1 Marco starts work at 20 45 and finishes at 02 08 the next day.

Find the length of time, in hours and minutes, he works.

20h 45′ → midnight → 2h 08′

3h 15′ + 2h 8′ = 5h 23′

..... 5 ..... h ..... 23 ..... min [1]

2

120 121 149 164 216

From this list, write down

(a) a square number

..... 121 ..... [1]

(b) a cube number.

..... 216 ..... [1]

3 Calculate.

$$\sqrt{15} + \frac{4.8}{2.2}$$

..... 6.05 ..... [1]

4 The mean mass of four men in a rowing team is 97.5 kg.
The modal mass is 101 kg.
The range of the masses is 8 kg.

Find the mass of each of the four men.

Total mass of 4 men = $97.5 \times 4 = 390$

Assume 101 appears twice, because mean < 101 so 101 must be in the 3rd & 4th position

$\Rightarrow 1^{st} = 101 - 8 = 93$

$\Rightarrow 2^{nd} = 390 - 93 - 101 \times 2 = 95$

..... 93 ..... kg , ... 95 ..... kg , ... 101 ..... kg, ... 101 ..... kg [3]
1st 2nd 3rd 4th

5 **Without using a calculator**, work out $\frac{5}{7} - \frac{2}{3}$.

You must show all your working and give your answer as a fraction in its simplest form.

$\frac{5 \times 3 - 2 \times 7}{7 \times 3} = \frac{1}{21}$

..... $\frac{1}{21}$ ..... [2]

6 A spinner can land on the colours green, black or red.
The table shows the probabilities of the spinner landing on green or black.

Colour	Green	Black	Red
Probability	$\frac{2}{5}$	$\frac{1}{4}$	$\frac{7}{20}$

(a) Complete the table. $1 - \frac{2}{5} - \frac{1}{4}$ [2]

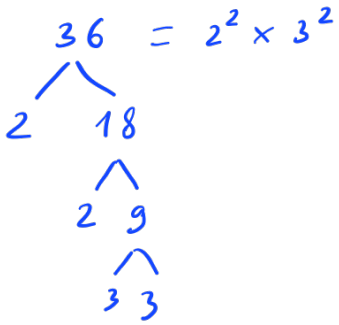
(b) Chang spins the spinner 120 times.

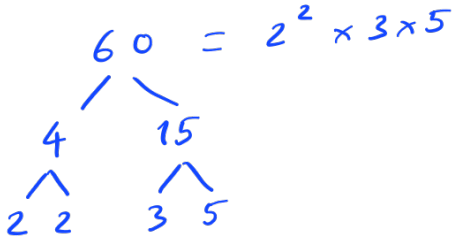
Find the expected number of times it lands on green.

$120 \times \frac{2}{5}$

48 [1]

7 Find the lowest common multiple (LCM) of 36 and 60.





$2^2 \times 3^2 \times 5 = 180$ [2]

8 A is the point $(-3, 5)$ and B is the point $(5, 2)$.

Find the coordinates of the midpoint of the line AB.

$\left(\frac{-3+5}{2}, \frac{5+2}{2} \right)$

(1 , 3.5) [2]

9 Solve the simultaneous equations.

$$3x - 2y = 21 \quad (1)$$
$$+\ 5x + 2y = 51$$

$3x + 5x = 21 + 51$

$8x = 72$

$x = 9$

Sub $x = 9$ into (1):

$3 \times 9 - 2y = 21$

$27 - 21 = 2y$

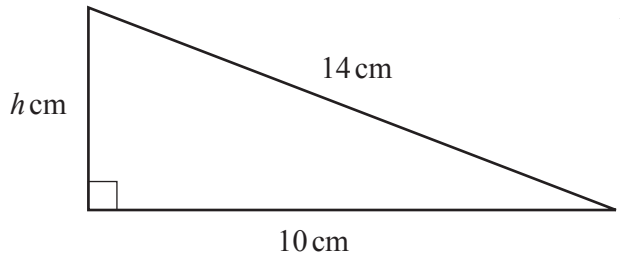
$6 = 2y$

$3 = y$

$x =$ ..... 9 .....

