

- 1 Buses on line A leave the bus depot every 20 minutes. Buses on line B leave the same depot every 50 minutes. If both lines started together at 08 00, how many times did the buses on both lines leave together from 08 00 to 13 00?

$$\begin{array}{l} 2 \quad 20, 50 \\ 2 \quad 10, 25 \\ 5 \quad 5, 25 \\ 5 \quad 1, 5 \\ \hline 1, 1 \end{array}$$

No of times = $\frac{5 \times 60}{100} + 1$

$$= 4$$

$$\text{LCM} = 2 \times 2 \times 5 \times 5$$

$$= 100$$

Answer [2]

- 2 (a) A stack of paper is made up of 3500 sheets of the same thickness. If the height of the stack of paper is 112 cm, find, in standard form, the thickness of a single sheet of paper in cm.

$$\text{Thickness} = \frac{112}{3500}$$

$$= 0.032$$

$$= 3.2 \times 10^{-2}$$

Answer 3.2×10^{-2} cm [1]

- (a) A printer produces extremely fine ink droplets which enable it to print images on papers. One ink droplet is 2.5 picolitres. One ink droplet is needed to produce one dot of a printed image. How many litres of ink are needed to print an image with 300 trillion dots? Express your answer in standard form.
[1 picolitre = 10^{-12} litres]

$$\text{No of litres} = 300 \times 10^{12} \times 2.5 \times 10^{-12}$$

$$= 750 \text{ l}$$

$$= 7.5 \times 10^2 \text{ l}$$

Answer 7.5×10^2 litres [1]

[Turn Over]

- 3 John's starting monthly pay is \$2500. He is given a yearly increment of \$150 by his company. He wants to save 10% of his monthly salary. The table below shows his monthly savings in each year.

Year	1	2	3	...	n
Monthly Savings	250	x	y	...	z

- (a) Find the value of x and of y.

$$\text{Increase each year} = \frac{10}{100} \times 150$$

$$= \$15$$

Answer x = 265, y = 260 [1]

- (b) Find, in terms of n, an expression for z.

Answer $15n + 235$ [1]

- 4 Tom had a collection of 54 toy vehicles. Of these, 24 were cars, 12 were vans and the rest were trucks. Tom decided that it was time to reduce his collection of vehicles. He sold c cars, v vans and t trucks. He found that the ratio of cars to vans to trucks was now 2 : 2 : 1. Find c, v and t, given that he has sold at least one of each type of vehicle and the smallest possible number of vehicles.

$$C : V : T$$

$$24 : 12 : 18$$

$$2 : 2 : 1 \quad (\times 5)$$

$$10 : 10 : 5$$

Answer c = 14
v = 2
t = 13 [2]

- 5 A solid cylinder of volume 21000 cm^3 rests with its curved surface on the base of a storage tank. Given that the water level of the tank with the cylinder in the tank is 30 cm and that the water just covers the cylinder, calculate, in cm , the length of the cylinder.

$$\begin{aligned}
 V &= \pi r^2 h \\
 21000 &= \pi \left(\frac{30}{2}\right)^2 h \\
 h &= \frac{21000}{\pi} \times \frac{4}{900} \\
 &= 29.7089 \\
 &= 29.7
 \end{aligned}$$

Answer..... 29.7 cm [2]

- 6 y is directly proportional to the cube of x . If x is increased by 1.5% , find the percentage increase in y .

$$\begin{aligned}
 y &= kx^3 \\
 \% \uparrow my &= \frac{k(1.015x)^3 - kx^3}{kx^3} \times 100\% \\
 &= (1.015^3 - 1) \times 100\% \\
 &= 4.5678\% \\
 &= 4.57\%
 \end{aligned}$$

Answer..... 4.57 % [2]

- 7 Express $\frac{x}{x^2+x-6} - \frac{2}{x-2}$ as a single fraction in its simplest form.

$$\begin{aligned}
 &\frac{x}{(x+3)(x-2)} - \frac{2}{x-2} \\
 &= \frac{x - 2(x+3)}{(x+3)(x-2)} \\
 &= \frac{x - 2x - 6}{(x+3)(x-2)} \\
 &= \frac{-x-6}{(x+3)(x-2)}
 \end{aligned}$$

