Question	Topic	Video number
91	Geometric Proof	366
92	Area Under a Graph	389
93	Invariant Points	392
94	Simultaneous Equations (non-linear)	298

1. Two shops sell the same type of perfume.
A 100ml bottle of perfume normally costs £40.

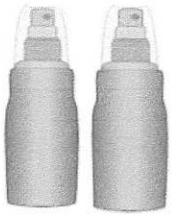
Shop A

50% extra free - 150ml

Only £40

Shop B

Buy one get the second HALF PRICE



Normal price £40 for 100ml

£60 for 200ml

Rebecca says that both offers give the same value for money.
Is she correct? Show your working.

No

Shop A

4000 ÷ 150 = 26.6p per ml

Shop B

6000 ÷ 200 = 30p per ml

Therefore Shop A is better value.

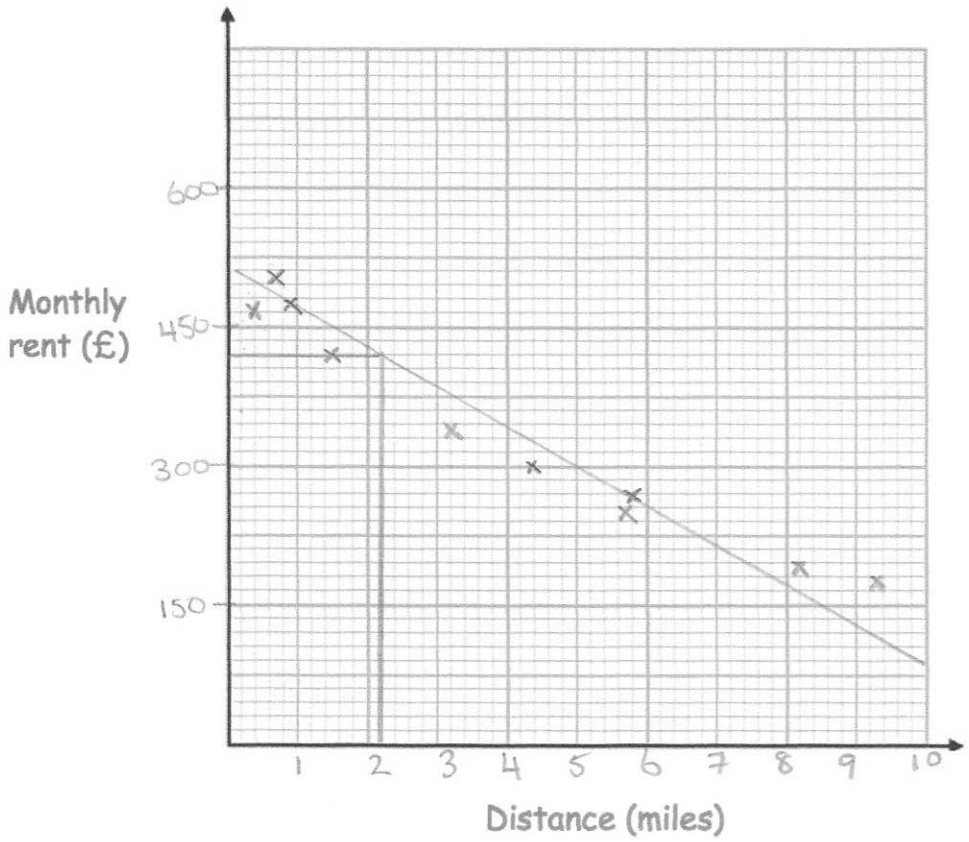
(5)

2. The table below shows information about the monthly rent of an apartment and the distance of the apartment from a city centre, in miles.

Distance (miles)	3.2	1.5	5.7	8.2	0.7	0.9	4.4	5.8	9.3	0.4
Monthly rent (£)	340	420	250	190	500	470	300	260	170	510

(a) Plot the data on the scatter graph below.
Clearly label your axes.

(3)



(b) Describe the relationship between the distance from the city centre and the monthly rent.

The further away from the centre, the less the rent.

(1)

An apartment is 2.2 miles from the city centre.

(c) Find an estimate for the monthly rent

£ 420

(2)

3. The population of England is 5.301×10^7
The number of people who live in London is 8.308×10^6

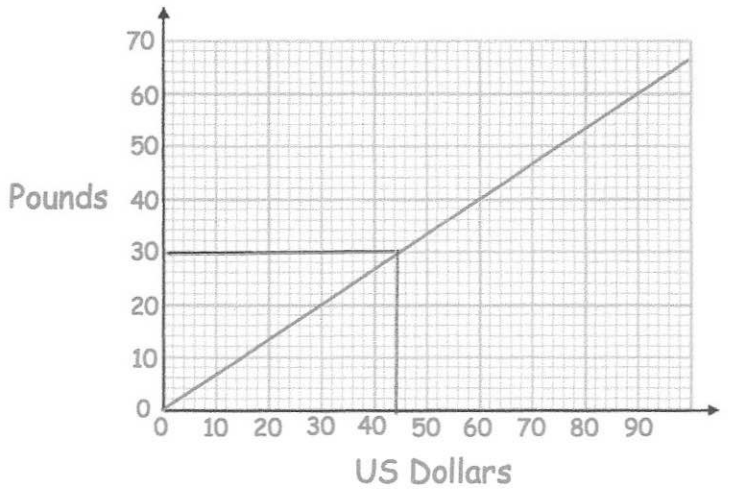
What percentage of the population of England live in London?

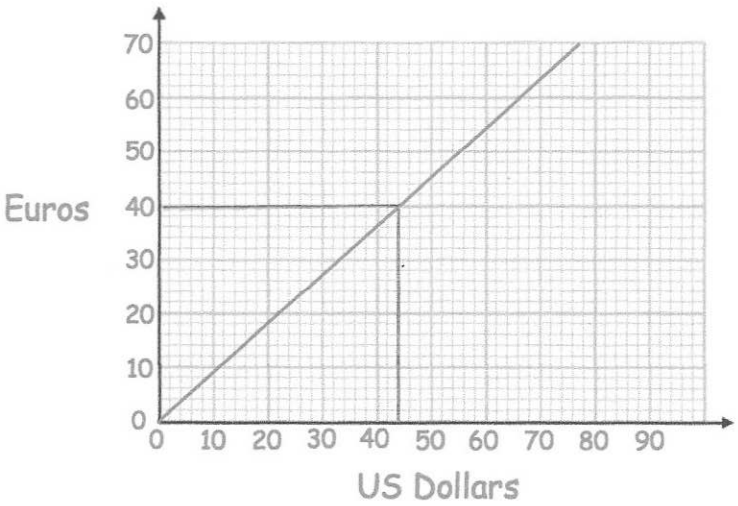
$$\frac{8.308 \times 10^6}{5.301 \times 10^7} \times 100$$

15.67 %

(2)

4.





(a) Change £30 into Euros.

