5.16 Spheres and Cones: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

Formulae You May Need

Revision Library formulae reminder, styled on Edexcel 1MA1 formulae-sheet conventions; wording is original.

Volume of a sphere = (4/3) x pi x r^3

Surface area of a sphere = 4 x pi x r^2

Volume of a cone = (1/3) x pi x r^2 x h

Curved surface area of a cone = pi x r x l (l = slant height)

Volume of a hemisphere = (2/3) x pi x r^3

Total surface area of a solid hemisphere = 3 x pi x r^2

Note: the surface area formulae for spheres and cones are supplied in relevant Edexcel questions.

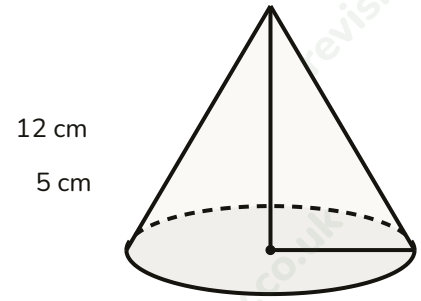
1 Write down the formula for the volume V of a sphere in terms of its radius r.

(Total for Question 1 is 1 mark)

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2 A cone has radius 5 cm and height 12 cm. Calculate its volume. Give your answer to 1 decimal place. Use π = 3.14159265 or your calculator's π key.

Diagram NOT accurately drawn



(Total for Question 2 is 2 marks)

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3 The volume of a sphere of radius r is given by one of the formulae below.

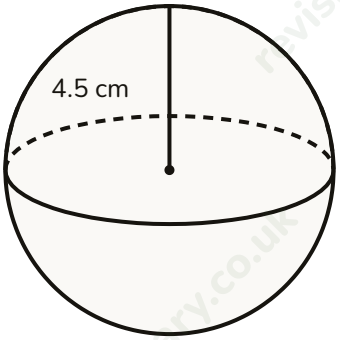
- ☐ A) $4 \pi r^2$
- ☐ B) $4/3 \pi r^3$
- ☐ C) $1/3 \pi r^2 h$
- ☐ D) $\pi r l$

(Total for Question 3 is 1 mark)

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4 A sphere has radius 4.5 cm. Calculate the surface area of the sphere. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

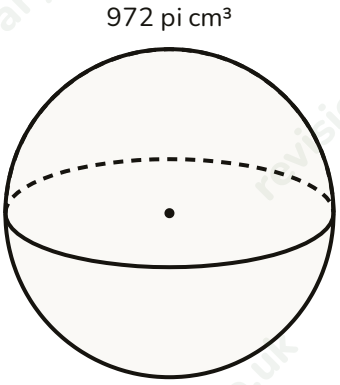


(Total for Question 4 is 2 marks)

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5 A sphere has volume $972\ \pi\ cm^3$. Find the radius of the sphere.

Diagram NOT accurately drawn

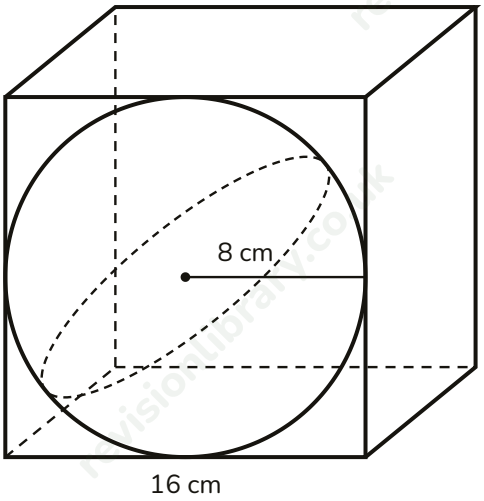


(Total for Question 5 is 3 marks)

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6 A sphere of radius 8 cm fits exactly inside a cube of side length 16 cm, touching every face of the cube. Work out the volume of empty space inside the cube that is not occupied by the sphere. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

