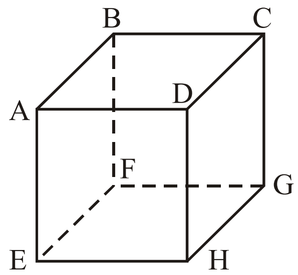
1. The following diagram shows a carton in the shape of a cube 8 cm long on each side:



(a) The longest rod that will fit on the bottom of the carton would go from E to G. Find the length l of this rod.

(b) Find the length L of the longest rod that would fit inside the carton.

Working:

Answers:

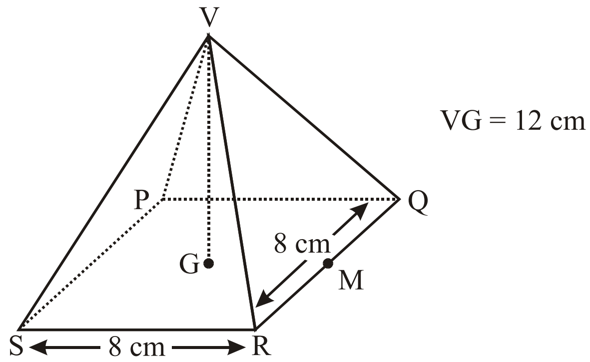
(a) …………………………………………..

(b) …………………………………………..

(Total 4 marks)

2. In the diagram below, PQRS is the square base of a solid right pyramid with vertex V. The sides of the square are 8 cm, and the height VG is 12 cm. M is the midpoint of [QR].

Diagram not to scale



(a) (i) Write down the length of [GM].

(ii) Calculate the length of [VM].

(2)

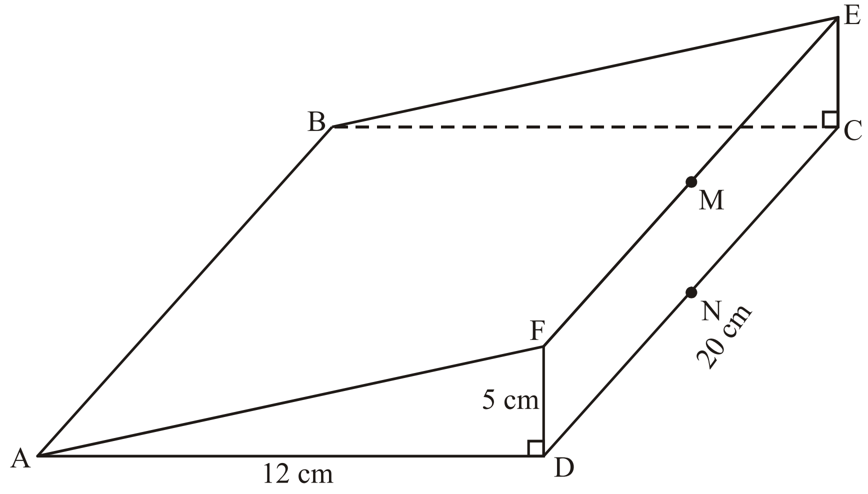
(b) Find

(i) the total surface area of the pyramid;

(ii) the angle between the face VQR and the base of the pyramid.

(4)
(Total 6 marks)

3. In the diagram below ABEF, ABCD and CDFE are all rectangles. AD = 12 cm, DC = 20 cm and DF = 5 cm.
M is the midpoint of EF and N is the midpoint of CD.



(a) Calculate (i) the length of AF;

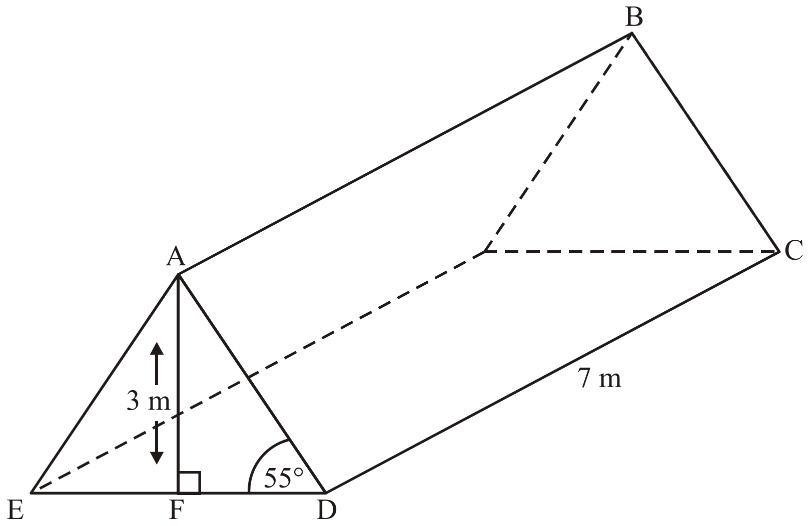
(ii) the length of AM.

