EQUITY
LEARNING PLACE

Additional Math Topical (Surds)

Question 1:

The area of a triangle is $\left(1+\frac{5\sqrt{5}}{2}\right)$ cm^2. If the length of the base of the triangle is $\left(3+2\sqrt{5}\right)$ cm, find, without using a calculator, the height of the triangle in the form of $\left(a+b\sqrt{5}\right)$ cm, where *a* and *b* are integers.

Question 2:

The length of each side of an equilateral triangle is $\frac{22}{5-\sqrt{3}}$ cm.

a) Show that the height of the triangle is $\left(\frac{3+5\sqrt{3}}{2}\right)$ cm.

b) Find the area of the triangle in the form $\frac{p+q\sqrt{3}}{2}$, where *p* and *q* are integers.

Question 3:

The area of a trapezium is $\left(27+\sqrt{5}\right)$ cm^2. Given that the length of the two parallel sides are $\left(1+\sqrt{5}\right)$ cm and $\left(3\sqrt{5}-5\right)$ cm, express the height of the trapezium in the form $\left(\frac{a+b\sqrt{5}}{c}\right)$ cm, where *a, b* and *c* are integers.

Question 4:

Find the value of k such that $\left(\frac{2}{\sqrt{6}}-\frac{\sqrt{150}}{6}+\frac{64}{\sqrt{384}}\right)\times\frac{\sqrt{3}}{5}=k\sqrt{2}$.

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Question 5:

Express the following in the form $a+b\sqrt{c}$

a) $\left(3-5\sqrt{2}\right)^2$,

b) $\dfrac{\sqrt{3}}{\sqrt{3}-\sqrt{2}}$

Question 6:

Given that $q=1+\sqrt{2}$, evaluate $\dfrac{q^2+3}{q+2}$

Question 7:

Given that $\dfrac{a+b\sqrt{5}}{4+3\sqrt{5}} = \dfrac{4+3\sqrt{5}}{2+\sqrt{5}}$, find the values of *a* and of *b*.

Question 8:

Given that $r=3-\sqrt{2}$, express $\dfrac{5-r^2}{r+1}$ in the form $a+b\sqrt{2}$, where *a* and *b* are constants

Question 9:

The base of a triangle is $\left(3+2\sqrt{7}\right)$ cm and its area is $\left(32+3\sqrt{7}\right)$ cm^2. Find the height of the triangle in the form $\left(a+b\sqrt{7}\right)$.

Question 10:

Without using a calculator, find the value of *m* such that $\left(\dfrac{3}{\sqrt{15}}+\dfrac{\sqrt{80}}{5}-\dfrac{15}{\sqrt{375}}\right)\times\dfrac{\sqrt{5}}{\sqrt{3}}=m\sqrt{3}$.

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Question 11:

Prove that $\frac{1}{\sqrt{2r-1}+\sqrt{2r+1}} = \frac{1}{2}\left(\sqrt{2r+1}-\sqrt{2r-1}\right)$.

Hence, find the exact value of

$$\frac{1}{\sqrt{1}+\sqrt{3}}+\frac{1}{\sqrt{3}+\sqrt{5}}+\frac{1}{\sqrt{5}+\sqrt{7}}+\frac{1}{\sqrt{7}+\sqrt{9}}+\frac{1}{\sqrt{9}+\sqrt{11}}$$

Question 12:

Without using a calculator, find the fractions *a* and *b*, for which $\frac{\sqrt{2}+\sqrt{7}}{\sqrt{21}-\sqrt{6}}$ can be expressed as $a\sqrt{42}+b\sqrt{3}$.

