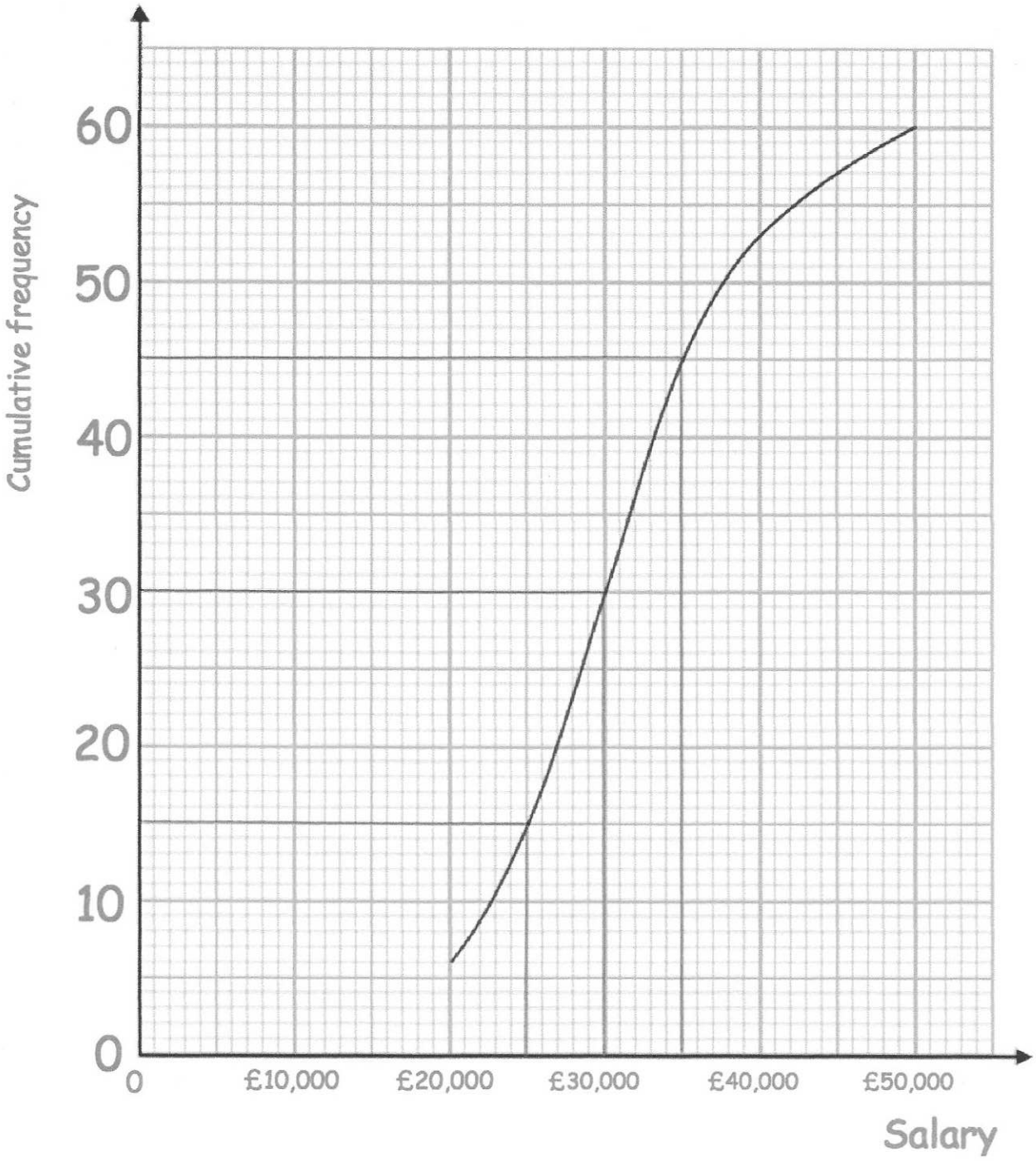
51. A university surveyed 60 mathematics graduates on their starting salary.
The cumulative frequency graph shows some information about the salaries.



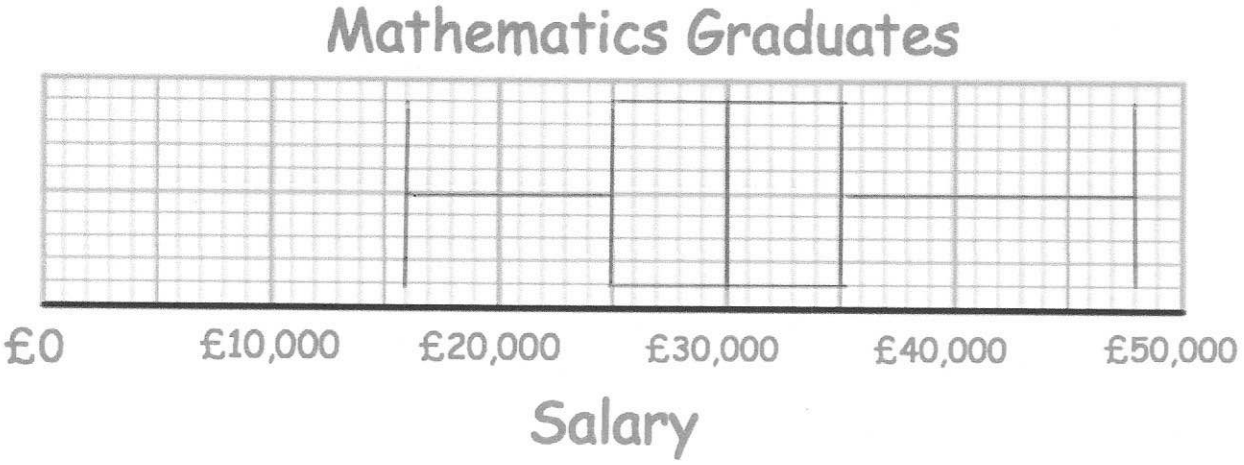
(a) Use the graph to find an estimate for the median salary.

