HIGHER

5.20 Exact trig values: 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Write down the exact value of cos 90 degrees.

(Total for Question 1 is 1 mark)

2 Write down the exact value of tan 45 degrees.

(Total for Question 2 is 1 mark)

3 Write down the exact value of sin 45 degrees, giving your answer as a surd in its simplest form.

(Total for Question 3 is 1 mark)

4 Write down the exact value of cos 45 degrees, giving your answer as a surd in its simplest form.

(Total for Question 4 is 1 mark)

5 Write down the exact value of sin 30 degrees.

(Total for Question 5 is 1 mark)

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6 Write down the exact values of each of the following.

(a) Write down sin 30 degrees. **(1)**

.....

(b) Write down cos 45 degrees. **(1)**

.....

(c) Write down tan 60 degrees. **(1)**

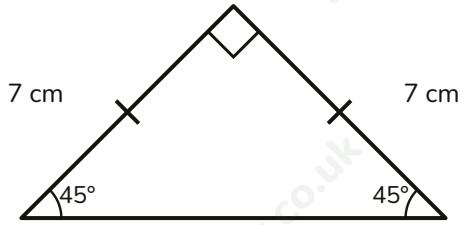
.....

(Total for Question 6 is 3 marks)

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7 A right-angled isosceles triangle has two equal sides of length 7 cm, meeting at a right angle. Calculate the length of the hypotenuse. Give your answer as an exact value in the form k $\sqrt{2}$.

Diagram NOT accurately drawn

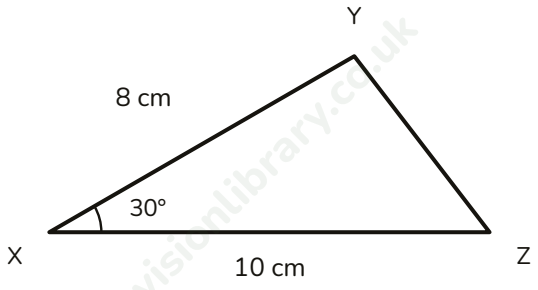


(Total for Question 7 is 2 marks)

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8 Triangle XYZ has XY = 8 cm, XZ = 10 cm and angle YXZ = 30 degrees. Calculate the exact area of triangle XYZ.

Diagram NOT accurately drawn

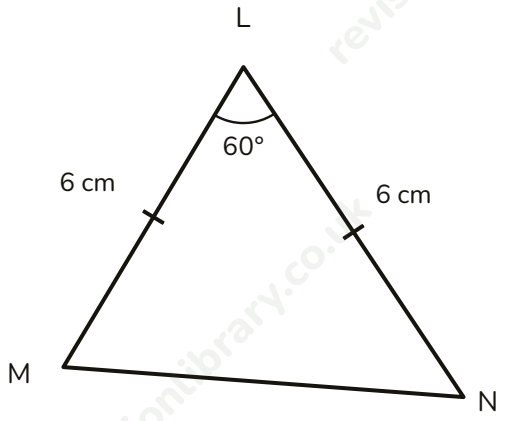


(Total for Question 8 is 3 marks)

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9 Triangle LMN has LM = 6 cm, LN = 6 cm and angle MLN = 60 degrees. Calculate the exact area of triangle LMN. Give your answer in the form k $\sqrt{3}$.

Diagram NOT accurately drawn

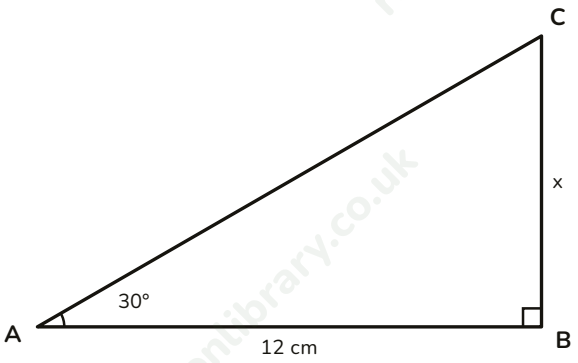


(Total for Question 9 is 3 marks)

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10 ABC is a right-angled triangle with the right angle at B. AB = 12 cm and angle BAC = 30 degrees. Work out the length BC. Give your answer in the form a $\sqrt{3}$ or as an integer, without using a calculator.

