Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2023

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]

GMC31

TUESDAY 21 NOVEMBER, 9.15 am – 11.15 am

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

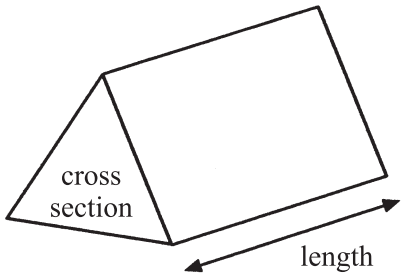
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twenty-nine** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

INFORMATION FOR CANDIDATES

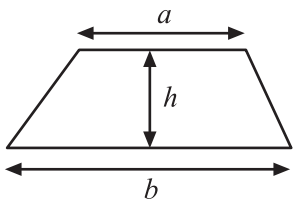
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

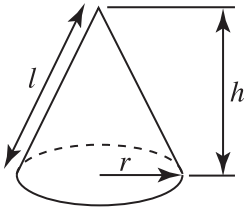


Area of trapezium = $\frac{1}{2}(a+b)h$



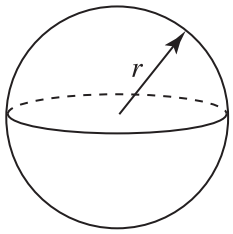
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

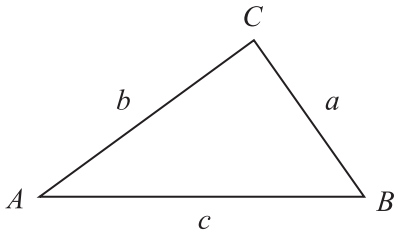


Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

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

Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$

1 Part of a rail timetable is shown below.

Northbound departures	Monday to Friday				
London Euston	07:36	11:33	12:33	15:33	19:33
Milton Keynes Central	08:09	12:10	13:10	16:11	20:10
Nuneaton	08:44	12:45	13:45	16:44	20:43
Preston	10:17	14:13	15:09	18:20	22:11
Kirkham and Wesham	10:27	14:23	15:19	18:30	22:21
Poulton-le-Fylde	10:37	14:33	15:28	18:39	22:31
Blackpool North (arrive)	10:44	14:40	15:36	18:47	22:38

Amy boards the train in Nuneaton at 13:45

(a) What time will she arrive in Blackpool North?

Answer 15:36 [1]

(b) How long does her journey take?

Give your answer in hours and minutes.

13:45 to 14:00 = 15 min

14:00 to 15:00 = 1 hr

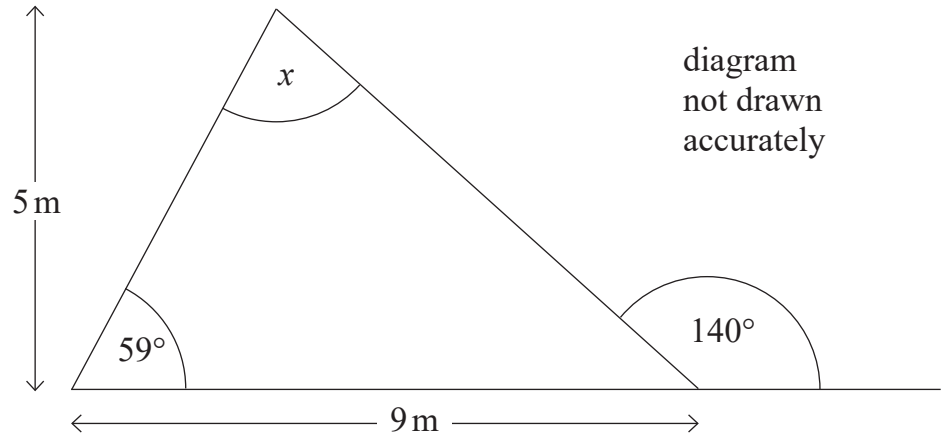
15:00 to 15:36 = 36 min

Total = 1 hr 51 min

Answer 1 hr 51 min [2]

[Turn over

2



(a) Calculate the size of angle x.

Angle on the straight line: $180° - 140° = 40°$

$x = 180° - (59° + 40°)$

$x = 180° - 99° = 81°$

Answer 81 ° [3]

(b) Calculate the area of the triangle.