40 Euros

(2)

(b) Change 200 Euros into Pounds (£)

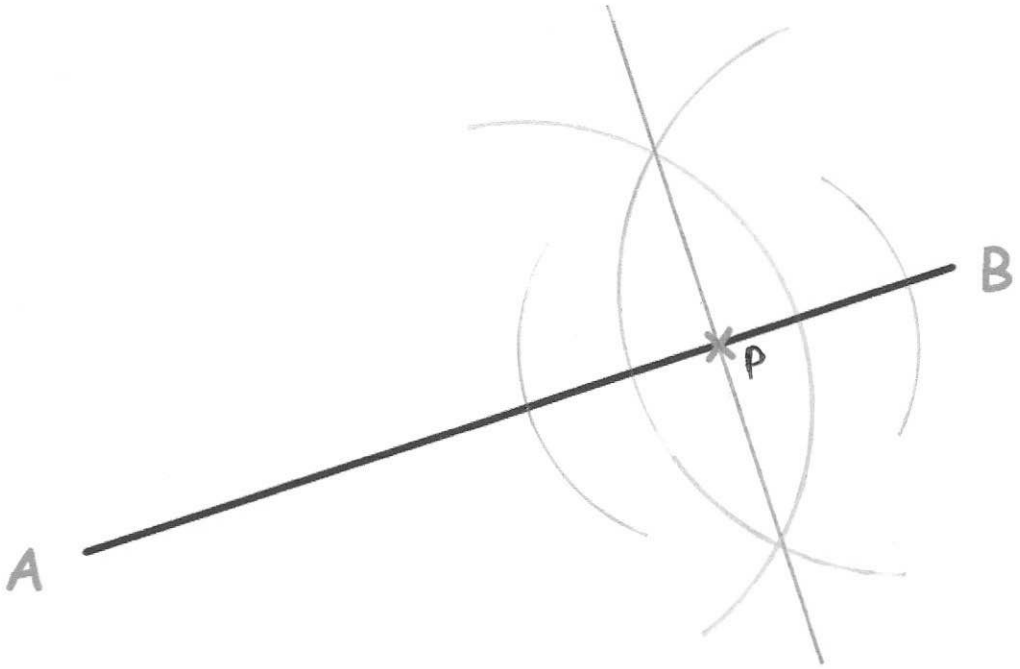
€40 = £30
×5 ×5
€200 = £150

£ 150

(2)

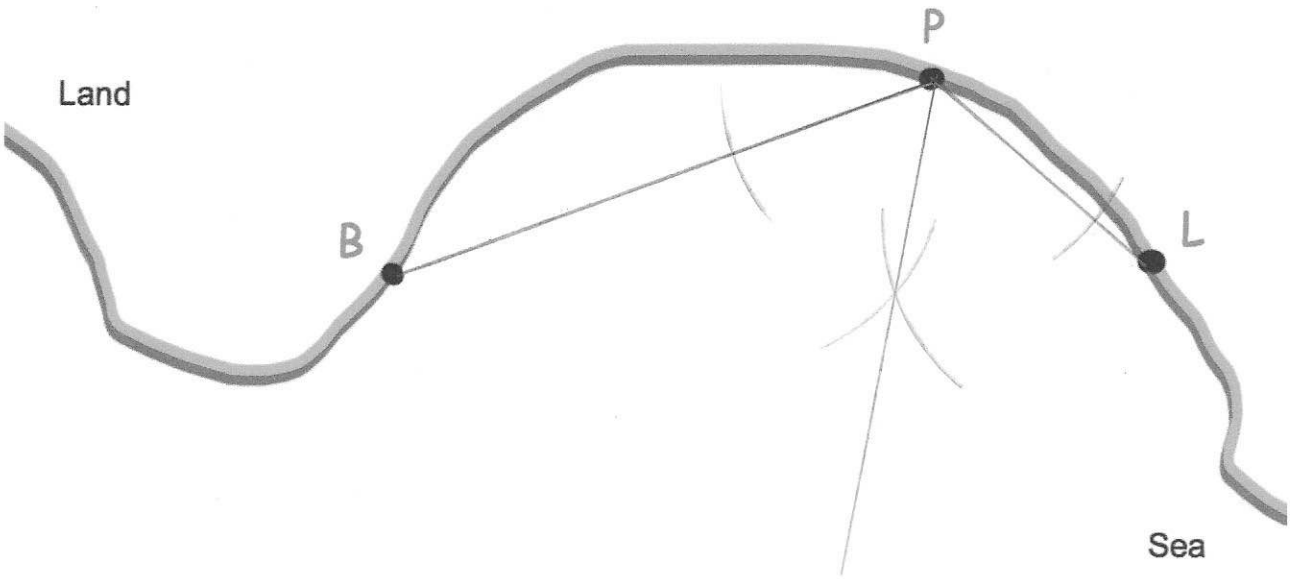
5. Use a ruler and compasses to construct the perpendicular to the line segment AB that passes through the point P.

You must show all construction lines.



(2)

6.

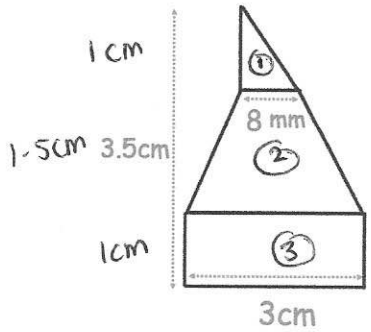


A yacht leaves the port, P, on a course that is an equal distance from PB and PL.

Using ruler and compasses only, construct the course on the diagram.
You must show your construction arcs.

(2)

7. A shape has been made from joining a rectangle, trapezium and triangle.



① $0.4cm^2$

② $2.85cm^2$

③ $3cm^2$

$6.25cm^2$

The height of the shape is 3.5cm.
The ratio of the height of the rectangle to the height of the trapezium to the height of the triangle is 2:3:2. =7 parts
Calculate the area of the shape.

$3.5 \div 7 = 0.5$

$0.5 \times 2 = 1$

$0.5 \times 3 = 1.5$

$0.5 \times 2 = 1$

① $\frac{1}{2} \times 0.8 \times 1 = 0.4cm^2$

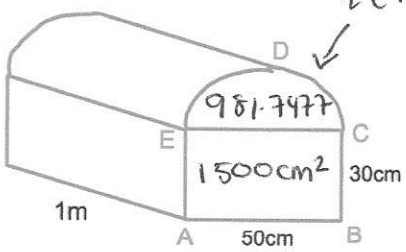
② $\frac{1}{2}(0.8+3) \times 1.5 = 2.85$

③ $1 \times 3 = 3$

6.25 ..... cm^2

(3)

8.



$\frac{1}{2}(\pi \times 25^2)$

Shown above is a prism that is 1m long.
ABCDE is the cross-section of the prism.
ABCE is a rectangle and CDE is a semi-circle.
Calculate the volume of the prism.
Give your answer correct to 1 decimal place.

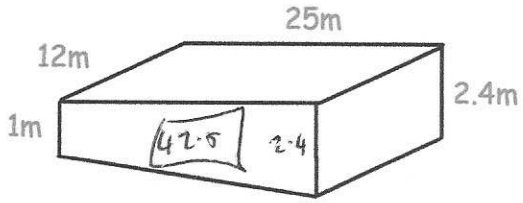
$2481.74.. \times 100$

$248174.8cm^3$

248174.8 ..... cm^3

(4)

9. The swimming pool in a leisure centre is shown below.



The length of the swimming pool is 25m and the width is 12m.
The depth of the shallow end is 1m and the depth of the deep end is 2.4m.
Given $1m^3 = 1000$ litres
Work out how much water, in litres, the swimming pool holds.

$\frac{1}{2}(1+2.4) \times 25 = 42.5$

$42.5 \times 12 = 510m^3$

510×1000

510000 ..... litres

(4)

---

10. The ~~weights~~ MASS of books on a shelf are recorded in a stem and leaf diagram.

Key: 0|1 means 0.1kg

0	1 1 1 2 2 3 4 4 8
1	0 0 2 3 7
2	2

(a) Write down the median.

0.4kg

(1)

(b) Work out the total ~~weight~~ MASS of books on the shelf.