Diagram NOT accurately drawn

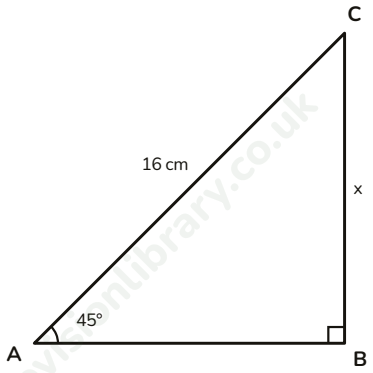


(Total for Question 10 is 3 marks)

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11 In a right-angled triangle the hypotenuse is 16 cm and one of the acute angles is 45 degrees. Work out the length of the side opposite this angle. Give your answer as an exact value, without using a calculator.

Diagram NOT accurately drawn



(Total for Question 11 is 3 marks)

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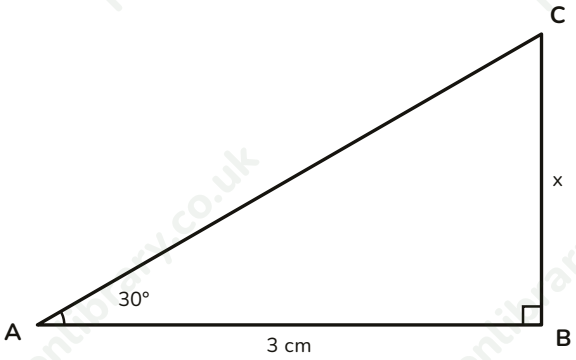
12 Work out the exact value of sin 0 + cos 60, where the angles are in degrees. Give your answer in its simplest form without using a calculator.

(Total for Question 12 is 4 marks)

---

13 ABC is a right-angled triangle with the right angle at B. AB = 3 cm and angle BAC = 30 degrees. Work out the length BC. Give your answer in the form a $\sqrt{3}$ or as an integer, without using a calculator.

Diagram NOT accurately drawn



(Total for Question 13 is 3 marks)

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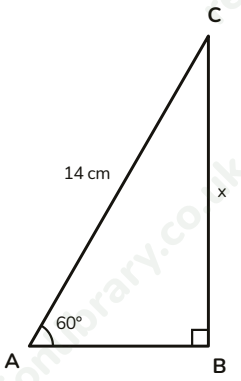
14 Work out the exact value of cos 90 - cos 60, where the angles are in degrees. Give your answer in its simplest form without using a calculator.

(Total for Question 14 is 4 marks)

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15 In a right-angled triangle the hypotenuse is 14 cm and one of the acute angles is 60 degrees. Work out the length of the side opposite this angle. Give your answer as an exact value, without using a calculator.

Diagram NOT accurately drawn



(Total for Question 15 is 3 marks)

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16 Given that cos x = 1/2 and x is an acute angle, write down the value of x in degrees.

(Total for Question 16 is 1 mark)

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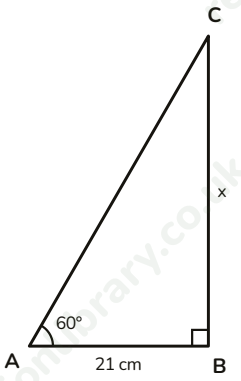
17 Work out the exact value of sin 90 - tan 60, where the angles are in degrees. Give your answer in its simplest form without using a calculator.

(Total for Question 17 is 4 marks)

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18 ABC is a right-angled triangle with the right angle at B. AB = 21 cm and angle BAC = 60 degrees. Work out the length BC. Give your answer in the form a $\sqrt{3}$ or as an integer, without using a calculator.

Diagram NOT accurately drawn



(Total for Question 18 is 3 marks)

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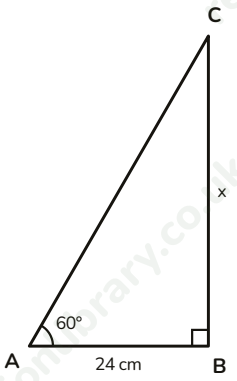
19 Given that tan x = $\sqrt{3}/3$ and x is an acute angle, write down the value of x in degrees.