$y =$ ..... 3 ..... [2]

10



NOT TO SCALE

The diagram shows a right-angled triangle.

(a) Calculate the value of h.

$h = \sqrt{14^2 - 10^2} = 4\sqrt{6} \approx 9.80$

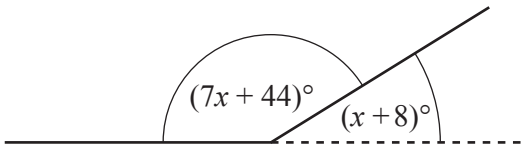
$h =$ ..... 9.80 ..... [3]

(b) Find the perimeter of this triangle.

$14 + 10 + 4\sqrt{6} \approx 33.8$

..... 33.8 ..... cm [1]

11



NOT TO SCALE

The diagram shows two sides of a regular polygon.
The interior angle of the polygon is $(7x+44)°$ and the exterior angle is $(x+8)°$.

Find the number of sides of this polygon.

$7x + 44 + x + 8 = 180$

$8x = 128$

$x = 16$

$\Rightarrow$ interior angle $= 7 \times 16 + 44 = 156$

$\frac{(n-2)180}{n} = 156$

$\Rightarrow 180n - 360 = 156n$

$24n = 360$

$n = 15$

..... 15 ..... [4]

12 Keita invests \$4000 at a rate of 2.6% per year compound interest.

Work out the interest earned on the investment at the end of 3 years.

interest $= 4000\left(1 + \frac{2.6}{100}\right)^3 - 4000 \approx 320$

\$ ..... 320 ..... [3]

13 Convert $0.2\dot{4}$ to a fraction.
You must show all your working and give your answer in its simplest form.

$x = 0.2444\ldots$

$10x = 2.4444\ldots$

$100x = 24.444\ldots$

$100x - 10x = 24 - 2 = 22$

$90x = 22$

$x = \frac{22}{90} = \frac{11}{45}$

..... $\frac{11}{45}$ ..... [2]

14 A map has a scale of 1 : 200 000.

Find the area, in square kilometres, of a lake that has an area of 12.4 cm^2 on the map.

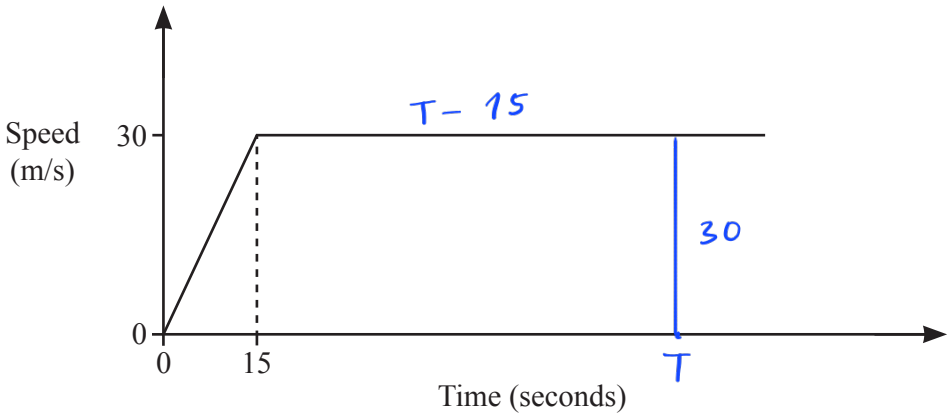
$1\ km^2 = 10^{10}\ cm^2$

$12.4 \times 200000^2 = 4.96 \times 10^{11}\ cm^2$

$= \frac{4.96 \times 10^{11}}{10^{10}} = 49.6\ km^2$

..... 49.6 ..... km^2 [2]

15 The diagram shows the speed–time graph for part of the journey of a car.



NOT TO SCALE

The car starts from rest and accelerates at a uniform rate for 15 seconds before reaching a constant speed of 30 m/s.