Give the correct unit of measurement with your answer.

Area = ½ × base × height

= ½ × 9 × 5 = 9 × 5 ÷ 2

= 22.5

Answer 22.5 m^2 [3]

3 A PE teacher recorded the time each pupil in class 11A took to run 200 m.

The results are displayed in the stem and leaf diagram below.

23	7				
24	1	4	5	8	
25	2	3	7	7	9
26	3	5			
27	1	2	8		
28	5	6	6	7	
29	3	3			

Key: 25 | 2 = 25.2 seconds

(a) What was the median time taken?

21 times, median = 11th = 26.3

Answer *26.3* seconds [1]

(b) What was the range of the times recorded?

29.3 – 23.7 = 5.6

Answer *5.6* seconds [1]

(c) The results for class 11B are summarised as follows.

Median = 28.3 seconds Range = 3.5 seconds

Use this information to say whether each of these statements is true or false.

(i) On average, pupils in class 11A were faster than pupils in class 11B.

Answer *true* [1]

(ii) Pupils' times in class 11A were more consistent than in class 11B.

Answer *false* [1]

[Turn over

4 A cashier counted the notes in the till.

Type of note	Number of notes	Value
£5	12	5 × 12 = £60
£10	9	10 × 9 = £90
£20	3	20 × 3 = £60
£50	1	50 × 1 = £50

What was the total value of the notes in the till?

£60 + £90 + £60 + £50 = £260

Answer £ 260 [2]

5 From the list

6 15 16 25 27 29 36

(a) Which is a multiple of 12? Answer 36 [1]

(b) Which is a power of 2? Answer 16 [1]

6 Rebecca has a 5 kg sack of rice.

She pours the rice into smaller bags, each bag holding 360 g.

(a) How many bags can Rebecca fill completely from the sack of rice?

5 kg = 5000 g

5000 ÷ 360 = 13.8888...

13 bags completely filled

Answer 13 [2]

(b) Sue bought a 10 kg sack of rice.

She thinks the maximum number of smaller bags she could fill would be **exactly** double the number Rebecca filled using the 5 kg sack.

Is Sue correct?

You must show work to justify your answer.

10 kg = 10 000 g

10 000 ÷ 360 = 27.7777...

Sue can fill 27 bags completely

Double Rebecca's number = 2 × 13 = 26

27 is not 26, so Sue is not correct:

she can fill 27 bags, not exactly double.

Answer No [2]

[Turn over

7 **(a)** Simplify $5x + 2y - 7x + 4y$

$5x - 7x = -2x, \quad 2y + 4y = 6y$

Answer $-2x + 6y$ [2]

(b) Expand $4(3 - 2p)$

$4 \times 3 = 12, \quad 4 \times (-2p) = -8p$

Answer $12 - 8p$ [2]

(c) Factorise

(i) $5k + 15$

Answer $5(k + 3)$ [1]

(ii) $c - c^2$

Answer $c(1 - c)$ [1]

8 A packet of biscuits contains x biscuits.

In a special offer an extra 2 biscuits are added to each packet.

(a) Write an expression in terms of x for the number of biscuits in each special offer packet.

Answer $x + 2$ [1]

(b) Alice buys 3 packets in the special offer.

Write an expression, in terms of x, for the total number of biscuits she will have.

Answer $3(x + 2)$ [1]

(c) Each packet of biscuits costs t pence.

Alice buys her 3 packets of biscuits and pays with a £5 note.

Write an expression in terms of t for the change, in pence, she will receive.

£5 = 500 pence, 3 packets cost 3t pence

Answer $500 - 3t$ pence [2]

[Turn over

9 A lorry needs to be driven 156 miles to a ferry port.

It needs to arrive at 4pm.

The lorry is driven at an average speed of 48 mph.

What is the latest time the journey should start?

Time = distance ÷ speed

= 156 ÷ 48

= 3.25 hours

= 3 hours 15 minutes

4 pm − 3 h 15 min = 12:45 pm

Answer 12:45 pm [3]

10 Harry wanted to investigate the relationship between how much money people spent on fuel for their car and how many miles they drove.

To get some data, he decided to post a survey to some people for them to fill in and return.

