

Dr Oliver Mathematics
Mathematics Standard Grade: Credit Level
2009 Paper 1: Non-Calculator
55 minutes

The total number of marks available is 38.

You must write down all the stages in your working.

1. Evaluate

$$(846 \div 30) - 1.09.$$

(2)

Solution

$$\begin{aligned}(846 \div 30) - 1.09 &= (84.6 \div 3) - 1.09 \\ &= 28.2 - 1.09 \\ &= \underline{\underline{27.11}}.\end{aligned}$$

2. Evaluate

$$4\frac{1}{3} - 1\frac{1}{2}.$$

(2)

Solution

$$\begin{aligned}4\frac{1}{3} - 1\frac{1}{2} &= 3 + \frac{2}{6} - \frac{3}{6} \\ &= 3 - \frac{1}{6} \\ &= \underline{\underline{2\frac{5}{6}}}.\end{aligned}$$

3. Given that

$$f(x) = x^2 + 3,$$

(a) evaluate $f(-4)$,

(2)

Solution

$$\begin{aligned}f(-4) &= (-4)^2 + 3 \\ &= 16 + 3 \\ &= \underline{19}.\end{aligned}$$

(b) find t when $f(t) = 52$.

(2)

Solution

$$\begin{aligned}f(t) = 52 &\Rightarrow x^2 + 3 = 52 \\ &\Rightarrow x^2 = 49 \\ &= \underline{x = \pm 7}.\end{aligned}$$

4. (a) Factorise

$$x^2 - 4y^2.$$

(1)

Solution

$$\left. \begin{array}{l} \text{add to: } 0 \\ \text{multiply to: } -4 \end{array} \right\} -2, +2$$

$$x^2 - 4y^2 = \underline{(x + 2y)(x - 2y)}.$$

(b) Expand and simplify

$$(2x - 1)(x + 4).$$

(1)

Solution

$$\begin{array}{r|rr} \times & 2x & -1 \\ \hline x & 2x^2 & -x \\ +4 & +8x & -4 \\ \hline \end{array}$$

$$(2x - 1)(x + 4) = \underline{2x^2 + 7x - 4}.$$

(c) Expand

$$x^{\frac{1}{2}}(3x + x^{-2}).$$

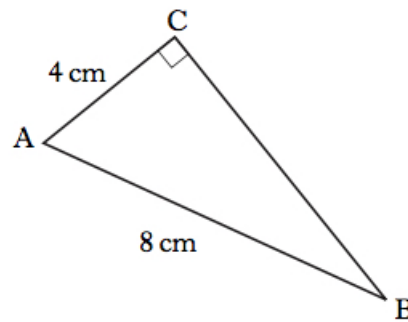
(2)

Solution

$$x^{\frac{1}{2}}(3x + x^{-2}) = \underline{\underline{3x^{\frac{3}{2}} + x^{-\frac{3}{2}}.}}$$

5. In triangle ABC , angle $ACB = 90^\circ$, $AB = 8$ centimetres, and $AC = 4$ centimetres.

(3)



Calculate the length of BC .

Give your answer as a surd in its simplest form.

Solution

$$\begin{aligned} BC &= \sqrt{AB^2 - AC^2} \\ &= \sqrt{8^2 - 4^2} \\ &= \sqrt{64 - 16} \\ &= \sqrt{8^2 - 4^2} \\ &= \sqrt{48} \\ &= \sqrt{16 \times 3} \\ &= \sqrt{16} \times \sqrt{3} \\ &= \underline{\underline{4\sqrt{3}}}. \end{aligned}$$

6. There are 4 girls and 14 boys in a class.

(3)

A child is chosen at random and is asked to roll a die, numbered 1 to 6.

Which of these is more likely?

A: the child is female.

OR

B: the child rolls a 5.

Justify your answer.

Solution

$$\begin{aligned} P(\text{girl}) &= \frac{4}{4+14} \\ &= \frac{4}{18} \end{aligned}$$

and

$$P(\text{rolls a 5}) = \frac{1}{6} = \frac{3}{18}.$$

Hence, the child is female is more likely.

7. This year, Ben paid £260 for his car insurance.
This is an increase of 30% on last year's payment.

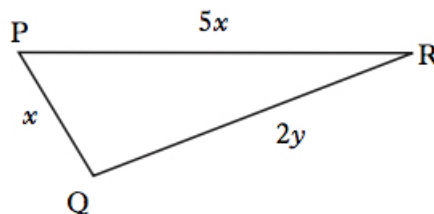
(3)

How much did Ben pay last year?