£ 30000

(1)

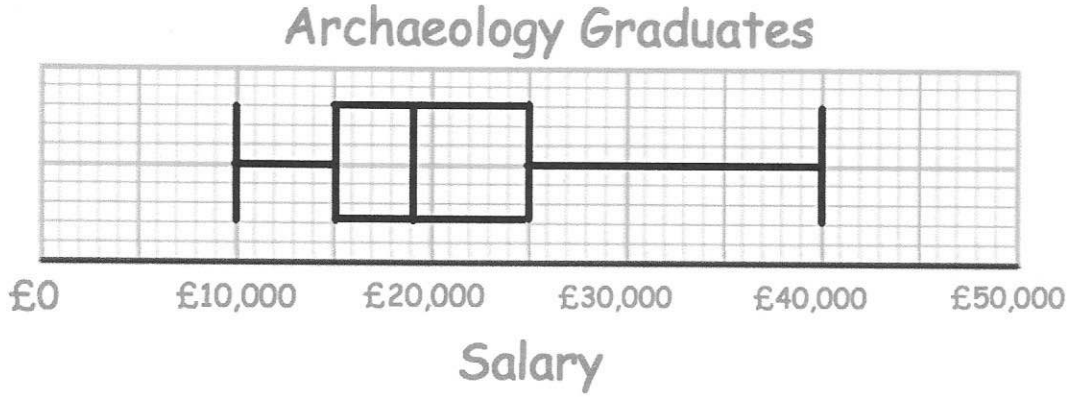
The 60 mathematics graduates
had a minimum salary of £16,000
and a maximum salary of £48,000.

(b) Use this information and the cumulative frequency curve to draw a box plot for the 60 mathematics graduates.



(3)

The university also surveyed 60 archaeology graduates.
The box plot below shows information about their salaries.



(c) Compare the distribution of the salaries of the mathematics graduates with the distribution of the salaries of the archaeology graduates.

The salaries have a similar spread, both with IQR of £10000. The mathematics graduates earn more, with a median of £30000 compared to £19000

(2)

52. Timothy asked 30 people how long it takes them to get to school.

The table shows some information about his results.

Time (t minutes)	Frequency
$0 < t \leq 10$ 5	2
$10 < t \leq 20$ 15	8
$20 < t \leq 30$ 25	12
$30 < t \leq 40$ 35	7
$40 < t \leq 50$ 45	1

fx
10
120
300
245
45
720

Work out an estimate for the mean time taken.

720 ÷ 30 = 24

24 .....minutes

(4)

53. Sally and Laura sit their driving tests.

The probability of Sally passing her driving test is 0.7
The probability of both Sally and Laura passing is 0.56

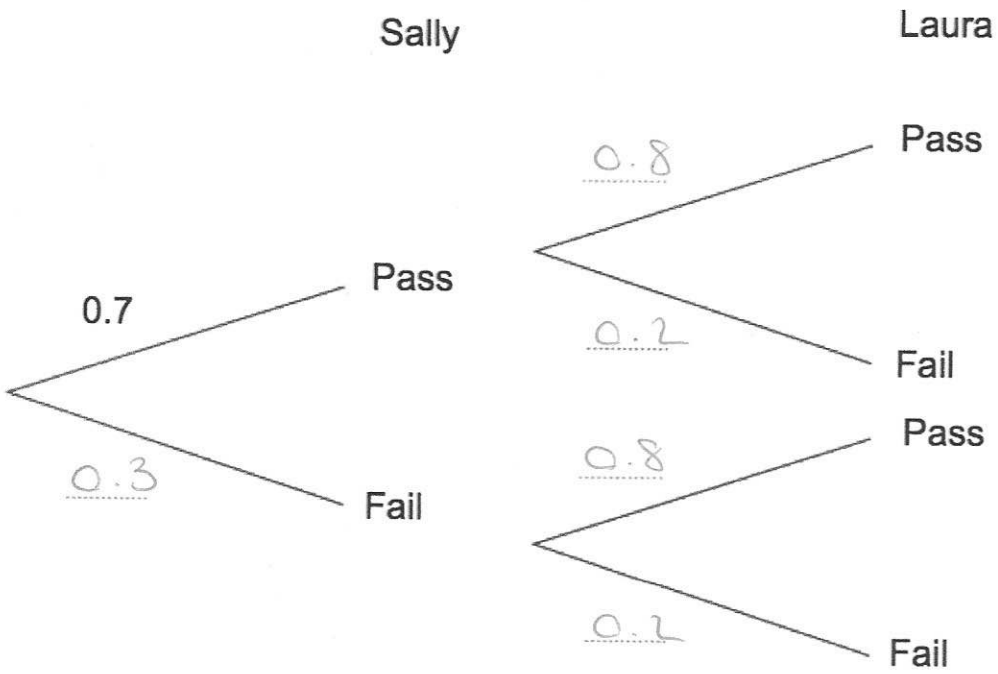
(a) Work out the probability of Laura passing her driving test.

$0.7 \times y = 0.56$

0.8

(2)

(b) Complete the tree diagram.



(2)

(c) Find the probability of both women failing.

0.3×0.2

0.06

(2)

54. Expand and simplify $(3y - 2)(y + 3)$

$3y^2 + 9y - 2y - 6$

$3y^2 + 7y - 6$

.....

(2)

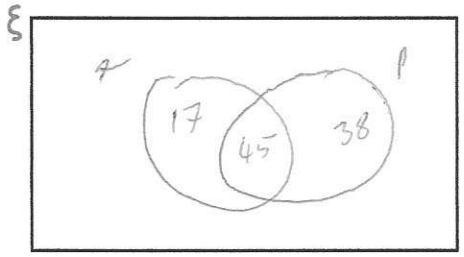
55. A PE test has two sections, theory and practical.

Everyone in a class who took the PE test passed at least one section.
62% passes the theory section and 83% passed the practical section.

38% passed only practical

17% passed only theory

(a) Represent this information on a Venn diagram



(3)

A student is selected at random.

Work out the probability that this person

(a) passed the theory section, given they passed the practical section.

45/83

.....

(2)

(b) passed the practical section, given they passed only one section.

38/55

.....

(2)

56. The test scores from the students in a school are summarised in the table.

Test score, x	Frequency
$0 < x \leq 30$	15
$30 < x \leq 40$	22
$40 < x \leq 50$	28
$50 < x \leq 70$	30
$70 < x \leq 100$	9