(Total for Question 19 is 1 mark)

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20 ABC is a right-angled triangle with the right angle at B. AB = 24 cm and angle BAC = 60 degrees. Work out the length BC. Give your answer in the form a $\sqrt{3}$ or as an integer, without using a calculator.

Diagram NOT accurately drawn

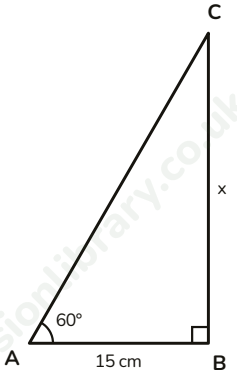


(Total for Question 20 is 3 marks)

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21 ABC is a right-angled triangle with the right angle at B. AB = 15 cm and angle BAC = 60 degrees. Work out the length BC. Give your answer in the form a $\sqrt{3}$ or as an integer, without using a calculator.

Diagram NOT accurately drawn



(Total for Question 21 is 3 marks)

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22 Work out the exact value of 4 cos 60 - 2 sin 30. Show your working.

(Total for Question 22 is 2 marks)

---

23 Work out the exact value of tan 60 x tan 30. Show your working clearly.

(Total for Question 23 is 3 marks)

---

24 Work out the exact value of sin 30 degrees + cos 60 degrees. Show your working.

(Total for Question 24 is 2 marks)

---

25 Work out the exact value of $(\sin 45 \text{ degrees})^2 + (\cos 45 \text{ degrees})^2$. Give your answer as an integer.

(Total for Question 25 is 2 marks)

---

26 Write down the exact value of cos 75 degrees. Give a brief reason.

Write down cos 75 degrees and give a reason. **(2)**

.....

(Total for Question 26 is 2 marks)

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27 Given that $\tan(\theta) = \sqrt{3}$ for $0 \leq \theta \leq 90$, find the exact value of θ. Hence work out the exact value of $\sin(\theta) + \cos(\theta)$, giving your answer as a single fraction in its simplest form.

(Total for Question 27 is 3 marks)

---

28 Show that sin 60 degrees x cos 30 degrees + cos 60 degrees x sin 30 degrees = 1. You must show each step of your working.

(Total for Question 28 is 4 marks)

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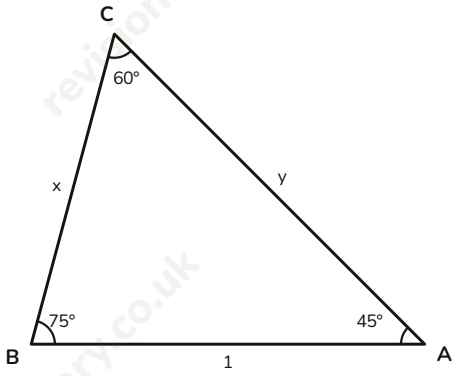
29 Show that tan 75 degrees = $2 + \sqrt{3}$. You may use exact values or angle formulae.

(Total for Question 29 is 3 marks)

---

30 In triangle ABC, angle A = 45 degrees, angle B = 75 degrees and angle C = 60 degrees. The side AB = 1 (the side opposite angle C). Use the sine rule to find the exact lengths of BC and AC, giving answers in simplified surd form.

Diagram NOT accurately drawn



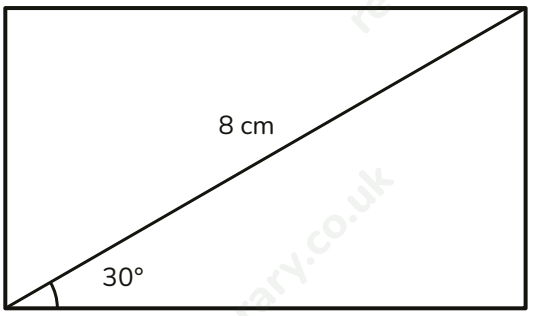
Use the sine rule to find BC and AC, exact surd form, given AB = 1 and angles A = 45, B = 75, C = 60. **(4)**

(Total for Question 30 is 4 marks)

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31 A rectangle has a diagonal of exact length 8 cm. The diagonal makes an angle of 30 degrees with one of the longer sides of the rectangle. Work out the exact area of the rectangle. Give your answer in the form $a*\sqrt{b}$ cm^2, where a and b are integers and b is as small as possible.