$2.3 + 6.2 + 2.2 = 10.7$

10.7kg

(2)

A book weighing 1.8kg is added to the shelf.

Peter says the median will remain the same.

(c) Is Peter correct? Explain your answer.

No, it would increase to 0.45kg.

.....

(2)

11. A teacher surveys 64 children on how they travelled to school.

20 of the students were in Year 7.
The teacher surveyed 30% more students in Year 9 than in Year 7.
The rest of the students surveyed were in Year 11.
75% of the students in Year 7 walked to school.
8 more students in Year 9 walked to school than did not walk.
Out of students surveyed, more Year 11 students walked to school than Year 9 students.

One of these students is picked at random

Write down the probability that the student chosen will walk to school.

	Year 7	Year 9	Year 11	Total
walk	15	17	18	50
other	5	9	0	14
Total	20	26	18	64

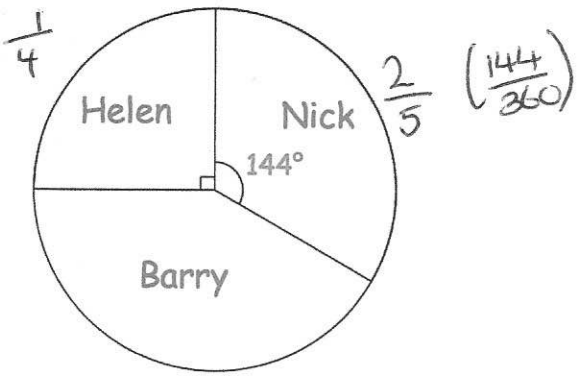
25/32

.....

(4)

12. Barry won £420 in a competition.

The pie chart shows how he shared the money with his brother, Nick, and sister, Helen.



With the money Barry kept for himself, he spent some and invested some, in the ratio 5:2. ⇒ 7 parts

How much money did Barry invest?

Helen: $\frac{420}{4} = £105$

Nick: $\frac{2}{5}$ of £420 = £168

Barry: $420 - (105 + 168) = £147$

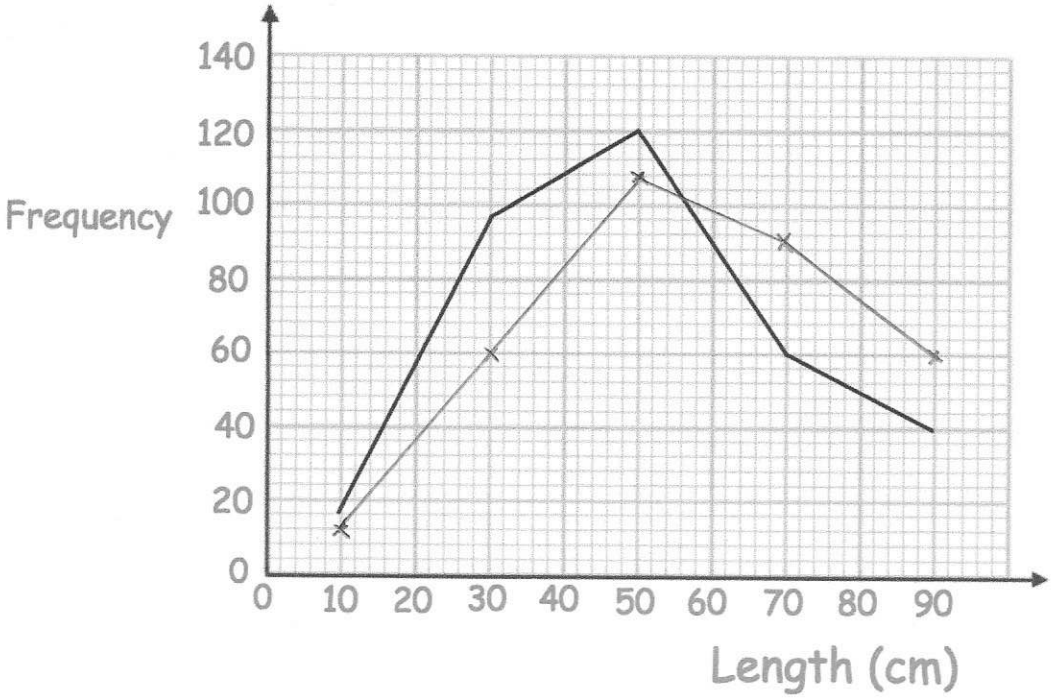
£147 ÷ 7 = 21

21 × 2 = £42

£42

(4)

13. The frequency polygon shows the length of 330 river eels.



The table shows the lengths of 330 sea eels.

Length (cm)	Frequency
$0 < t \leq 20$	12
$20 < t \leq 40$	60
$40 < t \leq 60$	108
$60 < t \leq 80$	90
$80 < t \leq 100$	60

Midpoint	fx
10	120
30	1800
50	5400
70	6300
90	+5400
	19020

(a) Draw a frequency polygon to show this information on the diagram above.

(2)

(b) Calculate an estimate of the mean length of a sea eel.

19020 ÷ 330

57.6363... cm

(3)

14. Trains to Portadown leave a train station every 28 minutes.
Trains to Portrush leave a train station every 16 minutes

A train to Portadown and a train to Portrush both leave the train station at 8am.

When will a train to Portadown and a train to Portrush both leave the train station at the same time?

28 56 84 112

16 32 48 64 80 96 112

9:52am

(3)

---

15. Simplify

$$\frac{10m^5n^4}{2m^2n}$$

$5m^3n^3$

$5m^3n^3$

(2)

16. Bethan owns 10 shops and 5 restaurants. She is going to visit three of her businesses and writes her list in order. The order will be:

shop, restaurant, shop
or
restaurant, shop, restaurant

How many different lists can Bethan write?

$10 \times 5 \times 9 = 450$

or

$5 \times 10 \times 4 = 200$

650

(3)

---

17. $v = u + at$

(a) Work out v when u = 23, a = 4 and t = 3

$V = 23 + (4)(3)$

35

(2)

(b) Work out u when v = 30, a = 2 and t = 8

$30 = u + (2)(8)$

14

(2)

(c) Work out t when v = 40, u = 12 and a = 4

$40 = 12 + (4)t$

7

(2)