Answer..... $\frac{-x-6}{(x+3)(x-2)}$ [3]

- 8 (a) Peter has a starting monthly salary of \$1600 and his company offers him a yearly increment of 5% . What will be his monthly salary after 5 years? Express your answer correct to the nearest dollar.

$$\begin{aligned}
 \text{Salary} &= 1600 \left(1 + \frac{5}{100}\right)^5 \\
 &= \$2042.0505 \\
 &= \$2042
 \end{aligned}$$

Answer \$..... 2042 [1]

- (b) John sets aside \$250 every month from January to December. In the following year, he deposits all the amount he sets aside in a bank that pays a simple interest of 0.05% per annum. How much interest will he receive after 4 years?

$$\begin{aligned}
 I &= \frac{250 \times 12 \times 0.05 \times 4}{100} \\
 &= \$6
 \end{aligned}$$

Answer \$..... 6 [2]

- 9 Given that $\frac{2p+q}{2p-q} = \frac{3}{4}q$, express p in terms of q .

$$4(2p+q) = 3q(2p-q)$$

$$8p+4q = 6pq-3q^2$$

$$8p-6pq = -4q-3q^2$$

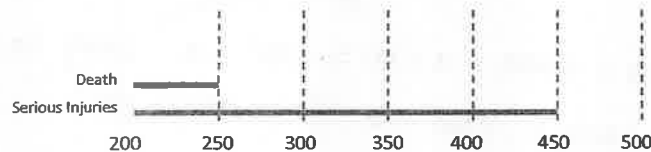
$$p(8-6q) = -4q-3q^2$$

$$p = \frac{-4q-3q^2}{8-6q}$$

Answer $p = \frac{-4q-3q^2}{8-6q}$ [3]

- 10 The bar chart shows the number of casualties (serious injuries and deaths) during a particular year.

Casualties In Road Accidents



- (a) One aspect of the graph is misleading. State the aspect and explain how it may lead to a misinterpretation of the graph. [2]

Answer

The horizontal axis does not start from 0.

This may lead to the misinterpretation that serious injuries is 5 times more than death.

- (b) The total number of casualties (slight injuries, serious injuries and deaths) was 7350 in that year. Does this mean that there were 7350 accidents? Give a reason for your answer. [1]

Answer

No because there may be more than 1 person injured in an accident.

[Turn Over

- 11 (a) Express x^2-2x+3 in the form $(x-a)^2+b$.

$$x^2-2x + \left(-\frac{2}{2}\right)^2 + 3 - \left(-\frac{2}{2}\right)^2$$

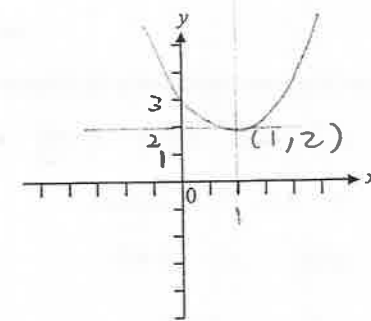
$$= (x-1)^2 + 3-1$$

$$= (x-1)^2 + 2$$

Answer $(x-1)^2 + 2$ [1]

- (b) Sketch, on the axes below, the graph of $y = x^2 - 2x + 3$. [2]

Answer



- 12 A map has a scale of 2 cm to 5 km.

- (a) The area of a lake is 0.5 km^2 . Calculate the area of the lake, in cm^2 , on the map. [2]

$$5 \text{ km} : 2 \text{ cm}$$

$$25 \text{ km}^2 : 4 \text{ cm}^2$$

$$0.5 \text{ km}^2 : \frac{4 \times 0.5}{25}$$

$$= 0.08 \text{ cm}^2$$

Answer 0.08 cm^2 [2]

- (b) The scale of the map can be expressed in the form $1 : n$. Find the value of n .

$$2 \text{ cm} : 5 \text{ km}$$

$$1 \text{ cm} : 2.5 \text{ km}$$

$$1 : 2.5 \times 1000 \times 100$$

$$= 250000$$

Answer 250000 [1]

- 13 Two villages, P and Q , are joined by straight road 6000 m long. Ann left P and ran to Q at a steady speed of 3 m/s. At the same instant that Ann left P , Ben left Q and cycled to P at a steady speed of 7 m/s.