Diagram NOT accurately drawn



(Total for Question 31 is 4 marks)

---

32 Solve the equation tan 2theta = $\sqrt{3}$ for $0 \leq \theta < 360$ degrees. Give all solutions in degrees and show your working clearly.

Solve tan 2theta = $\sqrt{3}$ for $0 \leq \theta < 360$ degrees, giving all solutions. **(9)**

(Total for Question 32 is 9 marks)

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Mark scheme · 5.20 Exact trig values: 2-hour Pack

Question 1

0 cao **B1**

Answer: 0

Question 2

1 cao **B1**

Answer: 1

Question 3

$\sqrt{2}/2$ oe, accept $1/\sqrt{2}$ **B1**

Answer: $\sqrt{2}/2$

Question 4

$\sqrt{2}/2$ oe, accept $1/\sqrt{2}$ **B1**

Answer: $\sqrt{2}/2$

Question 5

1/2 oe cao **B1**

Answer: 1/2

Question 6

(a) 1/2 cao **B1**

(a) Answer: 1/2

(b) $\sqrt{2}/2$ cao **B1**

(b) Answer: $\sqrt{2}/2$

(c) $\sqrt{3}$ cao **B1**

(c) Answer: $\sqrt{3}$

Question 7

hypotenuse = 7 / sin(45) or $\sqrt{7^2 + 7^2}$ set up **M1**

$7\sqrt{2}$ cm cao **A1**

Answer: $7\sqrt{2}$ cm

Question 8

Area = 1/2 x 8 x 10 x sin(30) correct formula with values substituted **M1**

sin(30) = 1/2 used correctly **M1**

Area = 20 cm² cao **A1**

Answer: 20 cm^2

Question 9

Area = 1/2 x 6 x 6 x sin(60) correct formula with values substituted **M1**

sin(60) = $\sqrt{3}/2$ used correctly **M1**

Area = $9\sqrt{3}$ cm^2 cao **A1**

Answer: $9\sqrt{3}$ cm^2

Question 10

BC = 12 x tan 30 **M1**

tan 30 = $\sqrt{3}/3$ used **M1**

$4\sqrt{3}$ cm oe **A1**

Answer: $4\sqrt{3}$ cm

Question 11

16 x sin 45 oe **M1**

exact value of sin 45 used **M1**

$8\sqrt{2}$ cm oe **A1**

Answer: $8\sqrt{2}$ cm

Question 12

exact value of sin 0 = 0 **B1**

exact value of cos 60 = 1/2 **B1**

correct sum or difference **M1**

1/2 oe **A1**

Answer: 1/2

Question 13

BC = 3 x tan 30 **M1**

tan 30 = $\sqrt{3}/3$ used **M1**

$\sqrt{3}$ cm oe **A1**

Answer: $\sqrt{3}$ cm

Question 14

exact value of cos 90 = 0 **B1**

exact value of cos 60 = 1/2 **B1**

correct sum or difference **M1**

-1/2 oe **A1**

Answer: -1/2

Question 15

14 x sin 60 oe **M1**

exact value of sin 60 used **M1**

$7\sqrt{3}$ cm oe **A1**

Answer: $7\sqrt{3}$ cm

Question 16

60 degrees **B1**

Answer: 60 degrees

Question 17

exact value of sin 90 = 1 **B1**

exact value of tan 60 = $\sqrt{3}$ **B1**

correct sum or difference **M1**

$1 - \sqrt{3}$ oe **A1**

Answer: $1 - \sqrt{3}$

Question 18

BC = 21 x tan 60 **M1**

tan 60 = $\sqrt{3}$ used **M1**

$21\sqrt{3}$ cm oe **A1**

Answer: $21\sqrt{3}$ cm

Question 19

30 degrees **B1**

Answer: 30 degrees

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Question 20

BC = 24 x tan 60	**M1**
tan 60 = $\sqrt{3}$ used	**M1**
$24\sqrt{3}$ cm oe	**A1**

Answer: $24\sqrt{3}$ cm

Question 21

BC = 15 x tan 60	**M1**
tan 60 = $\sqrt{3}$ used	**M1**
$15\sqrt{3}$ cm oe	**A1**