18. Make m the subject of

$$w(m + n) = x(m - n)$$

$mw + nw = mx - nx$

$mw + mx = nx - mw$

$nw + nx = m(x - w)$

$\frac{nw + nx}{x - w} = m$

$\frac{n(w + x)}{x - w} = m$

$m = \frac{n(w + x)}{x - w}$

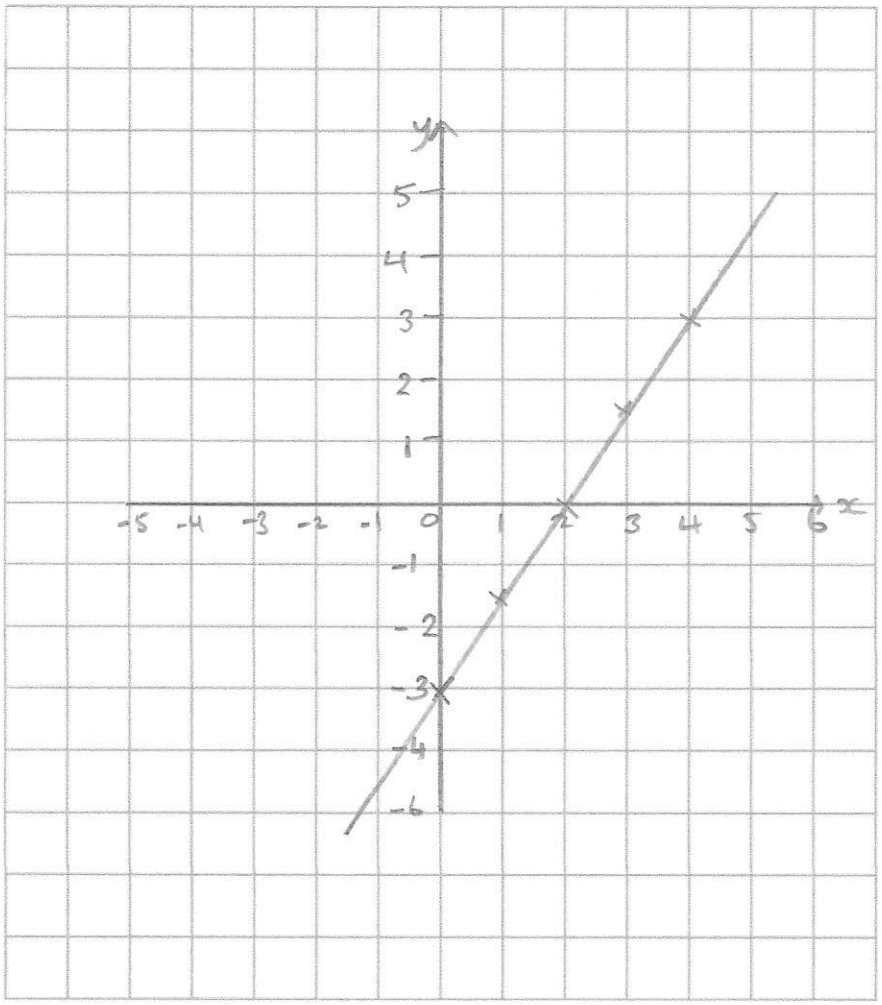
.....

(3)

---

19. On the grid, draw the graph of $3x - 2y = 6$

x	0	1	2	3	4
y	-3	-1.5	0	1.5	3



(4)

20. Four chairs and two tables cost £218.
Six chairs and seven tables cost £587.

Find the total cost of buying twenty chairs and five tables.

$4x + 2y = 218$ ① $\times 3$

$6x + 7y = 587$ ② $\times 2$

$12x + 6y = 654$

$-\ 12x + 14y = 1174$

$-8y = -520$

$y = £65$

$4x + 2(65) = 218$

$4x = 88$

$x = £22$

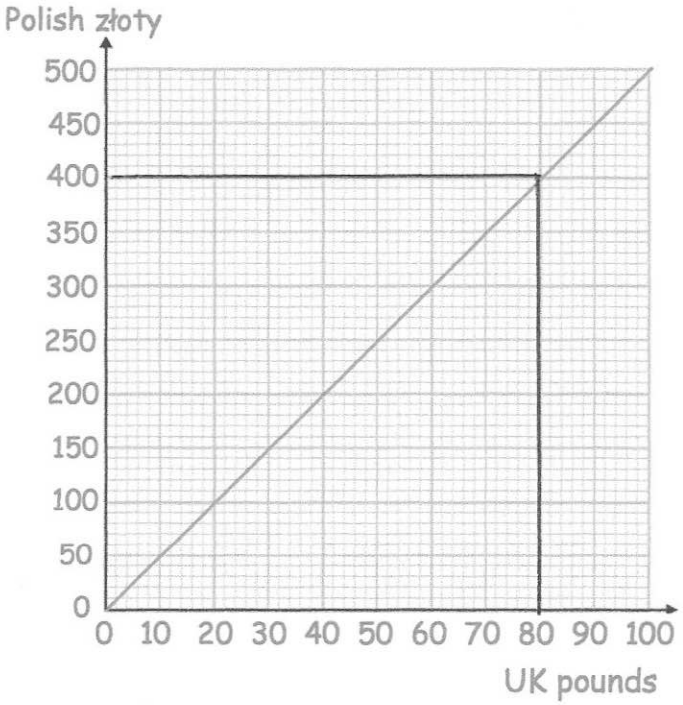
$20(22) + 5(65) = 765$

£ 765

(4)

---

21. Here is a conversion graph to convert between GB pounds and Polish złoty.



Jack has £400 and 1200 złoty.
His hotel bill is 2000 złoty

He pays the bill with 1200 złoty and some of the pounds.

Work out how much money Jack has left.

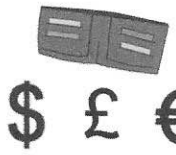
800 złoty = £160

£400 − £160 = £240

£ 240

(4)

22. Nancy goes to the Post Office to exchange money.



Exchange Rates
£1 : $1.31
£1 : €1.14
*Commission Charged

Nancy changes $759.80 and €342 into pounds sterling.
The Post Office deducts their commission and gives Nancy £827.20
What is the percentage commission?

$759.80 ÷ 1.31 = £580

€342 ÷ 1.14 = £300

£880

She has changed 880 − 827.20 = £52.80

$\frac{52.8}{880} = 6\%$

6 %

(4)

---

23. The ratio of the red cards to black cards in a deck is 3:10
2 more red cards are added to the deck.
The ratio of red cards to black cards is now 1:3

Work out the number of black cards in the deck.

$3x : 10x$

+2 red

$3x+2 : 10x$

Since 1:3

$9x+6 = 10x$

$x = 6$

$10 \times 6 = 60$

60

(3)

24. The population of a country is increasing by 5% a year.

How many years will it take the population of the country to double?

$100 \times 1.05^{14} = 197.99...$

$100 \times 1.05^{15} = 207.89...$

15 years

(3)

---

25. The length of each side of a regular hexagon is 4.7cm to 1 decimal place.

Write the error interval for the perimeter, P

$4.65 \times 6 = 27.9$

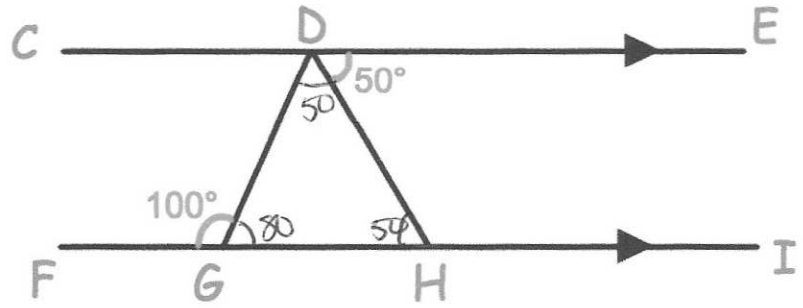
$4.75 \times 6 = 28.5$

$27.9\text{cm} \leq P < 28.5\text{cm}$

(3)

---

26. CE and FI are parallel lines.
Angle EDH = 50°
Angle DGF = 100°



Show, giving reasons, that triangle DGH is isosceles.