Frequency density

0.5

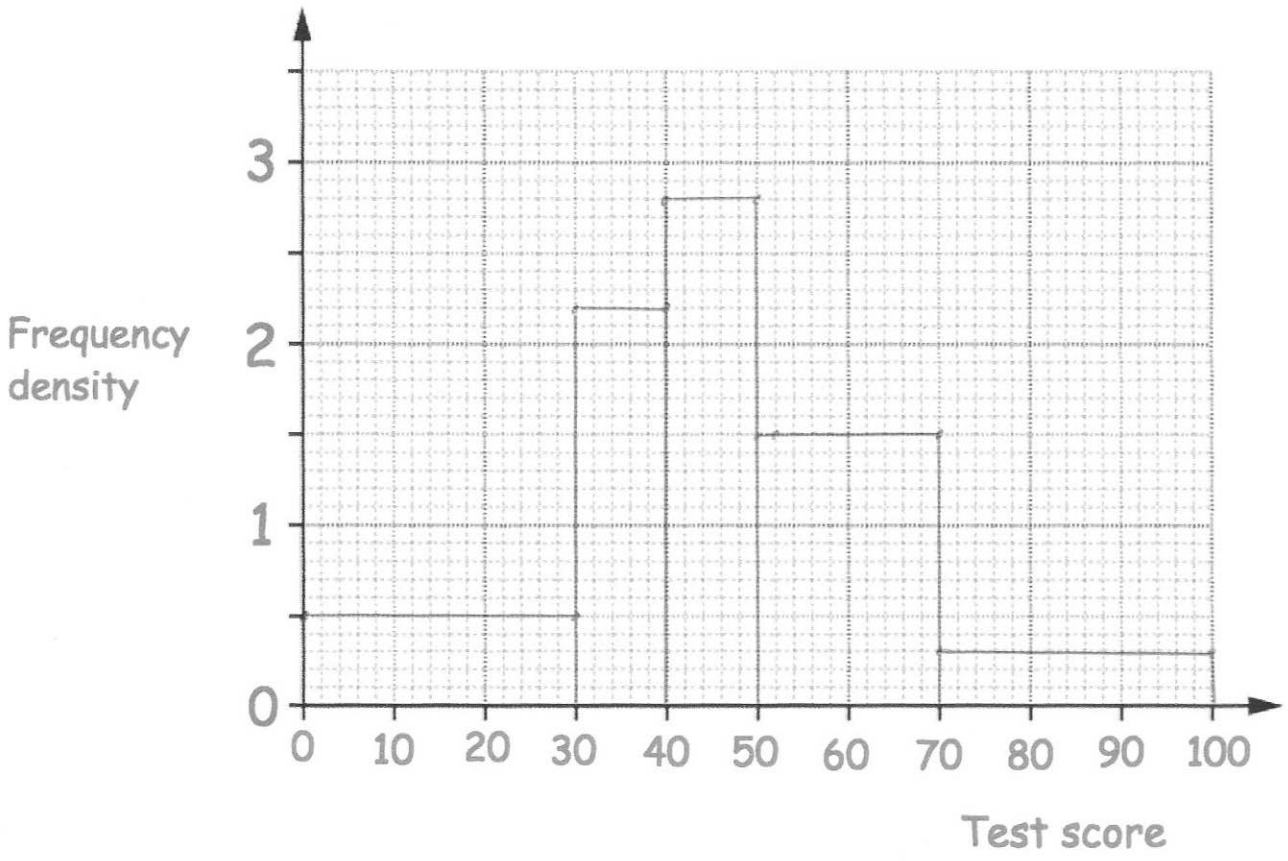
2.2

2.8

1.5

0.3

Draw a histogram for this data.



(3)

57. The volumes of two mathematically similar solids are in the ratio 8 : 125

The surface area of the smaller solid is 24 cm²

Work out the surface area of the larger solid.

r 8 : 125

s 2 : 5

a 4 : 25

24 ÷ 4 = 6

6 × 25 = 150

.....150.....cm²

(3)

---

58. Anthony measured the length and width of a rectangle.
He measured the length to be 18cm correct to the nearest centimetre.
He measured the width to be 10cm correct to the nearest 10 centimetres.

Calculate the lower bound for the area of this rectangle.

17.5 × 5 = 87.5

.....87.5.....cm²

(2)

---

59. Factorise fully

$9m^2 - 12mp$

.....3m(3m - 4p).....

(2)

---

60. (a) Factorise $y^2 - 12y - 64$

.....(y - 16)(y + 4).....

(2)

62. Solve the equation $4x^2 + x - 7 = 0$

Give your answers to two decimal places.

$a = 4 \quad b = 1 \quad c = -7$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-1 \pm \sqrt{1 - -112}}{8} = \frac{-1 \pm \sqrt{113}}{8}$$

x = ... or x = ...

(3)

---

63. The first 5 terms in a number sequence are

10 7 4 1 -2 ... ...

(a) Work out the *n*th term of the sequence.

$-3n + 13$

or $13 - 3n$

.....

(2)

(b) Find the 50th term of the sequence.

$-3 \times 50 = -150$

$-150 + 13 =$

.....

(2)

(b) Factorise $2y^2 + 7y - 15$

$(2y-3)(y+5)$

(2)

(c) Factorise fully $4y^2 - 49$

$(2y-7)(2y+7)$

(2)

---

61. (a) Solve $m^2 + 24m + 63 = 0$

$(m+21)(m+3)=0$

$m=-21$ or $m=-3$

(2)

(b) Solve $5y^2 + 8y - 100 = y^2 + 4y - 37$

$4y^2 + 4y - 63 = 0$

$(2y+9)(2y-7)=0$

$y=-4.5$ or $y=3.5$

.....

(2)

64. Here are the first 5 terms of a quadratic sequence

4 10 18 28 40

Find an expression, in terms of n, for the nth term of this quadratic sequence.

$a+b+c=4$

$4+c=4$ (4) 10 18 28 40

$c=0$

$3a+b=6$ (6) 8 10 12

$3+b=6$

$b=3$ (2) 2 2

$2a=2$

$a=1$

n^2+3n

(3)

---

65. Solve $5(3c-2)-7c=40-2c$

$15c-10-7c=40-2c$

$8c-10=40-2c$

$10c=50$

$c=5$

$c = 5$

(3)

---

66. (a) Solve the inequality $3(x-4) \leq 15$

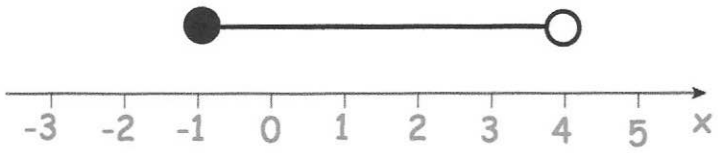
$3x-12 \leq 15$

$3x \leq 27$

$x \leq 9$

(2)

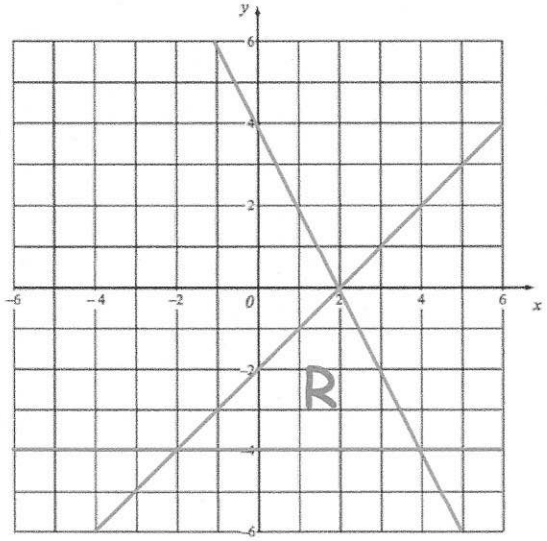
(b) Write down the inequality shown by the diagram.