(a) Calculate the acceleration for the first 15 seconds.

$\frac{30}{15} = 2$

..... 2 ..... m/s^2 [1]

(b) After T **minutes**, the total distance travelled is 45 **kilometres**.

45 000 m

Find the value of T.

$\frac{1}{2}(T - 15 + T) \times 30 = 45000$

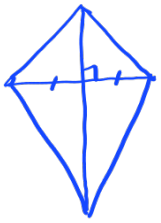
$15(2T - 15) = 45000$

$2T - 15 = 3000$

$T = 1507.5\ s = \frac{1507.5}{60}\ min$

$T =$ ..... 25.125 ..... min [4]

16 A kite is drawn on a coordinate grid.



The diagonals of the kite intersect at the point $(-2, -5)$.

One diagonal (d_1) has equation $y = 4x + 3$.

Find the equation of the other diagonal (d_2) of the kite.
Give your answer in the form $y = mx + c$.

$m_{d_1} = 4$

$d_1 \perp d_2 \Rightarrow m_{d_2} = -1 : 4 = -0.25$

$\Rightarrow$ Equation of d_2: $y - (-5) = -0.25[x - (-2)]$

$y + 5 = -0.25(x + 2)$

$y + 5 = -0.25x - 0.5$

$y =$ $-0.25x - 5.5$ [3]

17 y is proportional to the square of $(x - 7)$.
When $x = 12$, $y = 2$.

Find y when $x = 17$.

$y = k(x - 7)^2$

$2 = k(12 - 7)^2 \Rightarrow k = 0.08$

when $x = 17$, $y = 0.08(17 - 7)^2 = 8$

$y =$ 8 [3]

18 Two bottles are mathematically similar.
The small bottle has a capacity of 324 ml and a height of 12 cm.
The large bottle has a capacity of 768 ml.

Calculate the height of the large bottle.

$\frac{V_{small}}{V_{large}} = \left(\frac{h_{small}}{h_{large}}\right)^3 = \left(\frac{12}{h_{large}}\right)^3 = \frac{324}{768} = \frac{27}{64}$

$\Rightarrow \frac{12}{h_{large}} = \frac{3}{4} \Rightarrow h_{large} = \frac{12 \times 4}{3}$

16 cm [3]

19 $f(x) = 5x - 3,\ x > 1$

$g(x) = \frac{10}{x-2},\ x \neq 2$

(a) Find $gf(x)$.
Give your answer in its simplest form.

$\frac{10}{5x-3-2} = \frac{10}{5x-5} = \frac{2}{x-1}$

..... $\frac{2}{x-1}$ ..... [2]

(b) Find $g^{-1}(x)$.

g: $-2 \rightarrow$ reciprocal $\rightarrow \times 10$

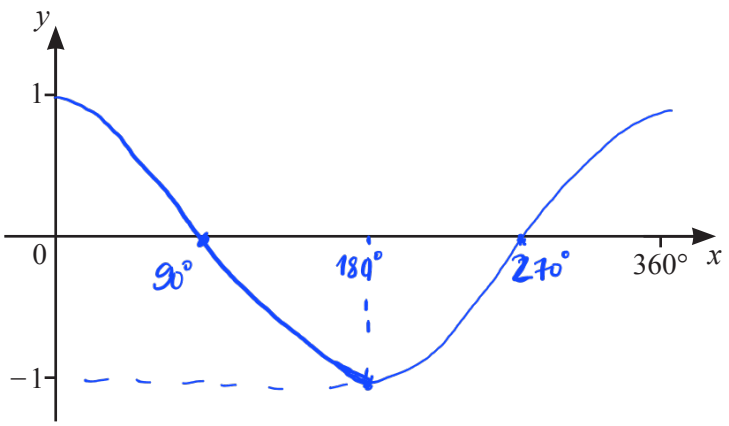
$+2 \leftarrow$ reciprocal $\leftarrow : 10$ $\quad g^{-1}$

$g^{-1}(x) =$ ..... $\frac{10}{x} + 2$ ..... [3]

(c) Find $ff^{-1}(x-1)$.