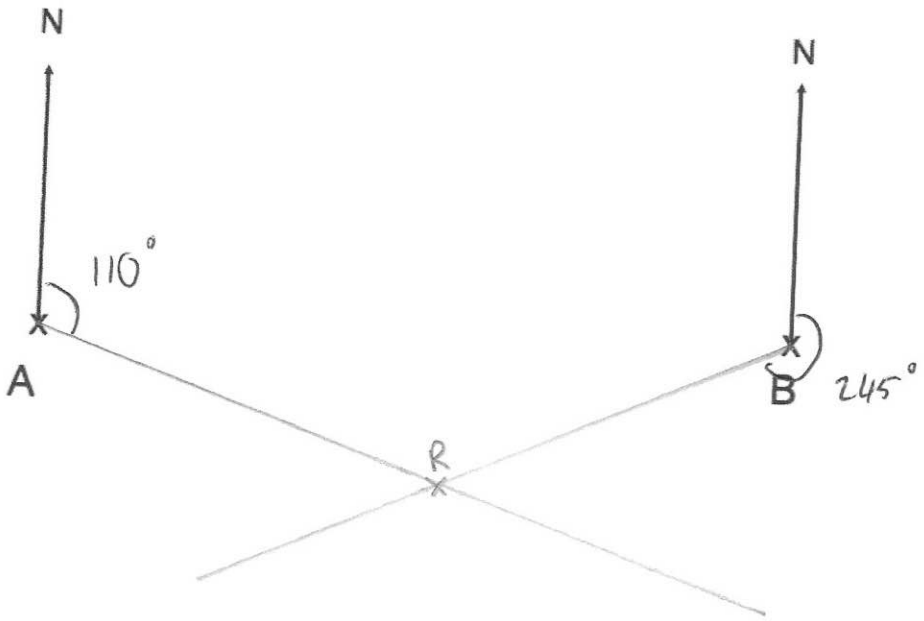
$\angle DGH = 80°$ (angles on straight line add to 180°)

$\angle DHG = 50°$ (alternate angles are equal)

$\angle GDH = 50°$ (angles in triangle add to 180°)

Since two angles are equal, DGH is isosceles **(4)**

27. The diagram shows the position of two towns, A and B.

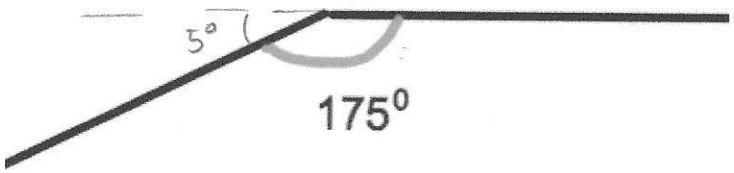


A rugby club, R, has bearing of 110° from town A.
The rugby club, R, has bearing 245° from town B.

In the space above, show the position of the rugby club R.
Mark the position with a cross (x) and label it R.

(3)

28. Shown below is an interior angle from a regular polygon.



Calculate the number of sides the polygon has.

$\frac{360}{5} = 72$

72 sides

(2)

29. A circular wheel has a diameter of 30cm.
The wheel rolls a distance of 60m.

Calculate the number of complete revolutions completed.

$\pi \times 30 = 94.2477...$ cm

$6000 \div 94.2477...$

$= 63.6619...$

63

(4)

30. Write the numbers below in the form 2^n

(a) 4

2^2

(1)

(b) 8

2^3

(1)

(c) 32

2^5

(1)

(d) ½

2^{-1}

(1)

(e) ¼

2^{-2}

(1)

(f) $\sqrt{2}$

$2^{1/2}$

(1)

(g) $\sqrt{8}$

$\sqrt{2^3} = (2^3)^{1/2}$

$= 2^{3/2}$

$2^{3/2}$

(2)

31. There are 1500 people at an ice hockey match.
The announcer says that this is exactly 30% more people than the previous match.

Explain why the announcer is wrong.

It would mean there were 1153.846... people at the previous match which is not possible.

$130\% = 1500$

$1\% = 11.538...$

$100\% = 1153.846...$

(3)

---

32. Expand and simplify $(x - 6)(x + 1)(x - 2)$

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

$(x^2 - 5x - 6)(x - 2)$

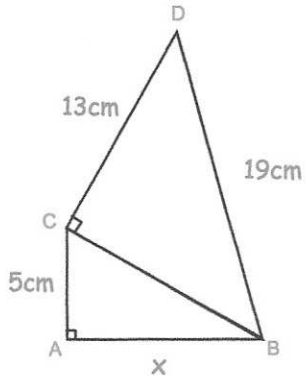
$x^3 - 5x^2 - 6x - 2x^2 + 10x + 12$

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

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

(3)

33. ABC and BCD are right angle triangles.



Find the length of AB

$19^2 - 13^2 = 192$

$CB = \sqrt{192}$

$= 8\sqrt{3}$

$(8\sqrt{3})^2 - 5^2 = 167$

$AB = \sqrt{167}$

$= 12.92288\ldots$

12.923 cm

(4)

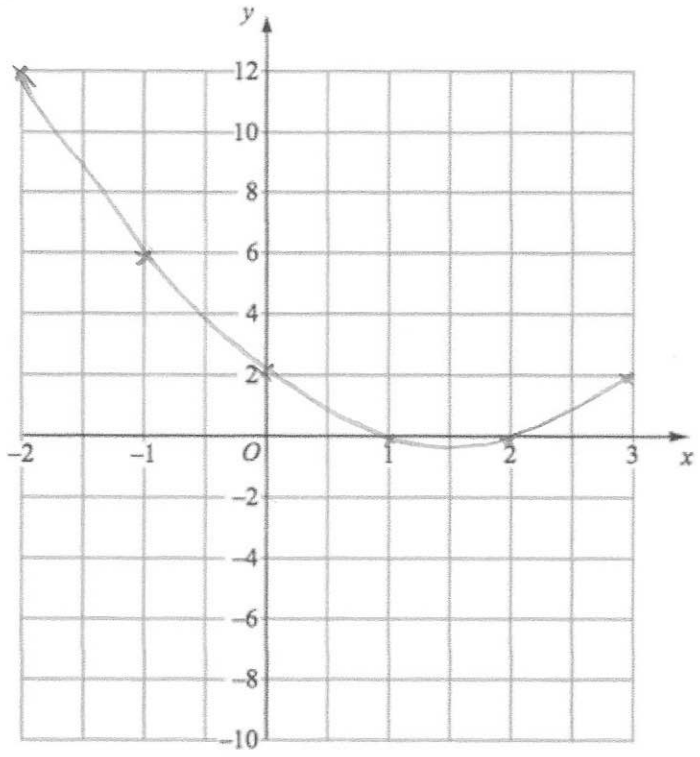
---

34. Draw the graph of $y = (x-1)(x-2)$

$y = x^2 - x - 2x + 2$

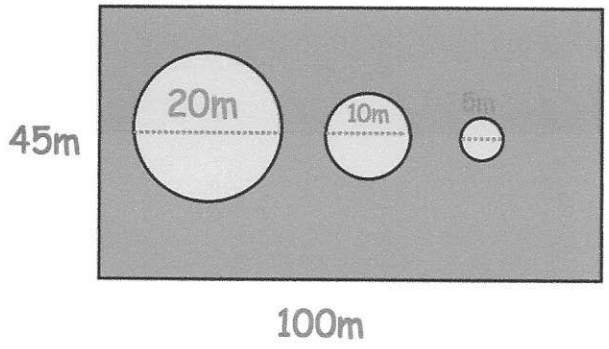
$y = x^2 - 3x + 2$

x	-2	-1	0	1	2	3
y	12	6	2	0	0	2



(3)

35. A rectangular lawn is 100m long and 45m wide.
There are 3 circular ponds, with diameters of 20m, 10m and 5m respectively.



Mrs Jones wants to cover the lawn with grass seed.
Each packet of grass seed covers $50m^2$ and costs £1.49

How much will it cost Mrs Jones to cover the lawn with grass seed?