$-1 \leq x < 4$

(2)

67.



The region labelled R satisfies three inequalities.

State the three inequalities

$y \geq -4$

$y \leq x - 2$

$y \leq -2x + 4$

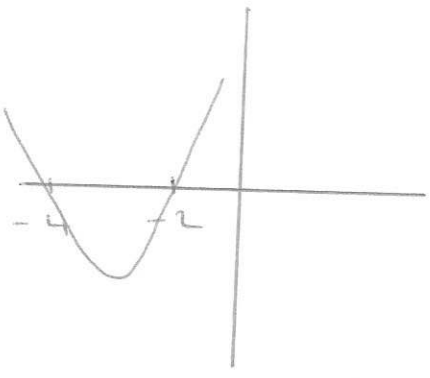
(3)

---

68. Solve the inequality $x^2 + 6x + 8 < 0$

$(x+2)(x+4) = 0$

$x = -2$ or $x = -4$



$-4 < x < -2$

(3)

69. A circle has centre (0, 0) and radius 6.

(a) Write down the equation of the circle.

$x^2 + y^2 = 36$

(2)

(b) Does the point (–3 , 5) lie on the circle?

$(-3)^2 + 5^2$

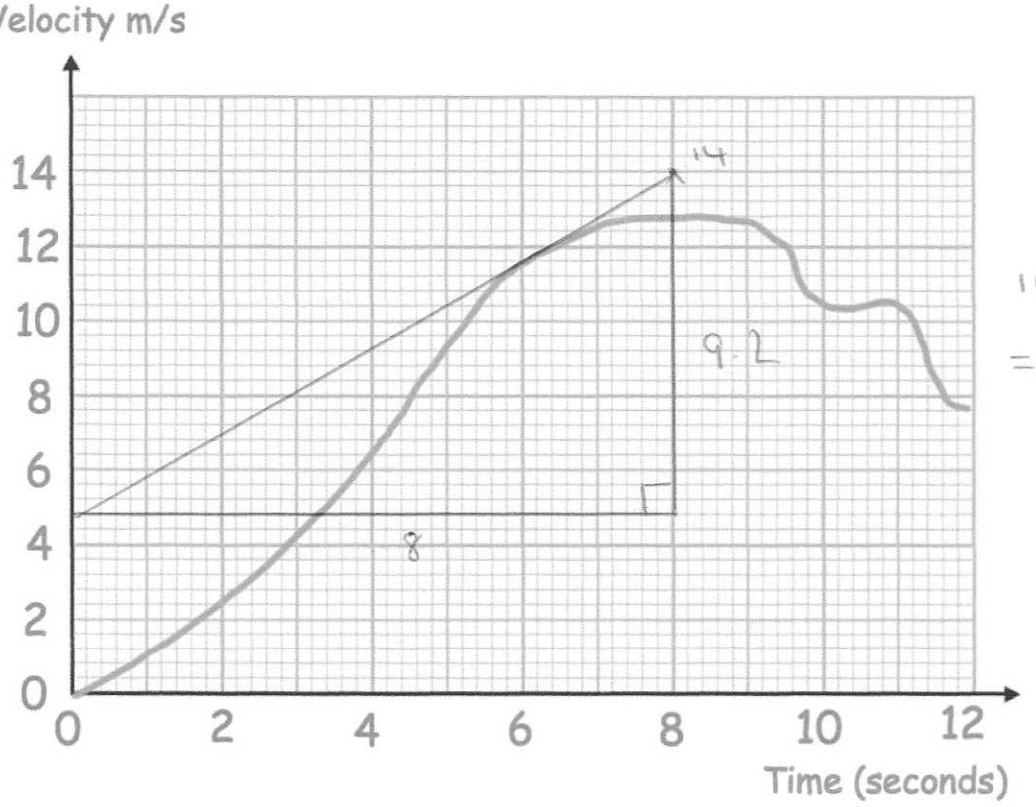
$= 9 + 25$

$= 34$

No

(2)

70.



$14 - 4.8$

$= 9.2$

Above is the velocity-time graph of a particle over 12 seconds.

Find an estimate of the particle's acceleration at 6 seconds
Include suitable units

$\frac{9.2}{8} = 1.15$

$1.15 m/s^2$

(3)

71. (a) Simplify

$$\frac{x^2 - 3x + 2}{x^2 + 5x - 6}$$

$$\frac{(x-2)(x-1)}{(x+6)(x-1)}$$

$\frac{x-2}{x+6}$

.....

(3)

(b) Simplify fully.

$$\frac{v + 3}{2} \div \frac{3v + 9}{5}$$

$$\frac{v+3}{2} \times \frac{5}{3v+9}$$

$$= \frac{5(v+3)}{6v+18} = \frac{5(v+3)}{6(v+3)}$$

$\frac{5}{6}$

.....

(2)

(c) Solve

$$\frac{7}{x+2} + \frac{10}{2x-5} = 3$$

$$\frac{7(2x-5)+10(x+2)}{(x+2)(2x-5)} = 3$$

$$14x - 35 + 10x + 20 = 3(x+2)(2x-5)$$

$$24x - 15 = 3(2x^2 - x - 10)$$

$$24x - 15 = 6x^2 - 3x - 30$$

$$0 = 6x^2 - 27x - 15$$

$$0 = 2x^2 - 9x - 5$$

$$(2x+1)(x-5) = 0$$

$$x = -\frac{1}{2} \text{ or } x = 5$$

$-\frac{1}{2}$ or 5

.....

(5)

72.

The functions $f(x)$ and $g(x)$ are given by the following:

$$f(x) = 3x - 1$$
$$g(x) = 2x + 4$$

(a) Calculate the value of $fg(2)$

$g(2) = 2 \times 2 + 4 = 8$

$f(8) = 3 \times 8 - 1 = 23$

$fg(2) = 23$

(2)

(b) Find $f^{-1}(x)$

$y = 3x - 1$

$y + 1 = 3x$

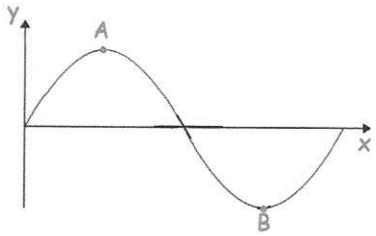
$x = \frac{y+1}{3}$

$\frac{x+1}{3}$

(2)

---

73. Shown is part of the curve y = sin x



(a) Write down the coordinates of the point A.