(a) Describe a possible problem with Harry's **method** of collecting data.

Answer *The surveys may not be returned, or not everyone he sends it to will drive a car.* [1]

(b) He posted the survey to 10 people.

Explain why it may be unwise for Harry to draw any **conclusions** from his data.

Answer *The sample size (10) is too small.* [1]

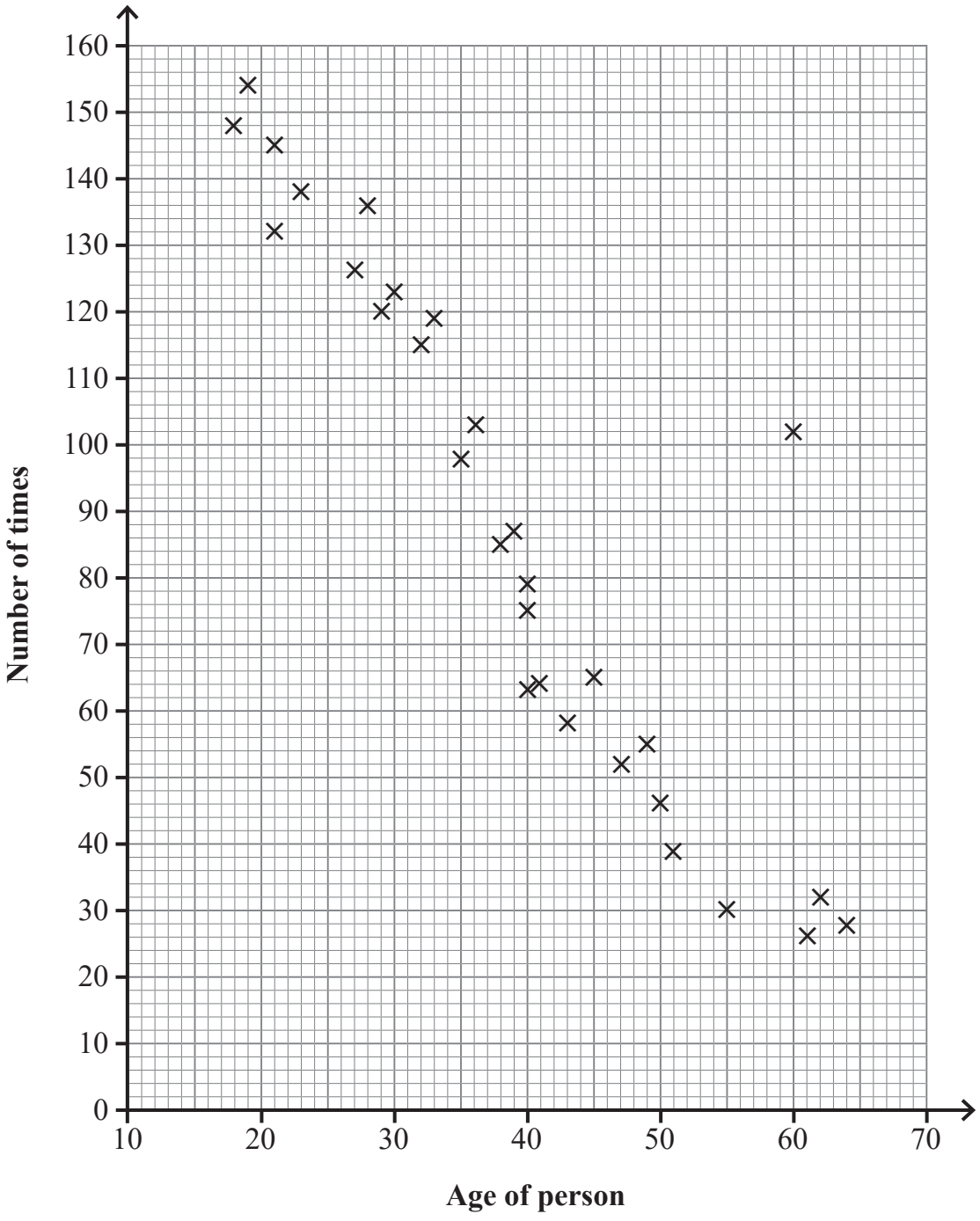
(c) Circle the correct word to describe the data Harry collected.