$45 \times 100 = 4500m^2$

$\pi \times 10^2 = 314.159...$

$\pi \times 5^2 = 78.539...$

$\pi \times 2.5^2 = 19.634...$

$412.33...$

$4500 - 412.33 = 4087.66m^2$

$4087.66 \div 50 = 81.7532$

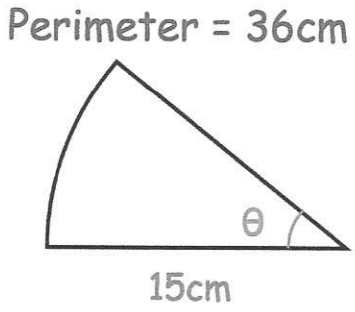
$82 \times 1.49 = 122.18$

£122.18

(5)

---

36. The perimeter of this sector is 36cm



Find the size of the angle, θ

$\frac{\theta}{360} \times \pi \times 30 = 6$

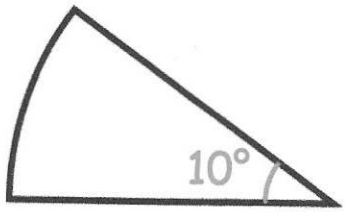
$\frac{\theta}{360} = 0.063$

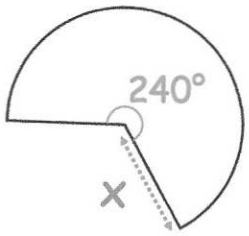
$\theta = 22.918...$

22.9°

(3)

37. The areas of these two sectors are equal.





Find the length of x

$\frac{10}{360} \times \pi \times 48^2 = 64\pi$

$\frac{2}{3} x^2 = 64$

$x = 4\sqrt{6}$

$= 9.7979...$

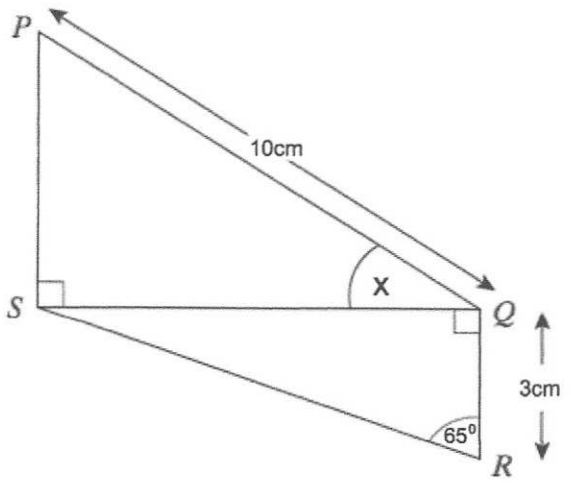
$\frac{240}{360} \times \pi \times x^2 = 64\pi$

$\frac{240}{360} \times x^2 = 64$

9.8 cm

(4)

38. Two right-angled triangles are shown below.
PQ is 10cm.
QR is 3cm.
Angle QRS is 65°



Calculate the size of angle PQS

$QS = \tan(65) \times 3$

$= 6.4335...$

$\cos x = \frac{6.4335...}{10}$

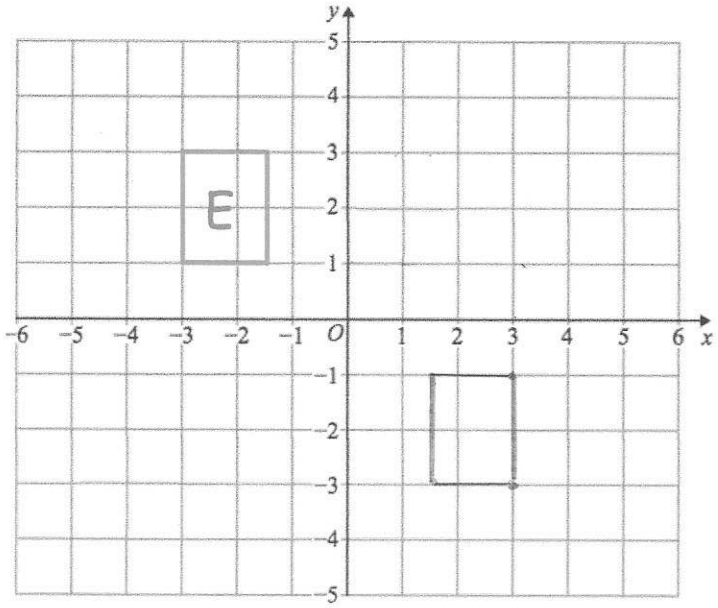
$\cos^{-1}\left(\frac{6.4335...}{10}\right)$

$= 49.96$

49.96°

(5)

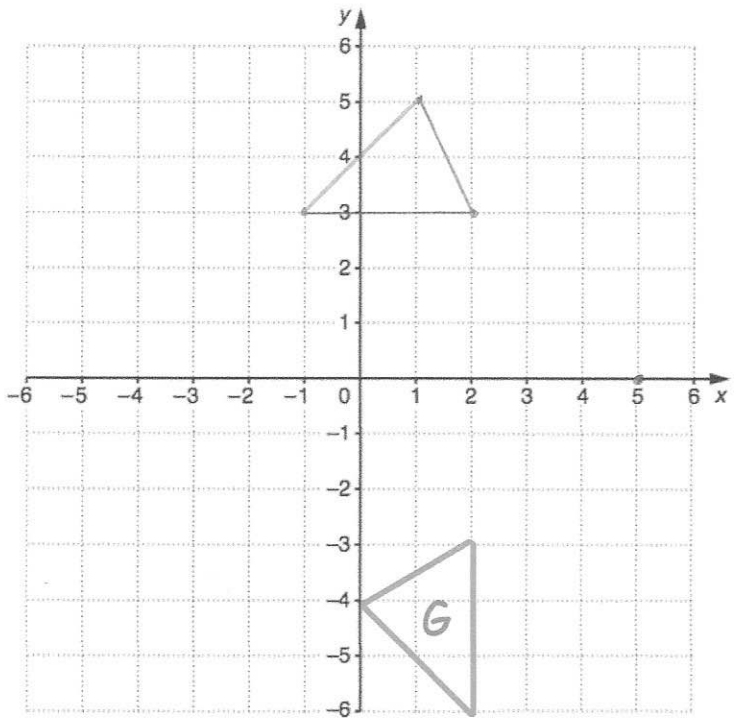
39.



Translate E by $\begin{pmatrix} 4.5 \\ -4 \end{pmatrix}$

(2)

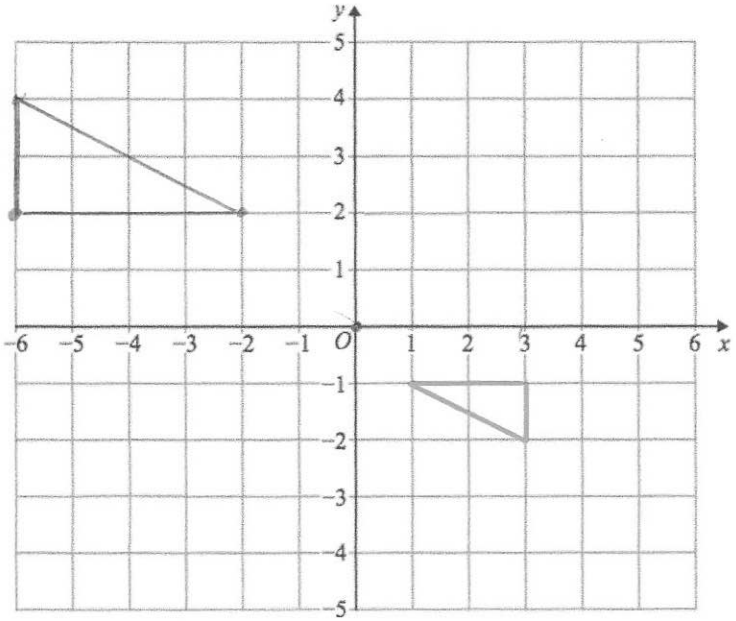
40.



rotate 90° clockwise about (5, 0)

(2)

41.