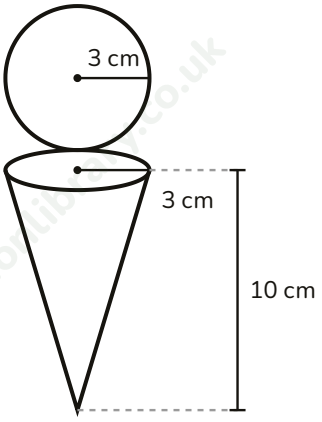


(Total for Question 6 is 4 marks)

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7 A spherical scoop of ice cream has radius 3 cm. It is placed on top of an empty cone-shaped wafer with radius 3 cm and height 10 cm. If all of the ice cream melts and drips into the wafer, determine whether the wafer will overflow. You must show your working.

Diagram NOT accurately drawn

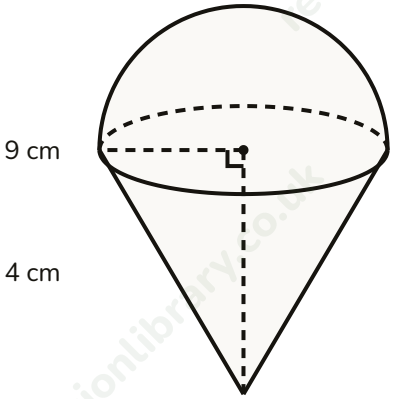


(Total for Question 7 is 3 marks)

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8 A toy is made from a cone and a hemisphere. The hemisphere sits on top of the cone and both have radius 9 cm. The perpendicular height of the cone is 4 cm. Work out the total volume of the toy. Give your answer in terms of π.

Diagram NOT accurately drawn

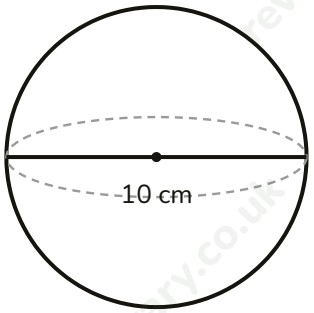


(Total for Question 8 is 4 marks)

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9 A sphere has diameter 10 cm. Calculate the surface area of the sphere. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

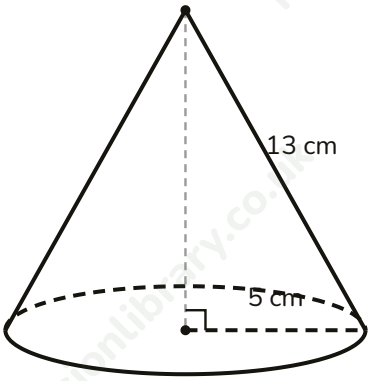


(Total for Question 9 is 3 marks)

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10 A cone has base radius 5 cm and slant height 13 cm. Show that the curved surface area of the cone is 65 π cm^2.

Diagram NOT accurately drawn

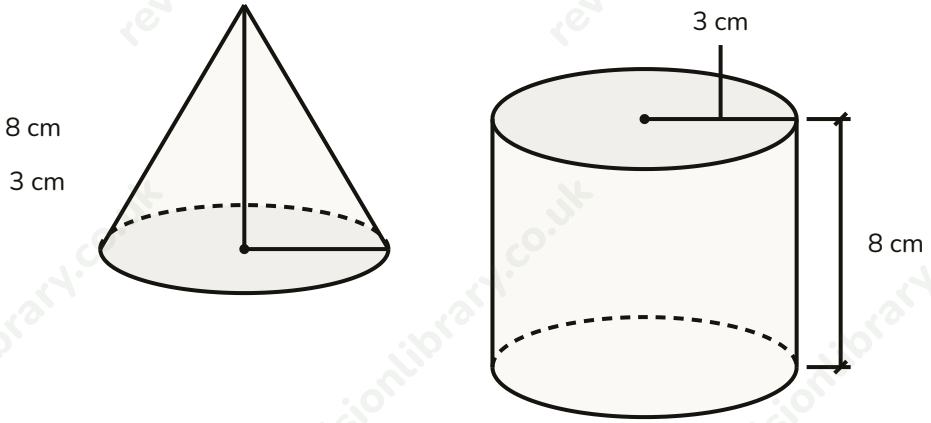


(Total for Question 10 is 2 marks)

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11 A cone and a cylinder have the same radius 3 cm. The cone has height 8 cm and the cylinder has height 8 cm. Work out the total volume of the two solids. Give your answer in terms of π.

