0.54, 0.55] and 0.5
and decision
Strand (iii)
ft their [0.54, 0.55] or [54(%), 55(%)]
if M1 gained
SC1 $37^3 : 32^3$

Q1ft

Alternative method 4

$\sqrt[3]{1.5}$ or 1.14471...

and

$\frac{37}{32}$ or 1.15625

M1

1.14471... and 1.15625

A1

1.14471... and 1.15625
and decision

Strand (iii)
ft their 1.14471... and their 1.15625
if M1 gained
SC1 $37^3 : 32^3$

Q1ft

[6]

M5.

(Linear sf =) 1.5

681 or 1021.5 implies B1

B1

454×1.5^3

M1

1532 (…)

Accept 1530 or 1500 with working

A1

Alternative
Radius of larger cylinder
= [5.7, 5.71]

B1

$\pi \times \text{radius}^2 \times 15$

M1

[1531.5, 1532.5]

A1

[3]

M6.

(a) (height of cylinder =) 14

May be seen in method or on diagram

B1

$\frac{1}{3} \times \pi \times 6^2 \times$ their 14 (= 168π)

oe eg [527.5, 528]

M1

$\frac{2}{3} \times \pi \times 6^3$ (= 144π)

oe eg [452, 452.16]

M1

$168\pi + 144\pi$

oe eg $312\pi - 168\pi = 144\pi$

A1

(b) 1500(g)

B1

($312\pi \times$) 2^3 (= 2496π)

oe

eg $\frac{1}{3} \times \pi \times 12^2 \times$ *their 28* + $\frac{2}{3} \times \pi \times 12^3$

or *[7837.4, 7842.432]*

M1

Their 1500 ÷ their 2496π

M1Dep

[0.19, 0.1914]

ft their 1500 and their 28

Accept 0.2 if correct method seen

A1ft

[8]

M7. 15 ÷ 10 (= 1.5)

or $10 \div 15 \left(= \frac{2}{3}\right)$ *oe*

or $\left(\frac{w}{15} =\right) \frac{3}{10}$ or $\left(\frac{15}{w} =\right) \frac{10}{3}$

Accept ratios e.g. 3 : 10

or $\left(\frac{w}{3} =\right) \frac{15}{10}$

M1

$3 \times$ their 1.5

or $3 \div$ their $\frac{2}{3}$ *oe*

or $15 \times \frac{3}{10}$

1.5^2 or $\left(\frac{2}{3}\right)^2$ seen

or $3 \times \frac{15}{10}$

M1dep

4.5

1.5^2 and 30 seen

or $\left(\frac{2}{3}\right)^2$ *and 30 seen*

A1

15×4.5

$1.5^2 \times 30$ or $30 \div \left(\frac{2}{3}\right)^2$

M1

67.5 *oe*

A1

[5]

M8. $\frac{12}{10}$ (= 1.2) or $\frac{10}{12}$

oe

May be implied from answer of 600

M1

500 × their 1.2^3

oe

M1dep

864

Accept [863, 864]

A1

[3]

M9. Scale factor $\frac{18}{8}$ or $\frac{8}{18}$ seen *oe*

11.25 may be on diagram

B1

or *AC* = 5 × 2.25 (= 11.25)

or angle *B* = angle *E* seen

or angle *A* = angle *D* seen

Use of cosine rule to work out any angle

$8^2 = 4^2 + 5^2 – 2 \times 4 \times 5 \times \cos C$

$18^2 = 9^2 +$ their $11.25^2 - 2 \times 9 \times$ their $11.25 \times \cos C$

$4^2 = 5^2 + 8^2 - 2 \times 5 \times 8 \times \cos D$

$9^2 = 18^2 +$ their $11.25^2 - 2 \times 18 \times$ their $11.25 \times \cos A$

$5^2 = 4^2 + 8^2 - 2 \times 4 \times 8 \times \cos E$

)

their $11.25^2 = 9^2 + 18^2 - 2 \times 9 \times 18 \times \cos B$

M1

Correct rearranging of formula to isolate cosine

$\frac{4^2 + 5^2 - 8^2}{2 \times 4 \times 5}$ *or* $-\frac{23}{40}$

$\frac{9^2 + \text{their } 11.25^2 - 18^2}{2 \times 9 \times \text{their } 11.25}$ *or* $-\frac{23}{40}$

$\frac{5^2 + 8^2 - 4^2}{2 \times 5 \times 8}$ *or* $\frac{73}{80}$

$\frac{\text{their } 11.25^2 + 18^2 - 9^2}{2 \times \text{their } 11.25 \times 18}$ *or* $\frac{73}{80}$

$\frac{4^2 + 8^2 - 5^2}{2 \times 4 \times 8}$ *or* $\frac{55}{64}$

$\frac{9^2 + 18^2 - \text{their } 11.25^2}{2 \times 9 \times 18}$ *or* $\frac{55}{64}$

M1dep

Obtaining one angle

eg C = 125.(…) or 125
B = 30.(…) or 31 = E
A = 24.(…) or 24 = D
May be seen on diagram

A1

Substitution into $\frac{1}{2}$ *ab* sin *C*

$\frac{1}{2} \times$ *their 11.25* $\times 9 \times$ *sin their 125*

$\frac{1}{2} \times$ *their 11.25* $\times 18 \times$ *sin their 24*

L

$\frac{1}{2}$ × *18 × 9 × sin their 31*

oe

$\frac{1}{2}$ × *4 × 5 × sin their 125*

$\frac{1}{2}$ × *5 × 8 × sin their 24*

$\frac{1}{2}$ × *4 × 8 × sin their 31*

M1

[41, 42]

A1

[6]

M10.

80 ÷ 16 (= 5) **or** 16 × 5

16 ÷ 80 (= 0.2) ***or*** *80 × 0.2*

M1

196 × their 5^2 **or** $\frac{x}{196} = (\frac{80}{16})^2$

196 ÷ their 0.2^2 ***or*** $\frac{196}{x} = (\frac{16}{80})^2$

M1dep

4900

A1

Alternative 1

80 ÷ 16 (= 5) **or** 16 × 5

16 ÷ 80 (= 0.2) ***or*** *80 × 0.2*

M1

5000 ÷ their 5^2 **or** $\frac{5000}{x} = (\frac{80}{16})^2$

5000 × their 0.2^2 ***or*** $\frac{x}{5000} = (\frac{16}{80})^2$

M1dep

200

A1

Alternative 2

80 ÷ 16 (= 5) **or** 16 × 5

*16 ÷ 80 (= 0.2) **or** 80 × 0.2*

M1

their 5^2 **and** 5000 ÷ 196

*their 0.2^2 **and** 196 ÷ 5000*

M1dep

25 **and** [25.5, 25.5102041]

*0.04 **and** 0.039(2)*

A1

[3]