Solution

$$\begin{aligned} \text{Last year} &= \frac{260}{1 + 0.3} \\ &= \frac{260}{1.3} \\ &= \underline{\underline{£200.}} \end{aligned}$$

8. In triangle PQR , $PQ = x$ centimetres, $PR = 5x$ centimetres, and $QR = 2y$ centimetres.



The perimeter of the triangle is 42 centimetres.

- (a) Write down an equation in x and y to illustrate this information. (2)

Solution

$$x + 5x + 2y = 42 \Rightarrow \underline{\underline{6x + 2y = 42}} \quad (1).$$

PR is 2 centimetres longer than QR .

- (b) Write down another equation in x and y to illustrate this information. (2)

Solution

$$\underline{\underline{5x = 2y + 2}} \quad (2).$$

- (c) Hence calculate the values of x and y . (3)

Solution

Rearrange (2) and substitute into (1):

$$2y = 5x - 2 \Rightarrow 6x + (5x - 2) = 42$$

$$\Rightarrow 11x = 44$$

$$\Rightarrow \underline{\underline{x = 4}}$$

$$\Rightarrow 2y = 20 - 2$$

$$\Rightarrow 2y = 18$$

$$\Rightarrow \underline{\underline{y = 9}}.$$

9. A formula used to calculate the flow of water in a pipe is (3)

$$f = \frac{kd^2}{20}.$$

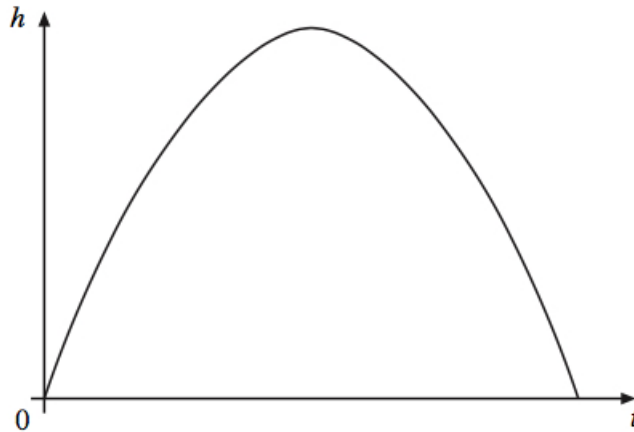
Change the subject of the formula to d .

Solution

$$f = \frac{kd^2}{20} \Rightarrow d^2 = \frac{20f}{k}$$
$$\Rightarrow \underline{\underline{d = \sqrt{\frac{20f}{k}}}}.$$

10. The diagram below shows the path of a rocket which is fired into the air. The height, h metres, of the rocket after t seconds is given by

$$h(t) = -2t(t - 14).$$



- (a) For how many seconds is the rocket in flight? (2)

Solution

$$\begin{aligned} -2t(t - 14) = 0 &\Rightarrow t = 0 \text{ or } t - 14 = 0 \\ &\Rightarrow t = 0 \text{ or } t = 14; \end{aligned}$$

so, the rocket is in flight for 14 seconds.

- (b) What is the maximum height reached by the rocket? (2)

Solution

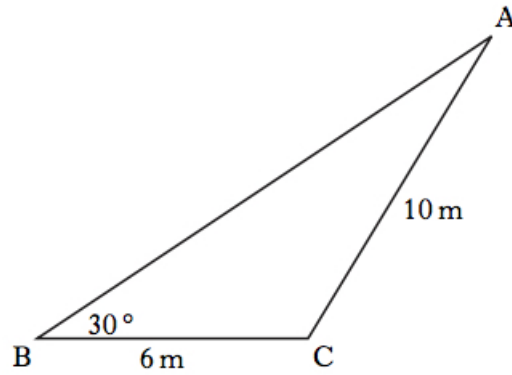
The vertex is at

$$t = \frac{0 + 14}{2} = 7$$

and

$$\begin{aligned} t = 7 &\Rightarrow h = -2 \times 7 \times (7 - 14) \\ &\Rightarrow h = -2 \times 7 \times (-7) \\ &\Rightarrow \underline{h = 98 \text{ m}}. \end{aligned}$$

11. In triangle ABC , $PQ = 6$ metres, $AC = 10$ metres, and angle $ABC = 30^\circ$. (3)



Given that $\sin 30^\circ = 0.5$, show that $\sin BAC = 0.3$.

Solution

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$$\begin{aligned}\frac{\sin BAC}{6} &= \frac{\sin 30^\circ}{10} \Rightarrow \sin BAC = \frac{6 \sin 30^\circ}{10} \\ &\Rightarrow \sin BAC = \frac{6 \times 0.5}{10} \\ &\Rightarrow \sin BAC = \frac{3}{10} \\ &\Rightarrow \underline{\underline{\sin BAC = 0.3}},\end{aligned}$$

as required.

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