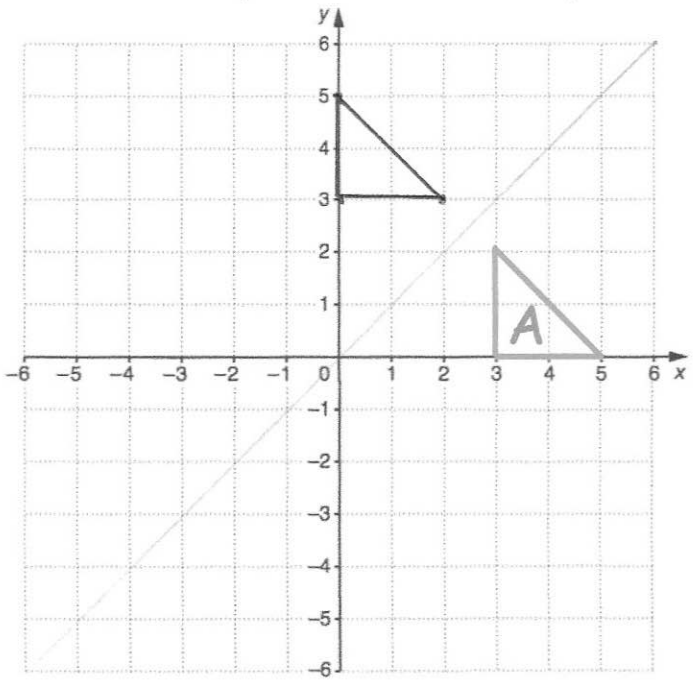


Enlarge by scale factor -2 using (0, 0) as the centre of enlargement

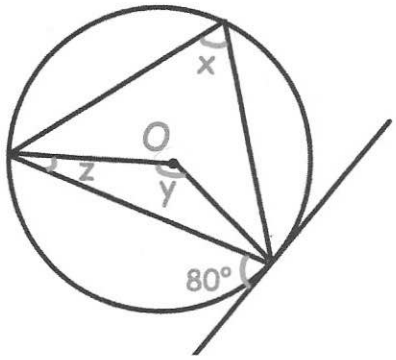
(2)

42.

Reflect shape A in the line y = x



43.



(a) Find the size of angle x.

80 °

(1)

(b) Find the size of angle y.

160 °

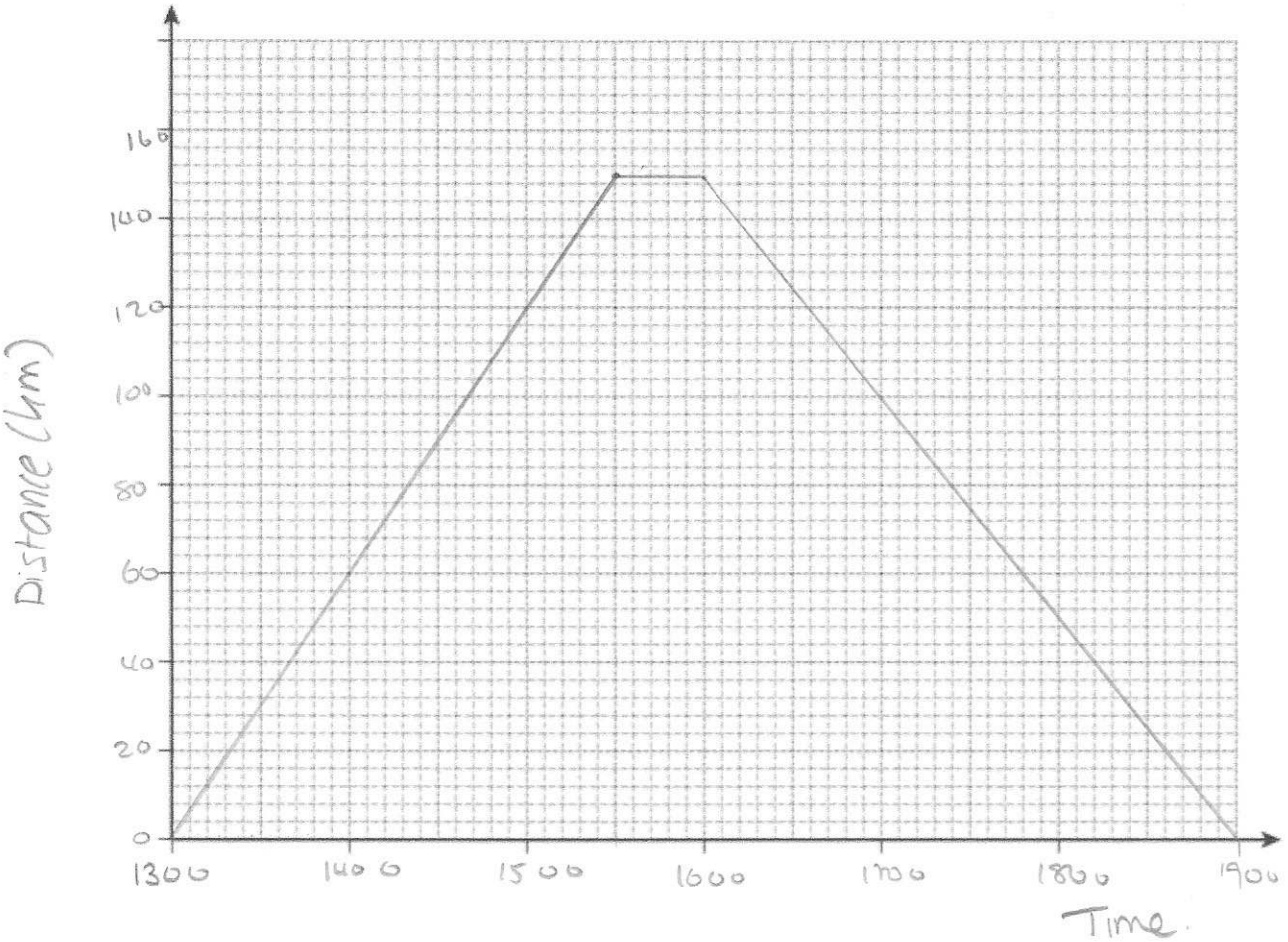
(1)

(c) Find the size of angle z.

10 °

(1)

44. Teddy leaves home at 13:00
He drives at an average speed of 60km/h for 2½ hours $60 \times 2.5 = 150$km
Teddy stops for 30 minutes.
He then drives home at an average speed of 50km/h



(a) Show this information on a distance-time graph.

(4)

(b) A film starts at 18:45

Does Teddy get home in time for the start?
Explain your answer.

No, he arrives home at 19:00

(1)

45. Michael drives 143 miles from town A to town B in 2 hours 36 minutes.
He then drives from town B to town C at the same speed and it takes 21 minutes.

How far did Michael drive in total?

$S = \frac{143}{2.6}$ $55 = \frac{D}{0.35}$

$= 55$mph. $= 19.25$

$143 + 19.25 = 162.25$

.....162.25.....miles
(4)

---

46. Material A has a density of 5.8g/cm³.
Material B has a density of 4.1g/cm³.

377g of Material A and 1.64kg of Material B form Material C.