Diagram NOT accurately drawn

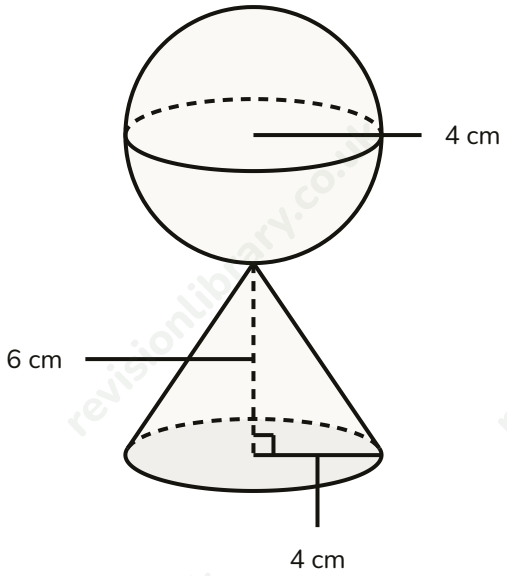


(Total for Question 11 is 4 marks)

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12 A solid is made by placing a complete sphere of radius 4 cm on top of a cone whose base radius is 4 cm and perpendicular height is 6 cm. The sphere touches the cone only at the cone's vertex, with no overlap between the solids. Calculate the total volume of the solid. Give your answer to 1 decimal place.

Diagram NOT accurately drawn

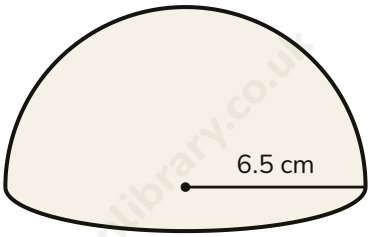


(Total for Question 12 is 8 marks)

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13 A pottery bowl is made in the shape of an open solid hemisphere with radius 6.5 cm. The flat circular top is open, so it is not coated. The outside curved surface of the bowl is coated with a glaze that costs 1.5p per cm^2. Work out the total cost of glazing the outside curved surface of the bowl.

Diagram NOT accurately drawn

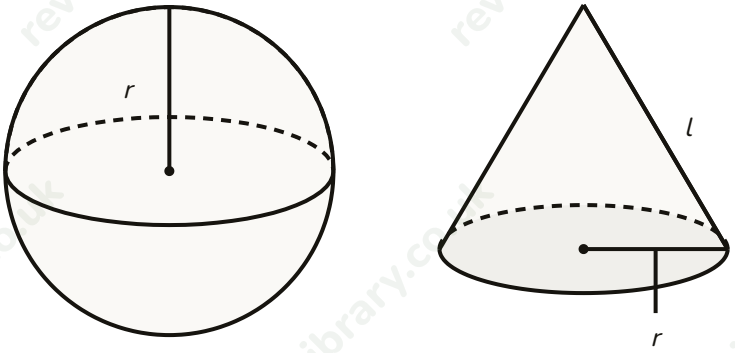


(Total for Question 13 is 3 marks)

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14 The surface area of a sphere with radius r is equal to the curved surface area of a cone with the same radius r and slant height l. Show that l = 4r.