(90 , 1)

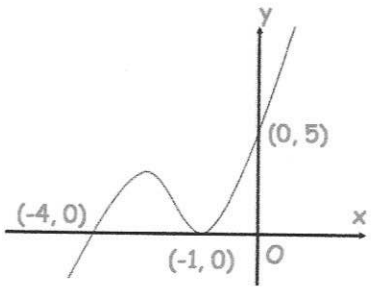
(1)

(b) Write down the coordinates of the point B.

(270 , -1)

(1)

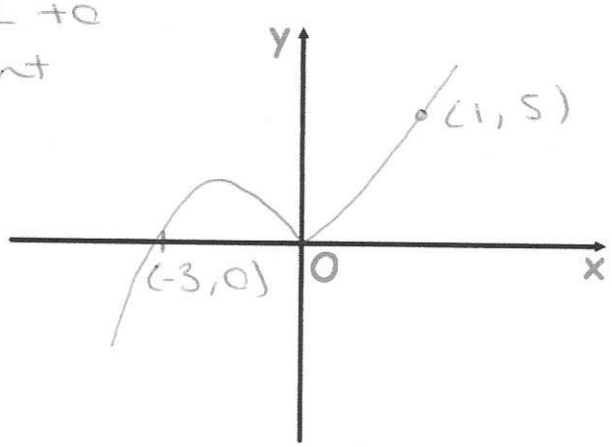
74. Shown below is the curve with equation $y = f(x)$.
The curve passes through the points (-4, 0), (-1, 0) and (0, 5)



Sketch the curve with equation:

(a) $y = f(x - 1)$

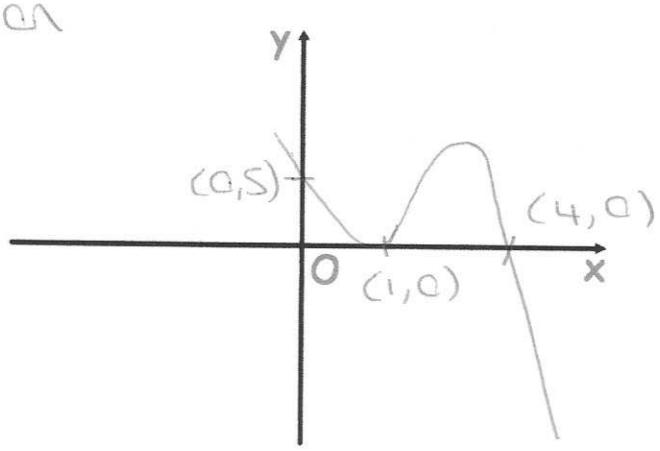
move one to the right



(2)

(b) $y = f(-x)$

reflection



(2)

75. Write $x^2 + 8x + 6$ in the form $(x + a)^2 + b$, where a and b are constants.

$(x+4)^2 - 16 + 6$

$(x+4)^2 - 10$

$(x+4)^2 - 10$

(3)

---

76. (a) Show that the equation $20 - x^3 - 7x^2 = 0$ can be rearranged to give

$$x = \frac{20}{x^2} - 7$$

$20 = x^3 + 7x^2$

$20 = x(x^2 + 7x)$

$\frac{20}{x} = x^2 + 7x$

$\frac{20}{x} - 7x = x^2 \Rightarrow x = \frac{20}{x^2} - 7$

(2)

(b) Using $x_{n+1} = \frac{20}{x_n^2} - 7$ with $x_0 = -9$

find the values of x_1, x_2 and x_3

$x_1 = \frac{20}{81} - 7 = -6.753086\ldots$

$x_2 = \frac{20}{45.60417} - 7 = -6.561443\ldots$

$x_3 = \frac{20}{43.05254} - 7 = -6.535451\ldots$

$x_1 = -6.75$

$x_2 = -6.56$

$x_3 = -6.54$

(3)

(b) Explain what the values of x_1, x_2 and x_3 represent

x_1, x_2 & x_3 are increasingly accurate solutions to $20 - x^3 - 7x^2 = 0$

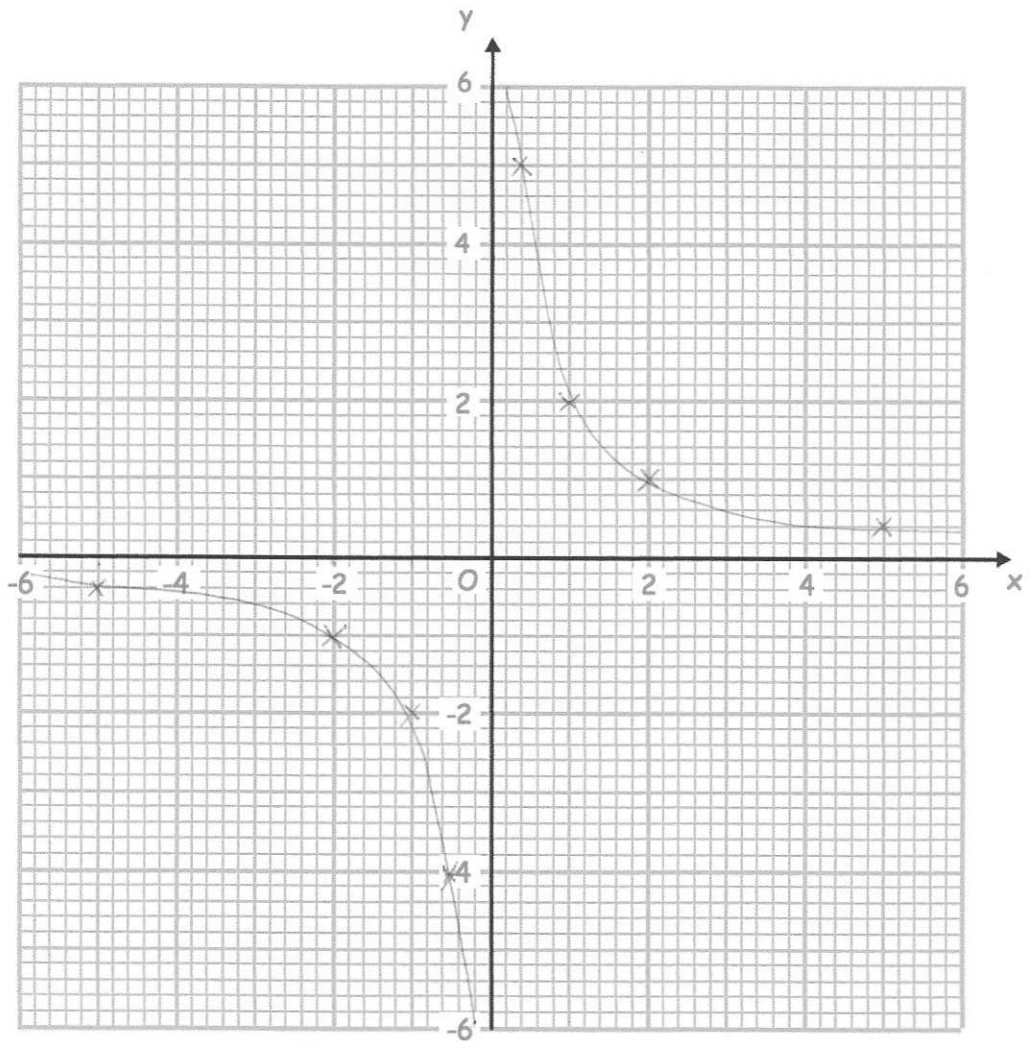
(2)