(3)

(b) Calculate the angle between AM and the face ABCD.

(3)
(Total 6 marks)

4. The following diagram shows a sloping roof. The surface ABCD is a rectangle. The angle ADE is 55°. The vertical height, AF, of the roof is 3 m and the length DC is 7 m.



(a) Calculate AD.

(b) Calculate the length of the diagonal DB.

Working:

Answers:

(a) ....

(b) ....

(Total 8 marks)

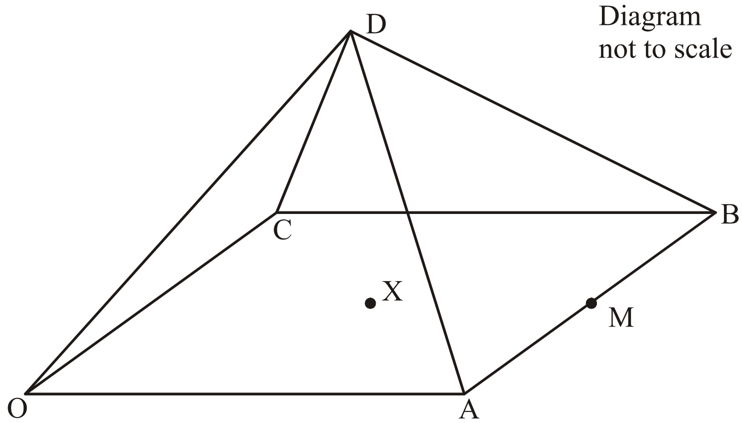
5. OABCD is a square based pyramid of side 4 cm as shown in the diagram.
The vertex D is 3 cm directly above X, the centre of square OABC.
M is the midpoint of AB.

(a) Find the length of XM.

(b) Calculate the length of DM.

(c) Calculate the angle between the face ABD and the base OABC.

Diagram not to scale



Working:

Answers:

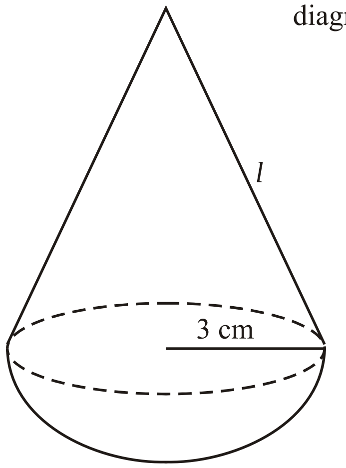
(a) ....

(b) ....

(c) ....

(Total 8 marks)

6. A child's toy is made by combining a hemisphere of radius 3 cm and a right circular cone of slant height l as shown on the diagram below.



(a) Show that the volume of the hemisphere is 18π cm^3.

(2)

The volume of the cone is two-thirds that of the hemisphere.

(b) Show that the vertical height of the cone is 4 cm.

(4)

(c) Calculate the slant height of the cone.

(2)

(d) Calculate the angle between the slanting side of the cone and the flat surface of the hemisphere.

(3)

(e) The toy is made of wood of density 0.6 g per cm^3. Calculate the weight of the toy.

(3)

(f) Calculate the total surface area of the toy.

(5)

(Total 19 marks)

1. (a) $l = \sqrt{8^2 + 8^2}$ (M1)

$= \sqrt{128}$

$= 11.3$ (3 s.f.) (A1)

(b) $L = \sqrt{\sqrt{128^2} + 8^2}$ **OR** $L = \sqrt{11.3^2 + 8^2}$ *(allow ft from (a))* (M1)

$= \sqrt{128 + 64}$ **OR** $= \sqrt{127.69} + 64$

$= 13.9$ (3 s.f.) **OR** $= 13.8$ (3 s.f.) (A1)

[4]

2. (a) (i) GM = 4 cm (A1)

(ii) $VM^2 = 4^2 + 12^2$

$= 16 + 144$

$= 160$

$VM = \sqrt{160} = 12.6$ cm (3 s.f.) (A1) 2

(b) (i) SA = area of square base + 4 (area of triangular face)

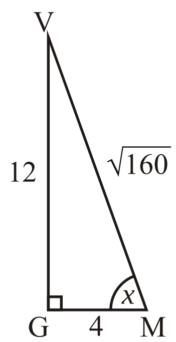
$= 8 \times 8 + 4 \times \frac{1}{2} \times 8 \times \sqrt{160}$ (M1)

$= 64 + 202.4$

$= 266\ \text{cm}^2$ (3 s.f.) (A1)

Note: *Using VM = 12.6 gives same final answer to 3 significant figures.*

(ii)



$\tan x = \frac{12}{4} = 3$ (M1)

$x = 71.6°$ (or 1.25 radians) (A1)

OR

$\sin x = \frac{12}{\sqrt{160}}$ (M1)

$\Rightarrow x = 71.6°$ (or 1.25 radians) (A1)