Qualitative (Quantitative)

[1]

[Turn over

11 The scatter graph shows information about how many times a day people checked their phones.



(a) What was the greatest number of times someone checked their phone?

Answer 154 [1]

14115

(b) How many times did the person aged 49 check their phone?

Answer 55 [1]

(c) Describe the correlation between the age of a person and the number of times they checked their phone.

Answer negative [1]

(d) Write a suitable sentence to describe the **relationship** between the age of a person and the number of times they checked their phone.

Answer The older the person, the fewer times they checked their phone. [1]

(e) Insert the correct word to complete the following sentence.

The data point at (60, 102) is an outlier . [1]

[Turn over

12 **(a)** Solve $\frac{x}{4} = 12$

$x = 12 \times 4$

Answer $x =$ 48 [1]

(b) Solve $5y + 3 = 2y - 9$

$5y - 2y = -9 - 3$

$3y = -12$

$y = -12 \div 3$

Answer $y =$ −4 [3]

13 Pete's wage was £480 last week.

£72 was for working overtime.

What percentage of his wage was **not** for working overtime?

Overtime: $\frac{72}{480} \times 100 = 15\%$

Not overtime = 100% − 15% = 85%

Answer 85 % [3]

14 An English exam consists of 2 papers.

Paper 1 has 85 marks available.

Paper 2 has 80 marks available.

To pass the English exam, a student must get $\frac{2}{3}$ of the total marks.

David's percentage score in Paper 1 is 60%.

How many of the 80 marks does he need in Paper 2 to pass the English exam?

Total marks = 85 + 80 = 165

Pass mark = $\frac{2}{3}$ × 165 = 110 marks

Paper 1 = $\frac{60}{100}$ × 85 = 51 marks

Paper 2 needs 110 − 51 = 59 marks

Answer 59 [3]

[Turn over

15 A sports referee trains by running diagonally across a rectangular pitch, as shown in the diagram below.

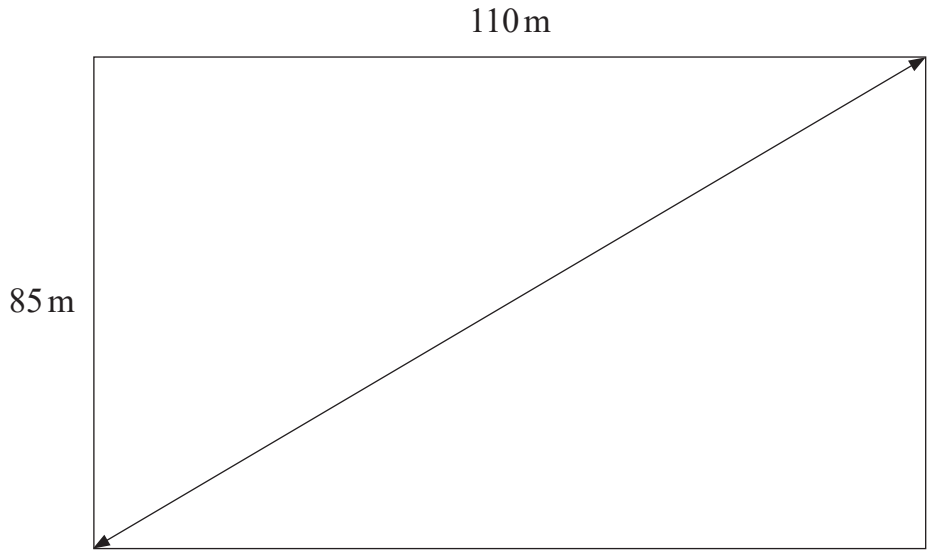


diagram not drawn to scale

The referee wants to run a distance of **at least** 1 km.

How many diagonal runs are needed?