77. (a) Complete the table of values for $y = \frac{2}{x}$

x	-5	-2	-1	-0.5	0.5	1	2	5
y	-0.4	-1	-2	-4	4	2	1	0.4

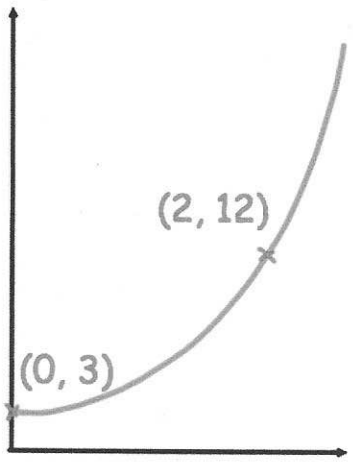
(2)

(b) On the grid, draw the graph of $y = \frac{2}{x}$ for $-5 \leq x \leq 5$



(2)

78.



The sketch shows a curve with equation
$y = ab^x$ where a and b are constants and $b > 0$

The curve passes through the points (0, 3) and (2, 12)

Calculate the value of a and b

$a = 3$

$y = 3b^2$

(2, 12)

$12 = 3b^2$

$b^2 = 4$

$b = 2$

a = 3

b = 2

(3)

79. Write $0.5\dot{1}\dot{2}$ as a fraction.
Give your answer in its simplest form.

$x = 0.51212...$

$10x = 5.1212...$

$1000x = 512.1212...$

$990x = 507$

$\frac{507}{990} = \frac{169}{330}$

$\frac{169}{330}$

(3)

---

80. Show that $(\sqrt{2} + 3\sqrt{8})^2 = 98$

$(\sqrt{2} + 3\sqrt{8})(\sqrt{2} + 3\sqrt{8})$

$= 2 + 3\sqrt{16} + 3\sqrt{16} + 9 \times 8$

$= 2 + (3 \times 4) + (3 \times 4) + 72$

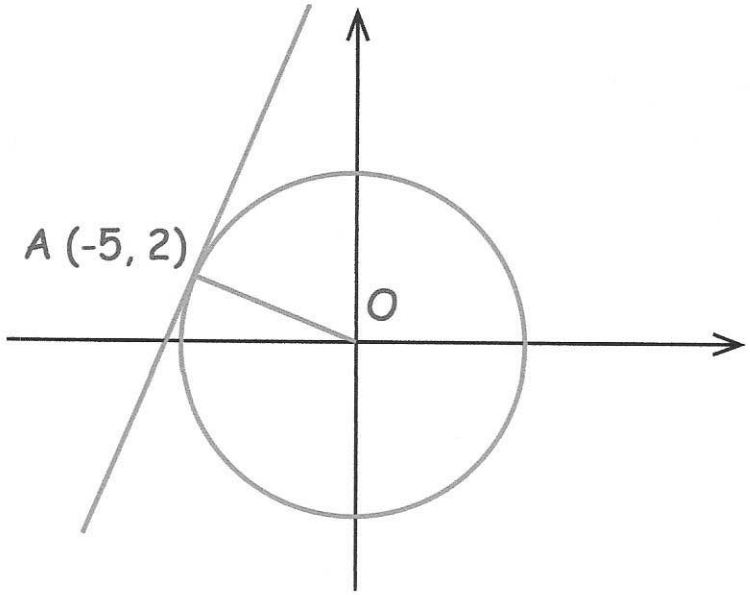
$= 2 + 12 + 12 + 72$

98

(3)

81.

The diagram shows the circle $x^2 + y^2 = 40$ with a tangent at the point (2, 6)



(a) Find the gradient of the line AO.

gradient = $-\frac{2}{5}$

$-\frac{2}{5}$

.....

(1)

(b) Find the gradient of the tangent

$\frac{5}{2}$

.....

(1)

(c) Find the equation of the tangent

$y = \frac{5}{2}x + c$

$2 = -\frac{25}{2} + c$

$c = 14.5$

$y = 2.5x + 14.5$

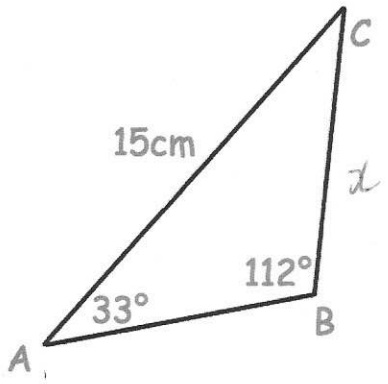
.....

(2)

or

$y = \frac{5}{2}x + \frac{29}{2}$

82. (a)



In triangle ABC the length of AC is 15cm.
Angle ABC = 112°
Angle BAC = 33°

Work out the length of BC.

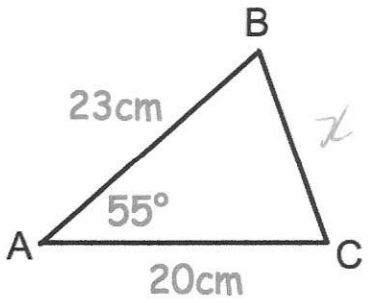
$\frac{x}{\sin 33} = \frac{15}{\sin 112}$

8.81

.....cm

(3)

(b)



Calculate the length of BC.

$x^2 = 23^2 + 20^2 - 2 \times 20 \times 23 \times \cos 55$

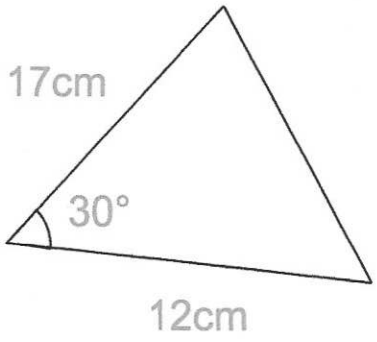
$x^2 = 401.3...$

$x =$

20.03 .....cm

(3)

83.



$\frac{1}{2}ab\sin C$

$\frac{1}{2} \times 17 \times 12 \times \sin 30$

$\frac{1}{2} \times 17 \times 12 \times \frac{1}{2}$

Calculate the area of the triangle.

51

.....cm²

(2)

84.