(a) Calculate the distance, in m, between Ann and Ben at the end of the first 2 minutes.

$$\begin{aligned}\text{Distance} &= 6000 - (3 \times 2 \times 60) - (7 \times 2 \times 60) \\ &= 4800\end{aligned}$$

Answer 4800 m [1]

(b) Ann and Ben passed each other at M . Calculate the distance PM in m.

Let t be the time they met

$$3t + 7t = 6000$$

$$10t = 6000$$

$$t = 600$$

$$\begin{aligned}\text{Distance} &= 3 \times 600 \\ &= 1800\end{aligned}$$

Answer 1800 m [2]

- 14 Find the integer values of x for which $3x - 5 < x + 1 \leq 2x + 1$.

$$3x - 5 < x + 1$$

$$2x < 6$$

$$x < 3$$

$$x + 1 \leq 2x + 1$$

$$0 \leq x$$

$$\therefore 0 \leq x < 3$$

$$\therefore x = 0, 1, 2$$

Answer 0, 1, 2 [3]

- 15 (a) Find the sum of the interior angles of a pentagon.

$$\begin{aligned}\text{Sum of int } \angle s &= (n-2) \times 180^\circ \\ &= (5-2) \times 180^\circ \\ &= 540^\circ\end{aligned}$$

Answer 540° [1]

(b) In the diagram, all the marked angles are x° . Find the value of x .

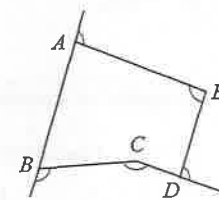
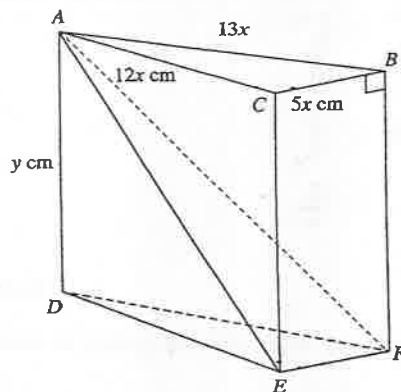


Diagram Not
Drawn To Scale

$$\begin{aligned}\angle BAE = \angle ABC = \angle CDE &= 180^\circ - x \quad (\text{adj } \angle s \text{ on a str line}) \\ \text{reflex } \angle BCD &= 360^\circ - x \quad (\angle s \text{ at a pt}) \\ 3(180^\circ - x) + 360^\circ - x &= 540^\circ \\ 3x &= 360^\circ \\ x &= 120^\circ\end{aligned}$$

Answer 120° [2]

- 16 The diagram shows a triangular prism.
 $AB = 13x$, $AD = y$ cm, $AC = 12x$ cm and $BC = 5x$ cm.



- (a) Show that triangle ABC is a right angled triangle.

[1]

Answer

$$AB^2 = AC^2 + CB^2$$

$\therefore$ by Pythagoras' Theorem, $\triangle ABC$ is a right
 $\angle$.

- (b) The volume of the prism is 100 cm^3 .

- (i) Show that $y = \frac{10}{3x^2}$.

[1]

Answer

$$V = \frac{1}{2} \times 5x \times 12x \times y$$

$$100 = 30x^2 y$$

$$y = \frac{10}{3x^2}$$

- (ii) A triangular pyramid $ADEF$ is cut from the prism. Find the volume of the pyramid in cm^3 .