$d^2 = 85^2 + 110^2$

$d^2 = 7225 + 12\,100 = 19\,325$

$d = \sqrt{19325} = 139.0143877...$ m

$1000 \div 139.0143877... = 7.193502...$

7 runs = 973.1 m (less than 1 km), so 8 runs needed

Answer 8 [5]

16 Find the area of the kite below.

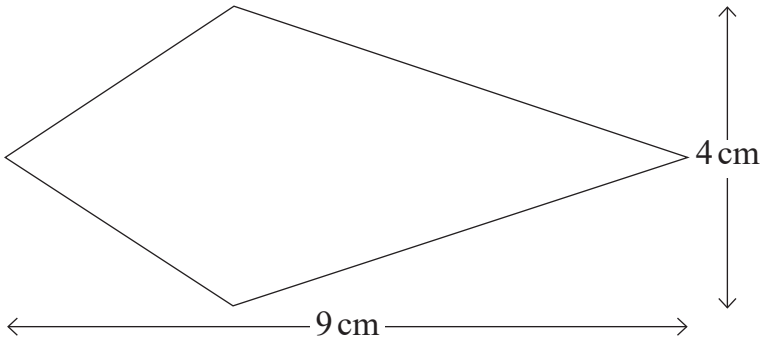


diagram
not drawn
to scale

Area of kite = ½ × 9 × 4

= 0.5 × 9 × 4

= 18

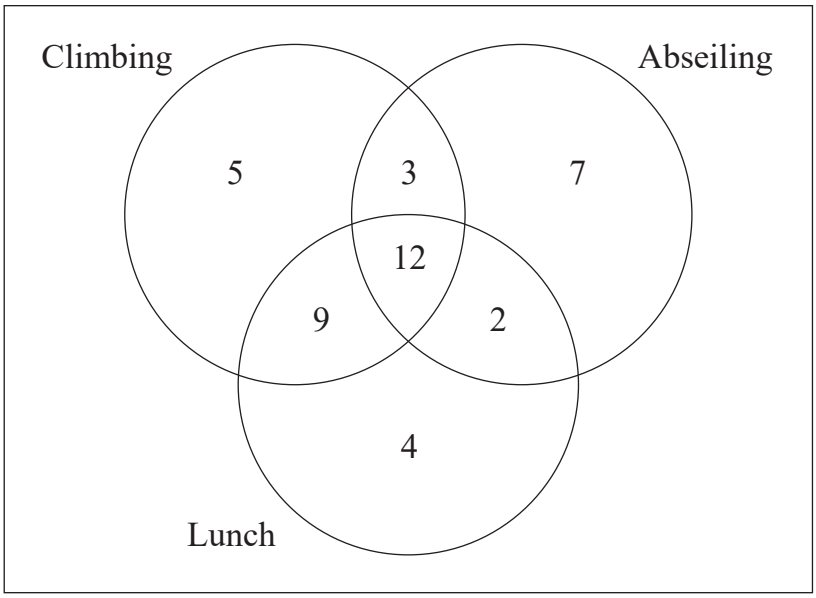
Answer 18 cm^2 [2]

[Turn over

17 A company took 42 employees on a team-building day.

Each person was able to choose which sporting activities to do and whether or not to have lunch.

The Venn diagram shows what choices they made.



(a) How many people did not take part in either of the sporting activities?

Answer 4 [1]

(b) How many people did not have lunch?

5 + 3 + 7 = 15

Answer 15 [1]

(c) The cost for someone to take part in one sporting activity and have lunch was £16

How much did the company pay for people who took part in one sporting activity and had lunch?

One activity and lunch = 9 + 2 = 11 people

11 × £16 = £176

Answer £ 176 [2]

18 C has the coordinates (–2, 4) and D has the coordinates (8, 7).

Find the coordinates of the midpoint of the line CD.