OR

$\cos x = \dfrac{4}{\sqrt{160}}$ (M1)

$\Rightarrow x = 71.6°$ (or 1.25 radians) (A1)

OR

$\sin x = \dfrac{12}{12.6}$ (M1)

$\Rightarrow x = 72.2°$ (or 1.26 radians) (A1)

OR

$\cos x = \dfrac{4}{12.6}$ (M1)

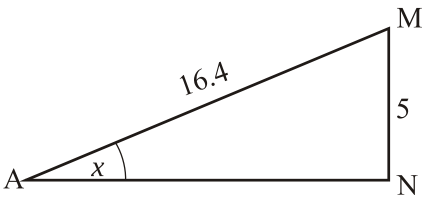
$\Rightarrow x = 71.5°$ (or 1.25 radians) (A1) 4

[6]

3. (a) (i) AF = $\sqrt{(12^2 + 5^2)}$ = 13 (A1)

(ii) AM = $\sqrt{(13^2 + 10^2)}$ = 16.4 (M1)(A1)

(b)



(M1)

***Note:** Award (M1) for correct angle.*

$\sin \hat{A} = \dfrac{5}{16.4}$ (M1)

$\hat{A} = 17.8°$ (A1) 3

[6]

4. (a) $\sin (55°) = \dfrac{3}{AD}$ (M1)(A1)

$AD = \dfrac{3}{\sin (55°)}$ (M1)

AD = 3.66232 = 3.66 m to 3 s.f. (units not required). (A1) (C4)

(b) $DB^2 = AD^2 + DC^2 = 3.66232^2 + 7^2$ (M1)(A1)

$DB^2 = 62.4126$ hence DB = 7.90 m (units not required). (A1)(A1)

Note: *Use of 3.662 makes no difference to final answer. Award at most (M0)(A0)(A0)(A1)ft for an incorrect cosine rule formula. Award at most (M1)(A0)(A0)(A1)ft for incorrect substitution into correct cosine rule formula.*

[8]

5. (a) XM = 2 (A1) (C1)

(b) DM = $\sqrt{(9+4)} = \sqrt{13}$ (= 3.61) (M1)(A2)

(c) $\tan D\hat{M}X = \frac{3}{2}$ (M1)(A1)

Note: *Award (M1) for the correct angle, (A1) for the correct ratio.*

angle $D\hat{M}X = 56.3°$ (A2) (C4)

OR

$\sin D\hat{M}X = \frac{3}{3.61}$ (M1)(A1)

angle $D\hat{M}X = 56.2°$ (A2)

OR

$\cos D\hat{M}X = \frac{2}{3.61}$ (M1)(A1)

angle $D\hat{M}X = 56.4°$ (A2)

Note: *Accept correct answer given in radians, or degrees, minutes and seconds.*

[8]

6. (a) $V = \frac{1}{2}\times\frac{4}{3}\pi r^3$ For using $\frac{4}{3}\pi r^3$ (with or without $\frac{1}{2}$) (M1)

$= \frac{2}{3} \times \pi \times 3^3$ For using $\frac{1}{2}$ (their sphere formula) (M1)

$= 18\pi$ cm^3 (AG) 2

(b)	$V = \frac{2}{3} \times 18\pi$ For using $\frac{2}{3}$ × their answer to (a)	(M1)	
	$= 12\pi$	(A1)	
	$12\pi = \frac{1}{3}\pi \times 3^2 \times h$ For equating the volumes	(M1)	
	$\frac{36\pi}{9\pi} = h\left(\frac{113.097}{28.27}\right)$	(A1)	
	$h = 4$ cm	(AG)	4
(c)	$l^2 = 4^2 + 3^2$ For using Pythagoras theorem	(M1)	
	$l = 5$	(A1)	2
(d)	For identifying the correct angle	(M1)	
	$\tan\theta = \frac{4}{3}$ or $\sin\theta = \frac{4}{5}$ or $\cos\theta = \frac{3}{5}$	(M1)	
	$\theta = 53.1°$ (0.927 radians)	(A1)	3
(e)	For summing volume of cone and hemisphere.	(M1)	
	Volume $= 12\pi + 18\pi$		
	$= 30\pi$ cm^3 (94.2 cm^3)		
	For multiplying the volume by 0.6	(M1)	
	Weight $= 0.6 \times 30\pi$		
	$= 56.5$ g	(A1)	3
(f)	Surface area of cone $= \pi rl$		
	$= \pi \times 3 \times 5 = 15\pi$	(M1)(A1)	
	Surface area of a hemisphere $= \frac{1}{2} \times 4\pi r^2$		
	$= \frac{1}{2} \times 4 \times \pi \times 3^2$		
	$= 18\pi$	(M1)(A1)	
	Total surface area $= 15\pi + 18\pi$		
	$= 103.67$		
	$= 104$ cm^2	(A1)	5
		[19]	