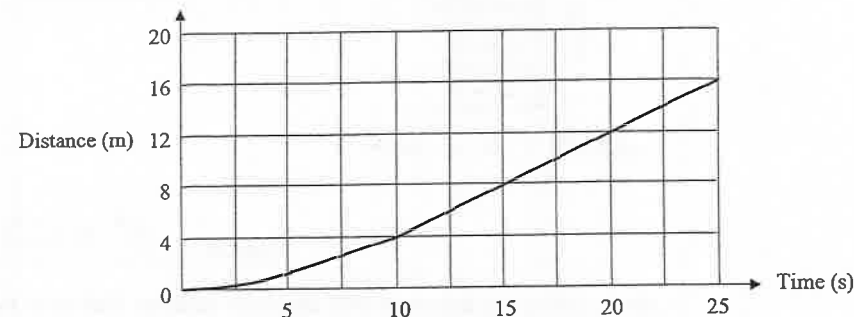
$$V = \frac{1}{3} \times 100$$

$$= \frac{100}{3}$$

Answer $\frac{100}{3}$ cm^3 [1]

[Turn Over]

- 17 The diagram is the distance time graph for the first 25 seconds of an object. The object started from rest.



- (a) Find the speed of the object when $t = 15$ s.

$$\text{Speed} = \frac{\Delta \text{dist}}{\Delta \text{time}}$$

$$= \frac{16-4}{25-10}$$

$$= \frac{4}{5}$$

Answer $\frac{4}{5}$ m/s [1]

- (b) The object moved with a constant acceleration for the first 10 seconds. Find this acceleration.

$$\text{acceleration} = \frac{\Delta \text{speed}}{\Delta \text{time}}$$

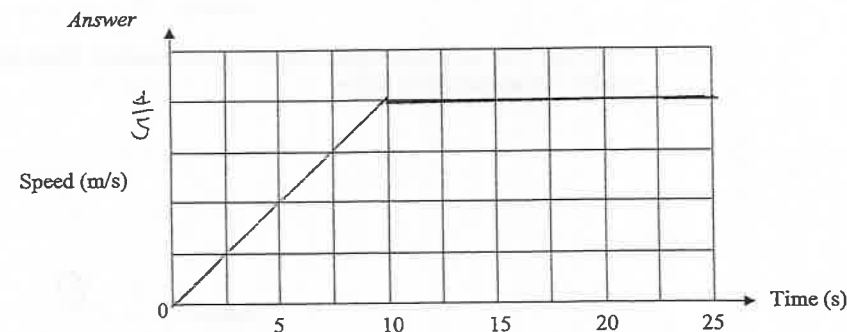
$$= \frac{\frac{4}{5} - 0}{10}$$

$$= \frac{1}{25}$$

Answer $\frac{1}{25}$ m/s^2 [1]

- (c) Complete the speed time graph for the same journey below.

[1]



- 18 (a) (i) Express 2007 as the product of its prime factors.

$$\begin{array}{r} 3 \overline{) 2007} \\ \underline{669} \\ 223 \end{array}$$

$$2007 = 3^2 \times 223$$

Answer..... $3^2 \times 223$ [1]

- (ii) Two of the factors of 2007 are square numbers. Find these two square numbers.

Answer..... 1 9 [1]

- (b) Expressed as the product of prime factors,

$$p = 2^{n+2} \times 3^n \times 5 \text{ and } q = 2^n \times 3^{n+1} \times 5^2$$

where n is a positive integer.

Find the highest common factor (HCF) of p and q in terms of n .

$$\begin{aligned} \text{HCF} &= 2^n \times 3^n \times 5 \\ &= 6^n \times 5 \end{aligned}$$

Answer..... $6^n \times 5$ [1]

- (c) 2, 3, 5 and 7 are all common prime factors of two numbers. Write down the digit that the two numbers must end in.

Answer..... 0 [1]

- 19 (a) Solve the equation $6^{2x-1} = \sqrt{6}$.

$$6^{2x-1} = 6^{\frac{1}{2}}$$

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

$$2x = \frac{3}{2}$$

$$x = \frac{3}{4}$$

Answer..... $\frac{3}{4}$ [2]

- (b) Simplify each of the following, giving your answer in positive index.