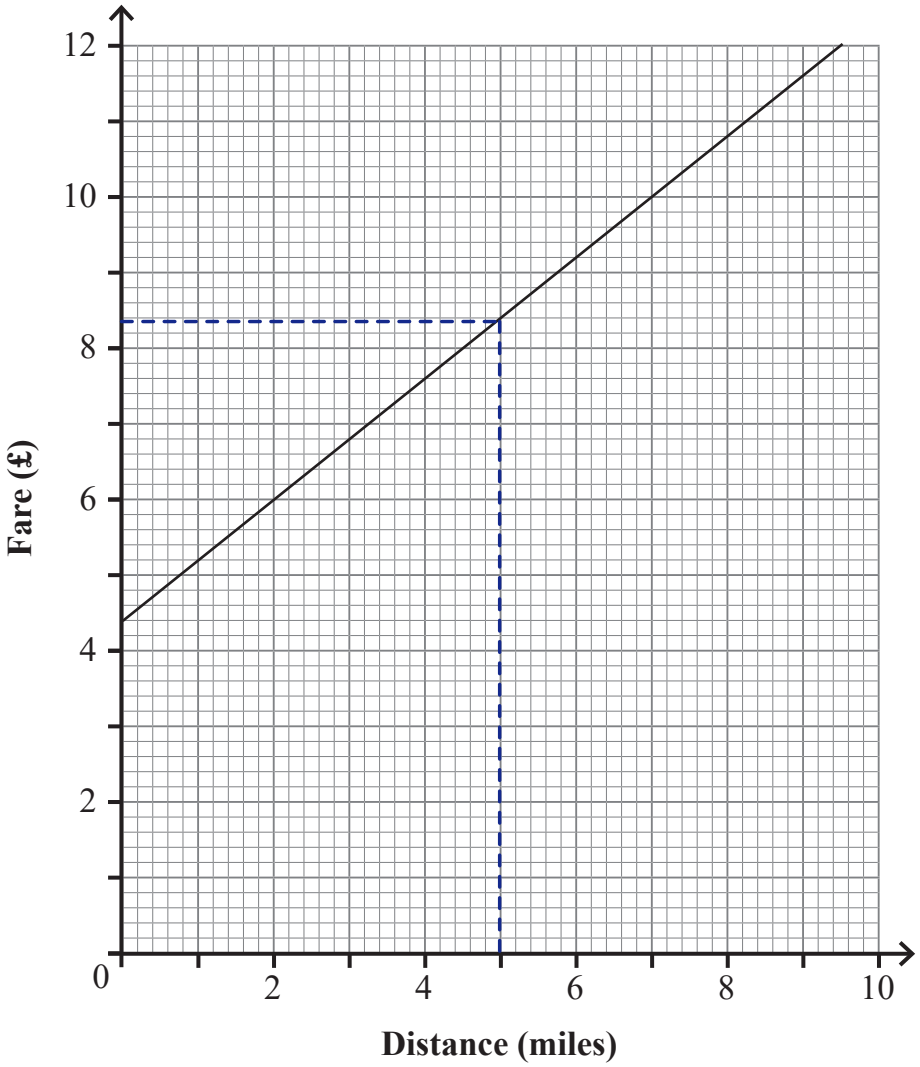
$x: \frac{-2 + 8}{2} = \frac{6}{2} = 3$

$y: \frac{4 + 7}{2} = \frac{11}{2} = 5.5$

Answer (3 , 5.5) [2]

[Turn over

19 The graph represents the fare (in £) for a taxi journey of a distance in miles.



(a) Paula was charged £8.40 for her journey to work.

How many miles did Paula travel?

Answer 5 miles [1]

(b) What is the cost per mile charged by the taxi firm?

0 miles = £4.40, 5 miles = £8.40
so 5 miles cost £4, 1 mile = £4 ÷ 5 = 80p

Answer 80p per mile [2]

20 (a) Raymond's car insurance quote is £1200 for a year.

He is entitled to 30% off for his no claims discount.

If he pays online, he will get a 5% discount off this reduced price.

How much will the online price be?

30% of £1200 = 0.3 × 1200 = £360

£1200 − £360 = £840

5% of £840 = 0.05 × 840 = £42

£840 − £42 = £798

Answer £ 798 [3]

(b) Raymond's father says the total discount was 35%

Is he correct?

You must show work to justify your answer.

Total saving = £1200 − £798 = £402

$\frac{402}{1200} \times 100 = 33.5\%$

(35% of £1200 = £420, not £402)

33.5% is not 35%, so he is not correct

Answer No [2]

[Turn over

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

$60 = 2 \times 2 \times 3 \times 5 = 2^2 \times 3 \times 5$

$36 = 2 \times 2 \times 3 \times 3 = 2^2 \times 3^2$

$LCM = 2^2 \times 3^2 \times 5$

$= 2 \times 2 \times 3 \times 3 \times 5 = 180$

Answer 180 [3]

22 A rectangle has length $(x + 5)$ and breadth $(x + 2)$

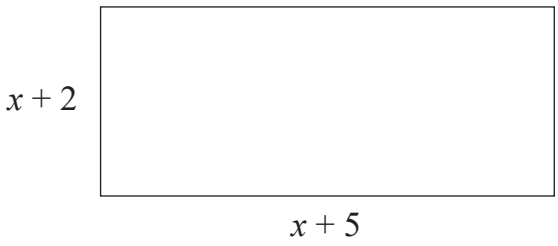


diagram not drawn to scale

Work out an expression for the area of the rectangle.