Work out the density of Material C.

Volume:

Material A: $\frac{377}{5.8} = 65\text{cm}^3$

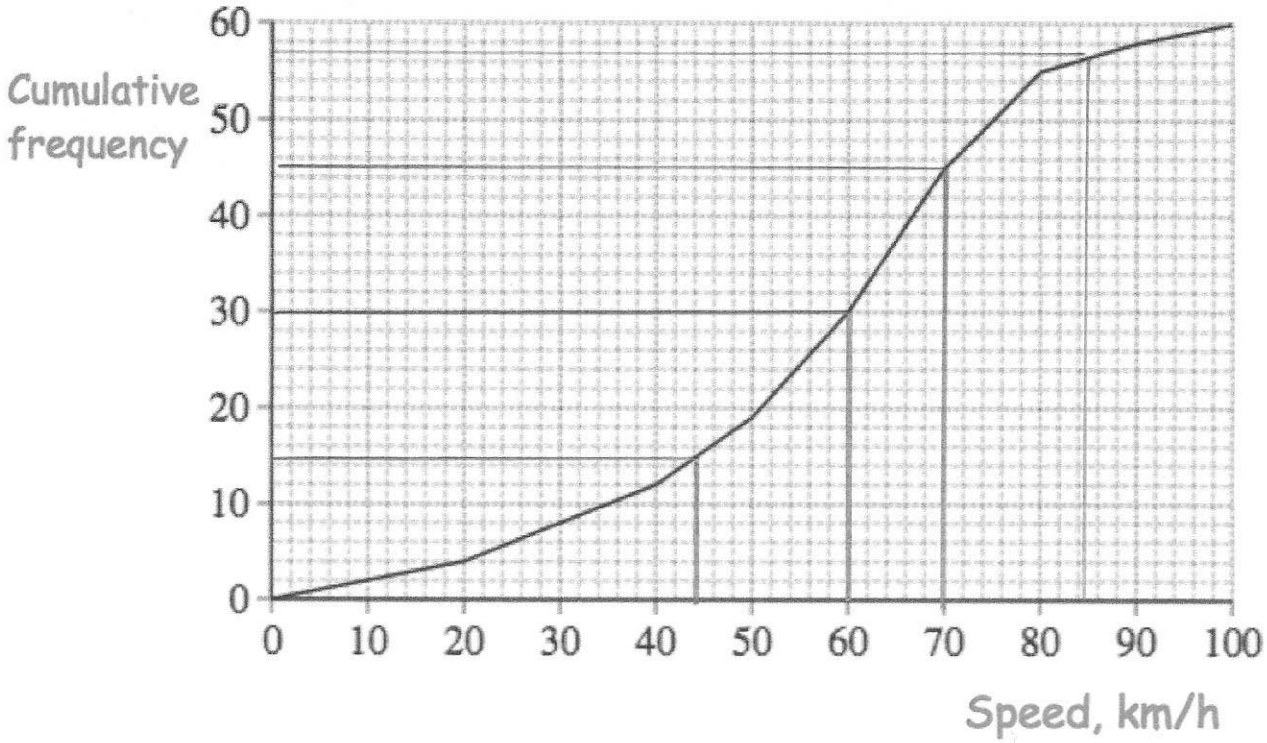
Material B: $\frac{1640}{4.1} = 400\text{cm}^3$

465cm^3

$= \frac{2017}{465} = 4.3376\text{g/cm}^3$

.....4.3376.....g/cm³
(4)

47. The cumulative frequency diagram shows the distribution of speeds for 60 cars on a road.



(a) Estimate the median speed.

60km/h

(1)

(b) Estimate the interquartile range of the speeds.

70 - 44

26km/h

(2)

The speed limit on the road is 85 km/h.

(c) How many cars exceeded the speed limit?

60-57

3

(2)

48. The table shows the heights of the child at a school.

Height	Frequency	x	fx
$120 < h \leq 130$	51	125	6375
$130 < h \leq 140$	120	135	16200
$140 < h \leq 150$	66	145	9570
$150 < h \leq 160$	59	155	9145
$160 < h \leq 170$	4	165	660
	300		41950

Work out an estimate for the mean height.

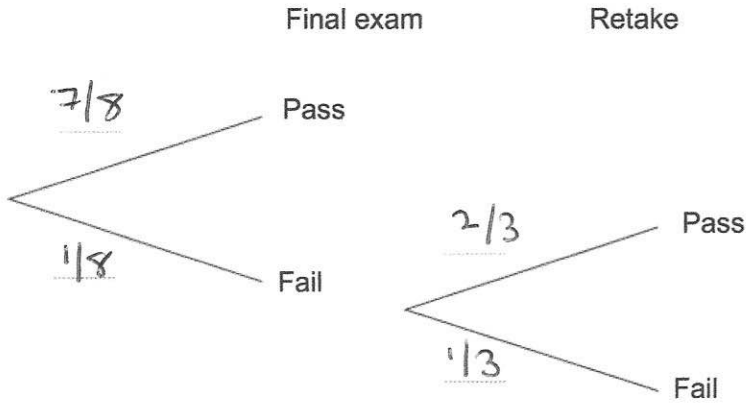
$$\frac{41950}{300} = 139.83....$$

.....139.8.....cm

(4)

49. A college course consists of 8 weeks of teaching with a final exam at the end of the course
If a student fails the final exam, they have one opportunity to retake the exam.

The probability of a student passing the final exam is $\frac{7}{8}$
The probability of a student passing the retake is $\frac{2}{3}$



(a) Complete the tree diagram.

(1)

If a student passes the final exam or retake, they receive a certificate.

(b) Work out the probability that a student receives a certificate.

$$\frac{7}{8} + \left(\frac{1}{8} \times \frac{2}{3}\right) = \frac{23}{24}$$

Since

$P(P) = \frac{7}{8}$

$P(FP) = \frac{1}{8} \times \frac{2}{3}$

23/24

(3)

50. Darren wants to estimate how many grasshoppers live in a field.
He catches and marks 24 grasshoppers.
He then releases the grasshoppers.

The next day, Darren returns to the same field and captures 51 grasshoppers.
7 of these have been marked.

Work out an estimate for the total number of grasshoppers in the field.

$$\frac{24}{x} = \frac{7}{51}$$

$$1224 = 7x$$

$$x = 174.85$$

174 or 175

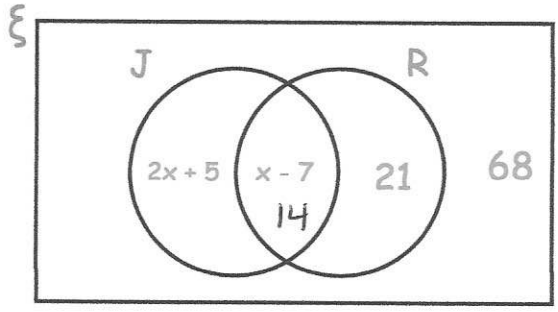
.....

(3)

---

51. The Venn diagram shows information about the cars in a car park.

ξ = 150 cars in the car park
R = red cars
J = cars manufactured in Japan



A car is chosen at random.
Work out the probability that it is red.

$$(2x+5) + (x-7) + 21 + 68 = 150$$

$$3x + 87 = 150$$

$$3x = 63$$

$$x = 21$$

$$14 + 21 = 35$$

35/150

7/30

.....

(4)