(i) $2x^{\frac{1}{3}} \div \frac{1}{2}x^{-1}$,

$$\begin{aligned} &2x^{\frac{1}{3}} \times \frac{2}{x^{-1}} \\ &= 4x^{\frac{1}{3} - (-1)} \\ &= 4x^{\frac{4}{3}} \end{aligned}$$

Answer..... $4x^{\frac{4}{3}}$ [1]

(ii) $\left(\frac{x^2}{3}\right)^{-3}$.

$$\begin{aligned} &\left(\frac{3}{x^2}\right)^3 \\ &= \frac{27}{x^6} \end{aligned}$$

Answer..... $\frac{27}{x^6}$ [1]

- 20 Two similar solids are made of the same material. The circular base area of the smaller one is 45 cm^2 while the larger one is 180 cm^2 .

- (a) Find the circumference of the base of the smaller solid if that of the larger solid is 10 cm.

$$\frac{A_1}{A_2} = \frac{45}{180}$$

$$\frac{C_1}{C_2} = \sqrt{\frac{1}{4}}$$

$$\frac{C_1}{10} = \frac{1}{2}$$

$$C_1 = 5$$

Answer.....5.....cm [2]

- (b) It costs 8 cents to wrap the larger solid. How much does it cost to wrap the smaller solid?

$$\frac{\text{Cost}_1}{\text{Cost}_2} = \frac{1}{4}$$

$$\frac{\text{Cost}_1}{8} = \frac{1}{4}$$

$$\text{Cost}_1 = \frac{1}{4} \times 8$$

$$= 2$$

Answer.....2.....cents [1]

- (c) The weight of a third solid is $\frac{8}{27}$ the weight of the larger solid. Express the ratio of the height of the third solid to that of the larger solid in its simplest form if both solids are similar.

$$\frac{W_3}{W_2} = \frac{8}{27}$$

$$\frac{H_3}{H_2} = \sqrt[3]{\frac{8}{27}}$$

$$= \frac{2}{3}$$

Answer.....2.....3..... [1]

[Turn Over]

- 21 A fitness centre advertised a programme designed specifically for men weighing 80 kg or more and claimed that their individual weight could be reduced by at least 20 kg on completion of the programme. 11 men enrolled in the programme and their weights, in kg when they started, are presented in the stem and leaf diagram below.

Stem	Leaf
8	0
9	9 9
10	0 0 1 2 2 2 5 5

- (a) State the modal weight of these men.

Answer.....102.....kg [1]

- (b) Find the median weight of these men.

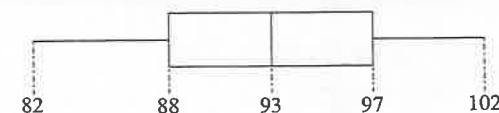
Answer.....101.....kg [1]

- (c) For these men, explain why the mean is not a suitable average. [1]

Answer

There is an extreme value of 80 kg which will deflate the mean when it is included.

- (d) The box-and-whisker diagram shows the weights of these men upon completion of the programme.



Based on the box-and-whisker diagram, it is claimed that none of these men have reduced their individual weights by 20 kg or more. Determine whether the claim is true and explain your answer briefly. [1]

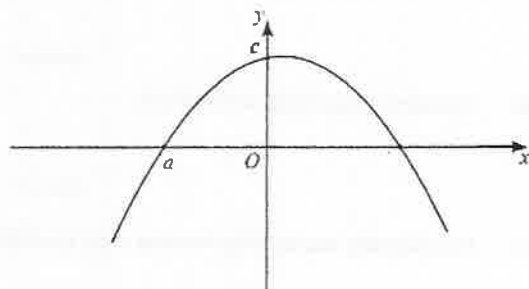
Answer

False. The man who weighed 105 kg may now be 82 kg (minimum). He has reduced by more than 20 kg.

- 22 (a) Factorise
- $24+5x-x^2$
- .

Answer $-(x+3)(x-8)$ [1]

- (b) (i) The diagram shows a sketch of $y=24+5x-x^2$. Write down the values of a and c .