Area $= (x + 5)(x + 2)$

$= x^2 + 2x + 5x + 10$

$= x^2 + 7x + 10$

Answer $x^2 +$ 7 $x +$ 10 [2]

23 A force of 240 N is applied to a brake pad with an area of 0.32 m^2

Calculate the pressure produced by the brake pad.

Pressure = Force ÷ Area

$= \frac{240}{0.32}$

= 750

Answer 750 N / m^2 [2]

[Turn over

24 A circular pizza is cut into six equal slices.

The pizza has a diameter of 10 inches.

If two slices of pizza are eaten, what area of pizza remains?

Radius = 10 ÷ 2 = 5 inches

Area = $\pi \times 5^2 = 78.53981634$

4 slices remain: $\frac{4}{6} = \frac{2}{3}$ of the pizza

$\frac{2}{3} \times 78.53981634 = 52.35987756$

Answer 52.36 square inches [3]

25 Calculate the interquartile range (IQR) for the following data.

24, 25, 25, 27, 28, 30, 30, 31, 34, 92

n = 10: Q1 = 3rd value = 25, Q3 = 8th value = 31

IQR = 31 − 25 = 6

Answer 6 [2]

26 At a barbeque there are 3 options.



PRICE PER OPTION

STEAK - £8.50

CHICKEN - £7.95

VEGETARIAN - £6.20

© *Getty Images*

30% of the people choose steak.

$\frac{1}{4}$ of the people choose chicken.

The remaining 36 people choose the vegetarian option.

Calculate the total spent on these options.

Steak + chicken = 30% + 25% = 55%

Vegetarian = 100% − 55% = 45% = 36 people

1% = 36 ÷ 45 = 0.8, 100% = 80 people

Steak = 0.8 × 30 = 24, Chicken = ¼ × 80 = 20

Total = 24 × £8.50 + 20 × £7.95 + 36 × £6.20

= £204 + £159 + £223.20 = £586.20

Answer £ 586.20 [5]

[Turn over

27 Show that $\frac{3x-1}{2}+\frac{11-7x}{6}$ simplifies to the single fraction $\frac{x+4}{3}$

Show each stage of your working clearly.