Find the pressure exerted by a force of 240 newtons on an area of 30cm².
Give your answer in newtows/m²

$P = \frac{F}{A}$

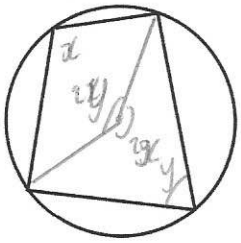
$30 \div 10000 = 0.003m^2$

$\frac{240}{0.003} = \frac{240000}{3}$

80000 N/m²

(3)

85.



Prove the opposite angles in a cyclic quadrilateral add to 180°

Angle at centre is twice the angle at the circumference

$\therefore 2y + 2x = 360$

$\div 2$

$x + y = 180°$ $\therefore$ opposite angles add to 180°

---

86. The number of days, D, to complete research is inversely proportional to the number of researchers, R, who are working.

The research takes 125 days to complete is 16 people work on it.

Find how many people are needed to complete the research in 40 days.

$D \propto \frac{1}{R}$

$D = \frac{F}{R}$

$125 = \frac{F}{16}$

$F = 2000$

$D = \frac{2000}{R}$

$40 = \frac{2000}{R}$

$40R = 2000$

$R = 50$

50

.....

(5)

87. A straight line, L, is perpendicular to the line with equation $y = 2x + 3$
L passes through the point (10, 3)

Find an equation for the straight line L.

x y

gradient of L = $-\frac{1}{2}$

$y = -\frac{1}{2}x + c$

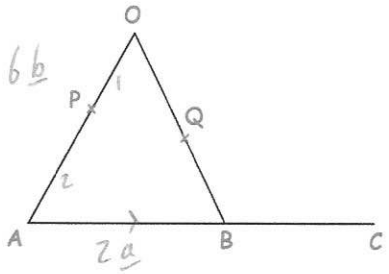
$3 = -5 + c$

$c = 8$

$y = -\frac{1}{2}x + 8$

(3)

88.



AOB is a triangle.
P is a point on AO.

$\overrightarrow{AB} = 2\underline{a}$ $\overrightarrow{AO} = 6\underline{b}$ AP:PO = 2:1

(a) Find the vector $\overrightarrow{OB}$ in terms of **a** and **b**

$2\underline{a} - 6\underline{b}$

(1)

Q is the midpoint of OB.
B is the midpoint of AC.

Show PQC is a straight line.

$\overrightarrow{PQ} = 2\underline{b} + \underline{a} - 3\underline{b}$

$= \underline{a} - \underline{b}$

$\overrightarrow{QC} = \underline{a} - 3\underline{b} + 2\underline{a}$

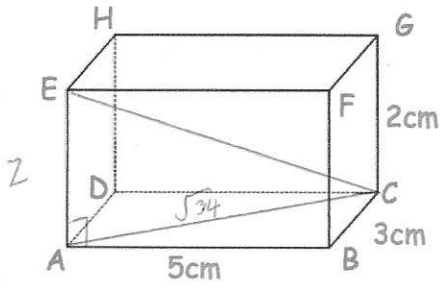
$= 3\underline{a} - 3\underline{b}$

$\overrightarrow{QC} = 3\overrightarrow{PQ}$ ∴ parallel

since $\overrightarrow{QC}$ & $\overrightarrow{PQ}$ are parallel and both pass through Q, PQC must be a straight line

(3)

89. Shown below is a cuboid



Calculate the size of angle ACE.

$AC^2 = 3^2 + 5^2$

$AC = \sqrt{34}$

$\tan(\angle ACE) = \frac{2}{\sqrt{34}}$

$\angle ACE = \tan^{-1}\left(\frac{2}{\sqrt{34}}\right)$

$= 18.93^\circ$

.....

(4)

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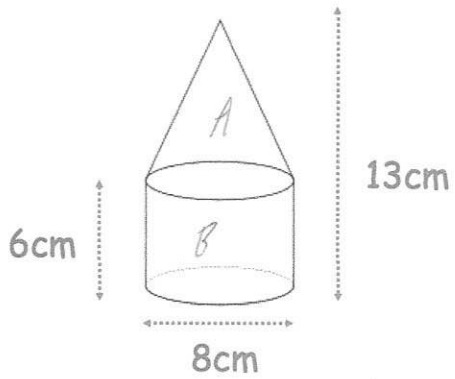
90. A solid is formed from a cylinder and a cone.
Find the volume of the solid.



Volume of A: $\frac{1}{3} \times \pi \times 4^2 \times 7 = \frac{112}{3}\pi$ (117.286...)

Volume of B: $\pi \times 4^2 \times 6 = 96\pi$ (301.59...)

418.88 to 2dp

.....cm^3

(3)

91. There are 8 sweets in a bag.
Three sweets are red, three sweets are blue and two sweets are green.

Three sweets are selected at random **without** replacement.

Calculate the probability that the sweets are **not** all the same colour.

$P(RRR) = \frac{3}{8} \times \frac{2}{7} \times \frac{1}{6} = \frac{1}{56}$

$P(BBB) = \frac{3}{8} \times \frac{2}{7} \times \frac{1}{6} = \frac{1}{56}$ $\Big\}$ $\frac{2}{56}$

Not same

$1 - \frac{2}{56} = \frac{54}{56}$

$\frac{27}{28}$

.....

(4)

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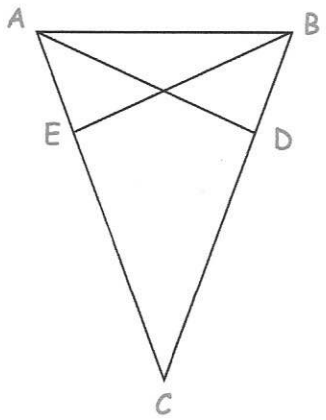
92. ABC is an isosceles triangle in which AC = BC.
D and E are points on BC and AC such that CE = CD.



Prove triangles ACD and BCE are congruent.

AC = BC (sides of isosceles triangle)

∠ACD = ∠BCE (shared)

CE = CD (given)

∴ SAS

(4)

93. Prove the sum of four consecutive odd numbers is always a multiple of 8

$(2n+1)+(2n+3)+(2n+5)+(2n+7)$

$= 8n + 16$

$= 8(n+2)$

$\therefore$ multiple of 8.

(4)

---

94. Find the exact value of Sin(45°) + Cos(30°)

$\frac{\sqrt{2}}{2} + \frac{\sqrt{3}}{2}$

$\frac{\sqrt{2}+\sqrt{3}}{2}$

.....

(3)

95. Bag A contains 5x coins.
Bag B contains 3x coins.
8 coins are taken from Bag B and put into Bag A
The ratio of coins in Bag A to Bag B is now 11:5

Work out the total number of coins.