..... $x - 1$ ..... [1]

20 **(a)**



Sketch the graph of $y = \sin x$ for $0° \leqslant x \leqslant 360°$. [2]

(b) Solve $3 - 2\sin x = \frac{13}{4}$ for $0° \leqslant x \leqslant 360°$.

$-2\sin x = \frac{13}{4} - 3 = 0.25$

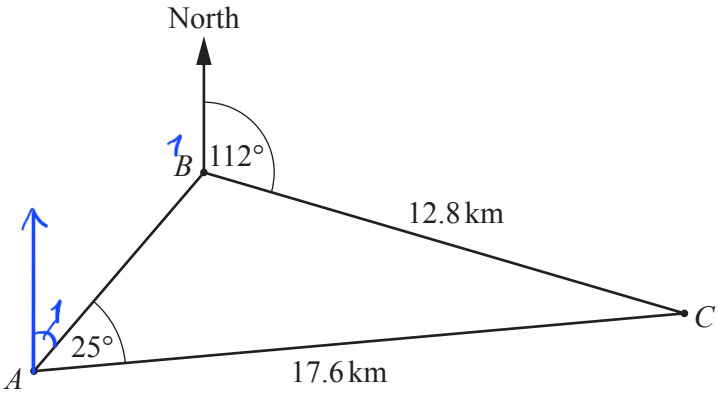
$\sin x = -0.125$

$x = -7.2°$ or $x = 180° - (-7.2°) = 187.2°$

or $x = 352.8°$

$x =$ ...187.2°... or $x =$ ...352.8°... [3]

21



NOT TO SCALE

The diagram shows the positions of three ships A, B and C.
$AC = 17.6$ km, $BC = 12.8$ km and angle $BAC = 25°$.
The bearing of C from B is 112° and angle ABC is obtuse.
Calculate the bearing of B from A.

$\frac{17.6}{\sin \hat{ABC}} = \frac{12.8}{\sin 25°}$

$\Rightarrow \sin \hat{ABC} = \frac{17.6 \sin 25°}{12.8} \approx 0.5811$

$\hat{ABC} = 35.5°$ or $\hat{ABC} = 180° - 35.5° = 144.5°$

Because $\hat{ABC}$ is obtuse so $\hat{ABC} = 144.5°$

$\Rightarrow \hat{B}_1 = 360° - 112° - 144.5° = 103.5°$

$\hat{A}_1 = 180° - 103.5° = 76.5°$

$\Rightarrow$ Bearing $A \to B = 076.5°$

.....076.5°..... [5]

22 **(a)** Expand and simplify.

$$(2x-1)(x+4)(x-3)$$

$(2x^2 - x + 8x - 4)(x-3)$

$(2x^2 + 7x - 4)(x-3)$

$2x^3 + 7x^2 - 4x - 6x^2 - 21x + 12$

$2x^3 + x^2 - 25x + 12$ [3]

(b) Write as a single fraction in its simplest form.

$$\frac{4}{2x-3} \div \frac{2x^2+14x}{2x^2+11x-21}$$

$\frac{4}{2x-3} : \frac{2x(x+7)}{(x+7)(2x-3)}$

$= \frac{4}{2x-3} : \frac{2x}{2x-3}$

$= \frac{4}{2x-3} \times \frac{2x-3}{2x}$

$= \frac{4}{2x}$

$= \frac{2}{x}$

$\frac{2}{x}$ [4]