$\frac{3x-1}{2}+\frac{11-7x}{6}=\frac{3(3x-1)}{6}+\frac{11-7x}{6}$

$=\frac{3(3x-1)+11-7x}{6}$

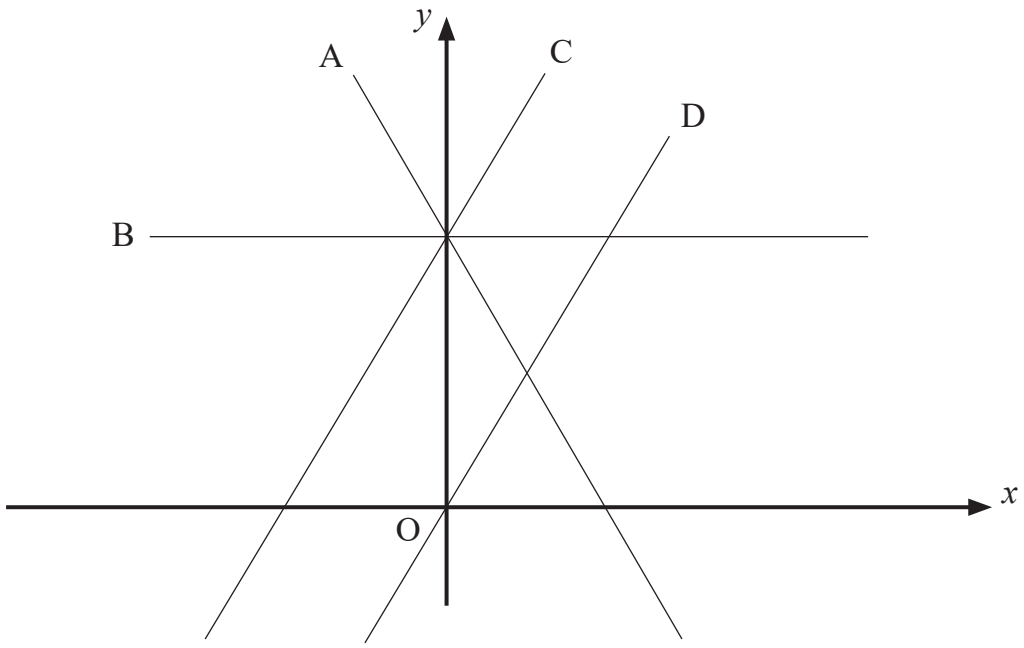
$=\frac{9x-3+11-7x}{6}$

$=\frac{2x+8}{6}$

$=\frac{2(x+4)}{6}=\frac{x+4}{3}$

[3]

28



A, B, C and D are four straight lines.

C and D are parallel.

The equations of three of these lines are

$$y = 4x \qquad y = 5 - 4x \qquad y = 5$$

Use this information to find the equation of the fourth line.

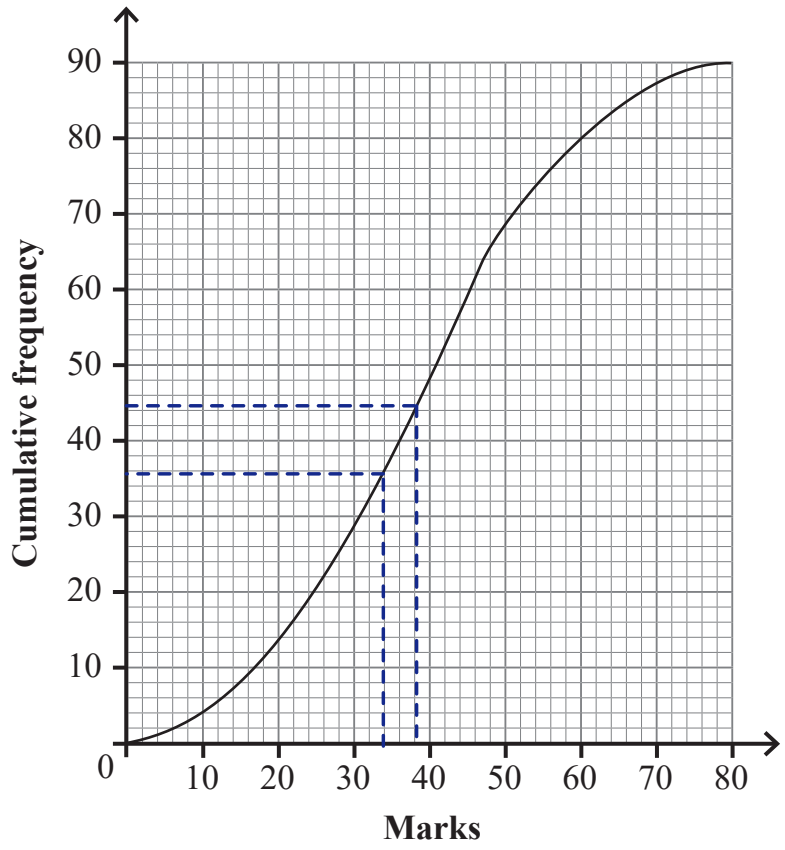
D passes through O (0, 0), so D is y = 4x
A has a negative gradient, so A is y = 5 − 4x
B is horizontal, so B is y = 5
C is parallel to D (gradient 4) and crosses the
y-axis at the same point as A and B (0, 5)

Answer _____ y = 4x + 5 _____ [4]

[Turn over

29 90 apprentices sat an engineering examination.

The cumulative frequency graph for the results is shown.



(a) Use the graph to estimate the median mark.

½ × 90 = 45th person

Answer 38.5 [1]

(b) The pass mark was 34

Use the graph to estimate how many apprentices passed.

Mark 34 gives 36 people below
Passed = 90 − 36 = 54

Answer 54 [2]

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