Question 13:

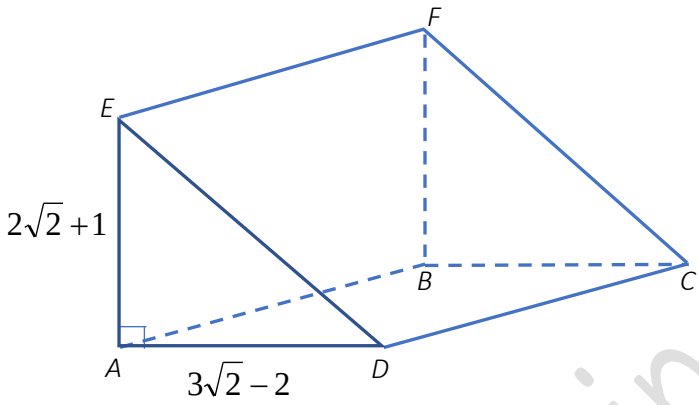
Express $\frac{2}{3-\sqrt{7}} - \left(\sqrt{7}-2\right)^2$ in the form of $a+b\sqrt{7}$ where a and b are integers.

Question 14:

A cuboid with a square base of length $\left(3-\sqrt{3}\right)$ cm, has a volume of $\left(18\sqrt{3}-24\right)$ cm^3. Find the height of the cuboid in the form $a+b\sqrt{3}$ where *a* and *b* are integers.

Question 15:

The volume of a prism *ABCDEF* is $9+4\sqrt{2}$ cm. The cross section is a right angled triangle where *AE* = $2\sqrt{2}+1$ cm and *AD* = $3\sqrt{2}-2$ cm.



Find

a) the area of triangle *ADE*, leaving your answer in surd form.

b) the length of *DC*, leaving your answer in the form $a+b\sqrt{2}$, where *a* and *b* are integers.

Question 16:

Express $\frac{\sqrt{8}}{4}-\frac{1}{\left(1+2\sqrt{2}\right)^2}$ in the form $a+b\sqrt{2}$, where *a* and *b* are rational numbers.

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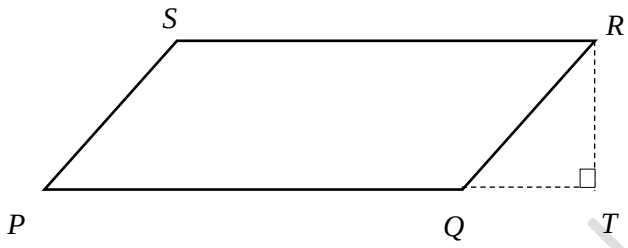
Question 17:

The diagram below shows a parallelogram *PQRS* whose area is $\left(7+8\sqrt{3}\right)\text{cm}^2$.



Given that the length of *QT* is $(5+\sqrt{3})$ cm and *QRT* is an isosceles triangle.

Find, in surd form,

(a) QR^2 in the form $a+b\sqrt{3}$,

(b) *SR* in the form $\dfrac{c+d\sqrt{3}}{2}$.

Question 18:

The area of triangle *XYZ* is $16+\dfrac{23}{4}\sqrt{3}\ \text{cm}^2$ and the length of the side *YZ* is $5+2\sqrt{3}$ cm. Find the length of the perpendicular from *X* to *YZ* in the form of $a+b\sqrt{3}$, where *a* and *b* are rational numbers.

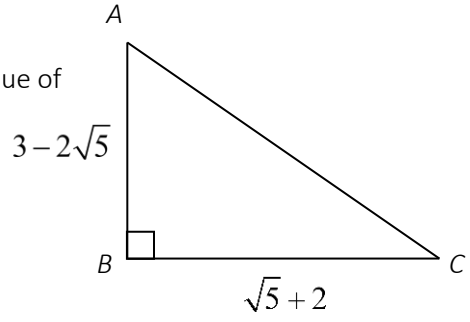
Question 19:

Triangle *ABC* is a right-angled triangle where $\angle ABC = 90°$.

Without using a calculator, find in the form of $a+b\sqrt{5}$, the value of

a) AC^2,

b) $\tan\angle ACB$.