Diagram NOT accurately drawn



(Total for Question 14 is 3 marks)

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Mark scheme · 5.16 Spheres and Cones: Test Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

$V = (4/3)\ \pi\ r^3$ or equivalent cao	**B1**

Answer: $V = (4/3)\ \pi\ r^3$

Question 2

use $V = (1/3)\ \pi\ r^2\ h$ with r=5, h=12	**M1**
314.2 cm^3 awrt	**A1**

Answer: 314.2 cm^3

Question 3

B cao	**B1**

Answer: B) $4/3\ \pi\ r^3$

Question 4

correct substitution into $A = 4 \times \pi \times r^2$, e.g. $4 \times \pi \times 4.5^2$ (oe)	**M1**
awrt 254 cm^2 (cao)	**A1**

Answer: 254 cm^2 (3 s.f.)

Question 5

sets $972\ \pi = 4/3\ \pi\ r^3$ and begins to rearrange	**M1**
$r^3 = 729$ oe (dep)	**M1**
r = 9 cm cao	**A1**

Answer: r = 9 cm

Question 6

16^3 oe (cube volume = 4096)	**M1**
$4/3 \times \pi \times 8^3$ oe (sphere volume seen, awrt 2140 to 2150)	**M1**
subtracts sphere volume from cube volume (dep)	**M1**
awrt 1950	**A1**

Answer: 1950 cm^3 (3 sf)

Question 7

$4/3 \times \pi \times 3^3$ oe (sphere volume = 36 π, awrt 113)	**M1**
$1/3 \times \pi \times 3^2 \times 10$ oe (cone volume = 30 π, awrt 94.2)	**M1**
cao: correct conclusion that the wafer will overflow, since 113 > 94.2 (or 36 π > 30 π), with correct comparison shown	**A1**

Answer: Yes, it overflows (113 cm^3 melted ice cream compared with 94.2 cm^3 capacity)

Question 8

cone: $1/3 \times \pi \times 9^2 \times 4$ oe	**M1**
hemisphere: $2/3 \times \pi \times 9^3$ oe	**M1**
adds the two volumes	**M1**
594pi cm^3 cao	**A1**

Answer: 594pi cm^3

Question 9

radius = 5 cm identified	**B1**
$4 \times \pi \times 5^2$ oe (100 π seen)	**M1**
awrt 314	**A1**

Answer: 314 cm^2 (3 sf)

Question 10

π x 5 x 13 correctly substituted into curved surface area = π r l	**M1**
cso: 65 π cm^2 obtained exactly, with the answer given (printed) reached correctly	**A1**

Answer: 65 π cm^2 (exact, as given)

Question 11

cylinder volume method: $V = \pi\ r^2\ h$, so 9 * 8 = 72, cylinder = 72 π	**M1**
cone method: $V = (1/3)\ \pi\ r^2\ h$, so (1/3) * 9 * 8 = 24, cone = 24 π	**M1**
add volumes: 72 π + 24 π	**M1**
96 π cm^3 cao	**A1**

Answer: 96 π cm^3

Question 12

compute sphere volume formula substitution: $(4/3)\ \pi * 4^3$	**M1**
simplify sphere volume to (256/3) π	**M1**
compute cone volume formula substitution: $(1/3)\ \pi * 4^2 * 6$	**M1**
simplify cone volume to 32 π	**M1**
convert sphere volume to decimal: (256/3) π = 268.082... cm^3	**M1**
convert cone volume to decimal: 32 π = 100.531... cm^3	**M1**
add decimal volumes: 268.082... + 100.531... = 368.613...	**M1**
368.6 cm^3 awrt	**A1**

Answer: 368.6 cm^3

Question 13

curved SA = $2 \times \pi \times r^2$, e.g. $2 \times \pi \times 6.5^2$ (oe), awrt 265 cm^2	**M1**
cost = curved SA x 0.015 (oe, ft their curved SA)	**M1**
£3.98 (awrt, cao, to the nearest penny)	**A1**

Answer: £3.98

Question 14

correct equation formed: $4 \times \pi \times r^2 = \pi \times r \times l$ (oe)	**M1**
divides both sides by π x r, r > 0 (oe)	**M1**
l = 4r fully shown with no errors (cso)	**A1**

Answer: l = 4r (shown)

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