$5x + 8 : 3x - 8 = 11 : 5$

$25x + 40 = 33x - 88$

$128 = 8x$

$x = 16$

$8 \times 16 = 128$

.....

(3)

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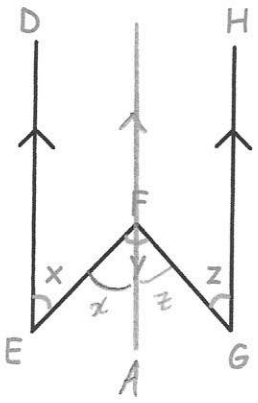
96. In the diagram below, the lines ED and GH are parallel.



Prove that $x + z = y$

$\angle DEF = \angle EFA$ as alternate angles are equal

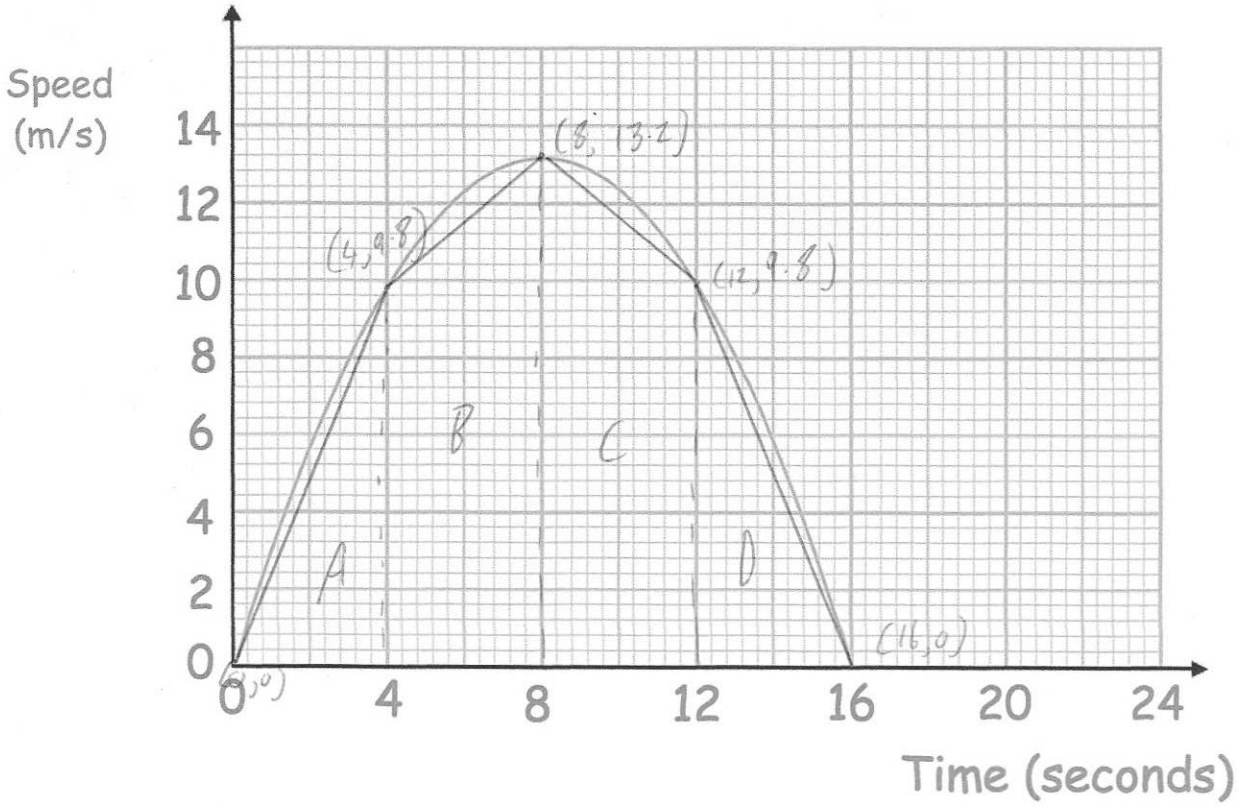
$\angle HGF = \angle GFA$ as " "

$\therefore \angle EFG = x + z$

$\therefore y = x + z$

(3)

97. Here is a speed-time graph for a toy rocket.



(a) Work out an estimate for the distance the rocket travelled in the 16 seconds.
Use 4 strips of equal width.

Area of A : $\frac{1}{2} \times 4 \times 9.8 = 19.6$

Area of B : $\frac{1}{2}(9.8 + 13.2) \times 4 = 46$

Area of C : $\frac{1}{2}(9.8 + 13.2) \times 4 = 46$

Area of D : $\frac{1}{2} \times 4 \times 9.8 = 19.6$

131.2 .....m

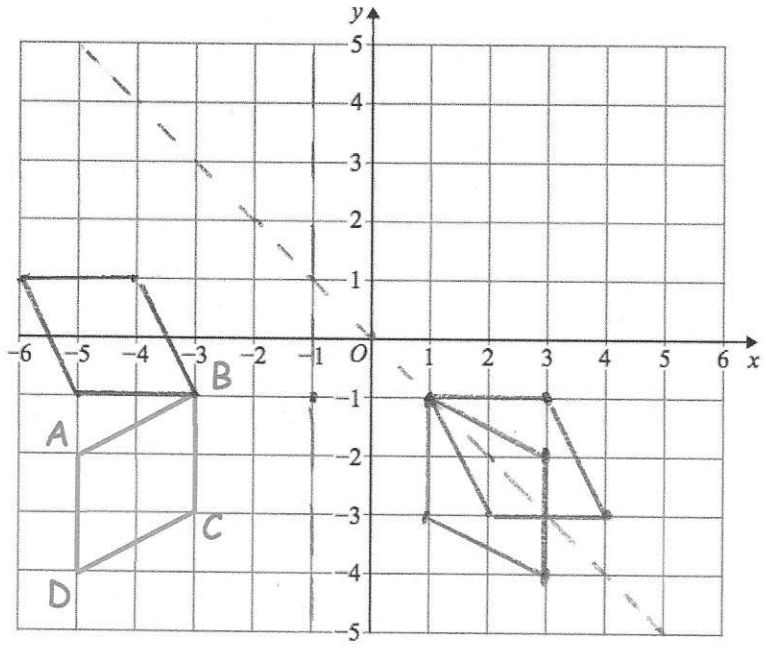
(3)

(b) Is your answer to (a) an underestimate or an overestimate of the actual distance the rocket travelled?
Give a reason for your answer

Underestimate as each shape (A to D) is entirely beneath the line/curve.

(1)

98. Here is quadrilateral ABCD



ABCD is reflected in the line $x = -1$

followed by a reflection in the line $y = -x$

followed by a rotation of 180° about $(-1, -1)$

Which of the vertices are invariant?

B

.....

(3)