Answer $a = -3$ [1]
 $c = 24$ [1]

- (ii) Find the equation of the line of symmetry of the graph $y=24+5x-x^2$.

$$x = \frac{8 + (-3)}{2}$$

$$x = \frac{5}{2}$$

Answer $x = \frac{5}{2}$ [1]

- 23 (a) Factorise completely
- $3uv-12u-v+4$
- .

$$3u(v-4) - (v-4) \\ = (v-4)(3u-1)$$

Answer $(v-4)(3u-1)$ [2]

- (b) (i) Factorise completely n^3-n .

$$n(n^2-1) \\ = n(n+1)(n-1)$$

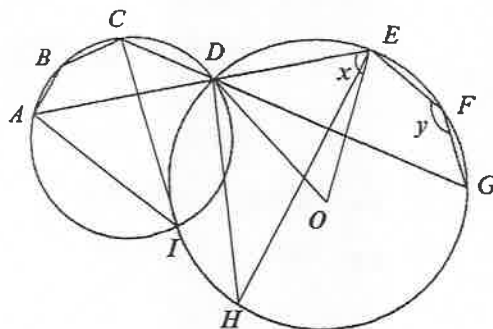
Answer $n(n+1)(n-1)$ [2]

- (ii) Hence, explain why n^3-n is divisible by 2 for any integer values of n . [1]

Answer

$n-1$, n , $n+1$ are consecutive numbers.
 There will be at least an even number among them.
 Hence, their product will be an even and divisible by 2.

- 24 The diagram shows two circles. A, B, C, D and I lie on the small circle. D, E, F, G, H and I lie on the large circle, centre O . CDG and ADE are straight lines.



- (a) Angle $DEO = x^\circ$. Find, as simply as possible in terms of x and stating all the reason(s), angle DHE .

$$\angle DOE = 180^\circ - 2x \quad (180^\circ \Delta)$$

$$\angle DHE = \frac{180^\circ - 2x}{2} \quad (\angle \text{ at centre} = 2 \angle \text{ at } \odot^a)$$

$$= 90^\circ - x$$

Answer..... $90^\circ - x$ [2]

- (b) Angle $EFG = y^\circ$. Find, as simply as possible in terms of y and stating all the reason(s), angle ABC .

$$\angle COE = y \quad (\text{ext } \angle \text{ of cyclic quad})$$

$$\angle ABC = \angle COE$$

$$= y \quad (\text{ext } \angle \text{ of cyclic quad})$$

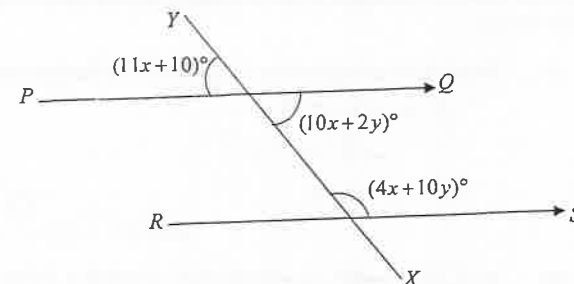
Answer..... y [2]

- (c) Explain briefly why angle $DAI =$ angle DCI . [1]

Answer

$\angle DAI$ and $\angle DCI$ are $\angle$ s in the same segment.

- 25 In the diagram, the line segment XY is the transversal of parallel lines PQ and RS .



- (a) Explain briefly why the sum of $(10x+2y)^\circ$ and $(4x+10y)^\circ$ is 180° [1]

Answer

They are interior $\angle$ s

- (b) Form an equation in x and y and show that it reduces to $x - 2y = -10$. [1]

Answer

$$11x + 10 = 10x + 2y \quad (\text{vert opp } \angle \text{s})$$

$$x - 2y = -10$$

- (c) Hence, find the value of x and of y .

$$10x + 2y + 4x + 10y = 180$$

$$14x + 12y = 180$$

$$7x + 6y = 90 \quad \text{--- (1)}$$

$$x - 2y = -10 \quad \text{--- (2)}$$

$$(2) \times 7 \quad 7x - 14y = -70 \quad \text{--- (3)}$$

$$(1) - (3) \quad 20y = 160$$

$$y = 8$$

$$x = 6$$

Answer $x = 6$
 $y = 8$ [3]