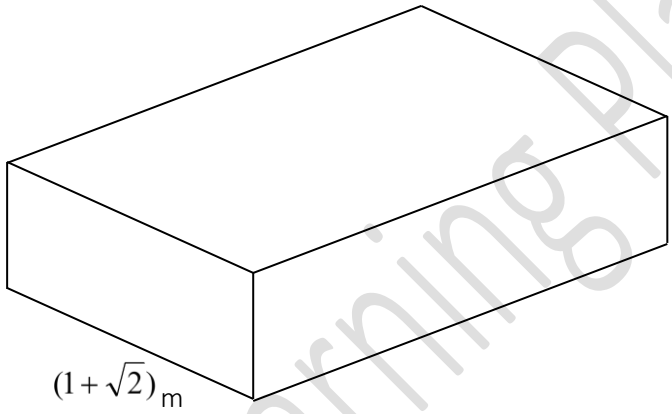


Question 20:

It is given that $\sqrt{3}(x-1)=3x-4$. Without using a calculator, find x in the form $a+b\sqrt{3}$, where a and b are rational numbers.

Question 21:

A hollow closed rectangular tank is constructed of thin sheet metal of negligible thickness. The length of the tank is twice the width. The total surface area of the tank is 48 m^2.



If the width is $(1+\sqrt{2})$ m, find the exact value of the height of the tank.

Question 22:

a) Without using a calculator, simplify $\frac{3}{\sqrt{3}}\left(\frac{3}{\sqrt{6}}-\frac{\sqrt{384}}{3}+\frac{\sqrt{50}}{2\sqrt{3}}\right)$

b) The area of a rectangle is $3\sqrt{6}\ \text{cm}^2$. Its length and breadth are $\frac{a+b\sqrt{3}}{2}\text{cm}$ and $\left(\sqrt{6}-\sqrt{2}\right)\text{cm}$ respectively.

Without using a calculator, find the values of the integers *a* and *b*.

Question 23:

Given that $\sqrt{6}=\left(\sqrt{6}-2\right)x-2$, evaluate $\frac{x^2+1}{x}$ without the use of a calculator.

Question 24:

Solve the following equations.

$$\frac{\sqrt{x-4}}{2}=2-\frac{1}{2}\sqrt{2x-1}$$

Question 25:

A cylinder has a radius of $\left(\sqrt{10}-\sqrt{2}\right)$ cm and a height of *h* cm. The volume of the cylinder is $\left(3+2\sqrt{5}\right)\pi$ cm^3. **Without using a calculator**, show that *h* can be expressed as $a+b\sqrt{5}$, where *a* and *b* are rational numbers.

Question 26:

A triangle ABC in which $AB=AC$ has an area of 46 cm^2. Given that the base BC is $\left(8\sqrt{3}-2\sqrt{2}\right)$ cm, find in rationalized surd form,

a) the height of the triangle

b) the perimeter of the triangle

Question 27:

Without using a calculator, find the integers *a* and such that $\frac{3\sqrt{5}-1}{\sqrt{5}+2}-\frac{15}{\sqrt{5}}=a+b\sqrt{5}.$

Question 28:

Without using a calculator, simplify $\left(3\sqrt{7}-2\right)\left(5+\sqrt{7}\right)$ in the form $a+b\sqrt{7}$, where *a* and *b* are integers.

Question 29:

Show that $\frac{1}{\sqrt{q-1}+\sqrt{q}}$ can be expressed as $-\sqrt{q-1}+\sqrt{q}$.

Hence, find the value of $\frac{1}{\sqrt{1}+\sqrt{2}}+\frac{1}{\sqrt{2}+\sqrt{3}}+....+\frac{1}{\sqrt{15}+\sqrt{16}}$.

Question 30:

Without using a calculator, simplify $\frac{\left(\sqrt{5}\right)^3-\left(\sqrt{3}\right)^3}{\sqrt{5}-\sqrt{3}}-\frac{\left(\sqrt{5}\right)^3+\left(\sqrt{3}\right)^3}{\sqrt{5}+\sqrt{3}}$, leaving your answer in exact form.