Answer: $15\sqrt{3}$ cm

Question 22

correct substitution 4(1/2) - 2(1/2)	**M1**
1 cao	**A1**

Answer: 1

Question 23

tan60 = $\sqrt{3}$ and tan30 = $\sqrt{3}/3$ (or $1/\sqrt{3}$) stated or used	**M1**
$\sqrt{3}$ x $\sqrt{3}/3$ = 3/3 simplification seen	**M1**
1 cao	**A1**

Answer: 1

Question 24

sin30 = 1/2 and cos60 = 1/2 both seen or used	**M1**
1 cao	**A1**

Answer: 1

Question 25

substitutes sin45 = $\sqrt{2}/2$ and cos45 = $\sqrt{2}/2$ and squares each term to reach 1/2 + 1/2 (or equivalent, e.g. 2/4 + 2/4)	**M1**
1 cao	**A1**

Answer: 1

Question 26

cos75 = cos(45 + 30) or note cos75 = sin15 oe	**B1**
cos75 = ($\sqrt{6}$ - $\sqrt{2}$) / 4 cao	**A1**

Answer: cos 75 degrees = ($\sqrt{6}$ - $\sqrt{2}$) / 4

Question 27

identifies θ = 60 (from the exact value tan60 = $\sqrt{3}$)	**M1**
substitutes sin60 = $\sqrt{3}/2$ and cos60 = 1/2	**M1**
($\sqrt{3}$ + 1)/2 oe cao	**A1**

Answer: θ = 60 degrees; sin60 + cos60 = ($\sqrt{3}$ + 1)/2

Question 28

substitutes all four exact values: sin60 = $\sqrt{3}/2$, cos30 = $\sqrt{3}/2$, cos60 = 1/2, sin30 = 1/2	**M1**
correctly multiplies $\sqrt{3}/2$ x $\sqrt{3}/2$ = 3/4	**M1**
correctly multiplies 1/2 x 1/2 = 1/4	**M1**
3/4 + 1/4 = 1 cso, answer given	**A1**

Answer: 1 (shown)

Question 29

use tan(45 + 30) = (tan45 + tan30) / (1 - tan45 tan30) or equivalent	**M1**
substitute tan45 = 1 and tan30 = $1/\sqrt{3}$ and simplify to ($\sqrt{3}$ +1)/($\sqrt{3}$ -1) or equivalent	**M1**
2 + $\sqrt{3}$ cao	**A1**

Answer: 2 + $\sqrt{3}$

Question 30

use sine rule: a/sinA = b/sinB = c/sinC and substitute c = 1, sin60 = $\sqrt{3}/2$	**M1**
find BC = a = sin45 / sin60 and simplify to $\sqrt{6}/3$ or equivalent	**M1**
find AC = b = sin75 / sin60 and simplify to an exact surd	**M1**
BC = $\sqrt{6}/3$ and AC = ($3\sqrt{2}$ + $\sqrt{6}$)/6 cao	**A1**

Answer: BC = $\sqrt{6}/3$, AC = ($3\sqrt{2}$ + $\sqrt{6}$)/6

Question 31

sets up longer side = 8 x cos30	**M1**
longer side = $4\sqrt{3}$ cm cao	**A1**
sets up shorter side = 8 x sin30, giving shorter side = 4 cm	**M1**
area = $16\sqrt{3}$ cm^2 cao (a = 16, b = 3)	**A1**

Answer: $16\sqrt{3}$ cm^2 (a = 16, b = 3)

Question 32

recognise general solution for tan x = $\sqrt{3}$ is x = 60 + k*180 degrees	**M1**
set 2theta = 60 + k*180 and solve for θ giving θ = 30 + k*90 degrees	**M1**
find integer k values that give θ in $0 \leq \theta < 360$ and list candidates	**M1**
substitute k = 0,1,2,3 to produce θ = 30, 120, 210, 300 degrees	**M1**
check that each value is distinct and within the interval	**M1**
state final set θ = 30, 120, 210, 300 degrees cao	**A1**
optional check: show tan 2theta equals $\sqrt{3}$ for each listed θ (e.g. 2*30=60, tan60 = $\sqrt{3}$) ft	**M1**
note that no other k produce values in the interval	**M1**
complete solution set given	**A1**

Answer: θ = 30 degrees, 120 degrees, 210 degrees, 300 degrees

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