Rewarding Learning

General Certificate of Secondary Education

Centre Number

Candidate Number

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]
Assessment

GMC31

Assessment Level of Control:
Tick the relevant box (✓)

Controlled Conditions	
Other	

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-eight** 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.

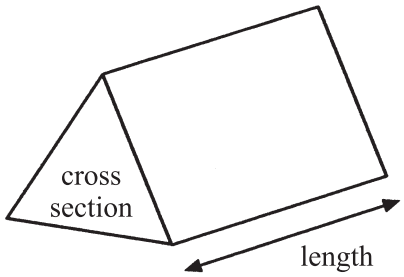
INFORMATION FOR CANDIDATES

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.

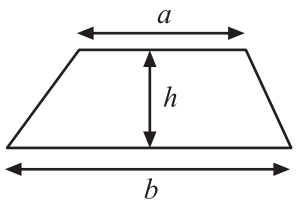
12370.05 **R**

Formula Sheet

Volume of prism = area of cross section × length

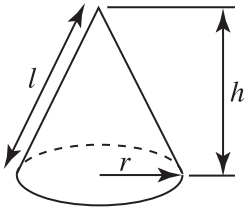


Area of trapezium = $\frac{1}{2}(a+b)h$



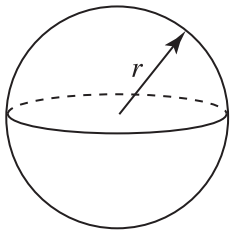
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

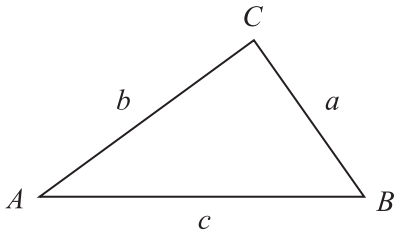


Volume of sphere = $\frac{4}{3}\pi r^3$

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 Solve the equations:

(a) $\frac{t}{8} = 4$

$t = 4 \times 8$

Answer $t =$ 32 [1]

(b) $9n - 2 = 52$

$9n = 52 + 2$

$9n = 54$

$n = 54 \div 9$

Answer $n =$ 6 [2]

[Turn over

2 A sports team recorded information about whether players were able to play on Saturday only, Sunday only, or both.

(a) Complete the two-way table below.

	Saturday only	Sunday only	Both Saturday and Sunday	
Defenders	5	2	0	7
Midfielders	4	1	3	8
Attackers	2	3	1	6
	11	6	4	21

[2]

(b) The team decides to play on Saturday.

How many midfielders are able to play?

Saturday only + both = 4 + 3 = 7

Answer 7 [1]

3 Simplify the expression

$$6e - 5w + 2e - 4w$$

6e + 2e = 8e, −5w − 4w = −9w

Answer 8e − 9w [2]

4 Jake earns £1400 each month.

Every month he pays 4% of his earnings into a savings scheme.

How much money will he have paid into this scheme after three months?

4% of 1400 = 1400 ÷ 100 × 4

= £56 per month

After 3 months: 56 × 3 = £168

Answer £ 168 [3]

[Turn over

5 Martin asks 20 workers how many hours they normally work in a week.

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

0	8								
1	3	7							
2	2	5	8						
3	2	2	4	6					
4	0	0	2	4	4	4	7	8	
5	1	3							

Key 4 | 2 means 42 hours

(a) For the data above, work out

(i) the range,

53 − 8 = 45

Answer 45 hours [1]

(ii) the median.

10th and 11th values:
(36 + 40) ÷ 2 = 38

Answer 38 hours [1]

(b) Another worker normally works 39 hours in a week.

This value is added to the stem and leaf diagram.

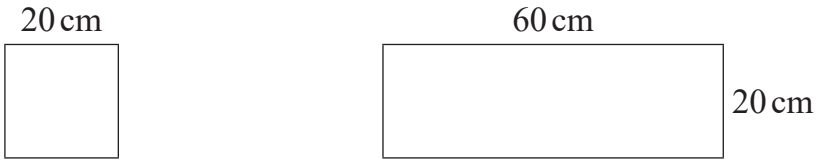
Circle the correct word or words to make each of the following statements correct.

(i) The mode will increase / decrease / (stay the same) [1]

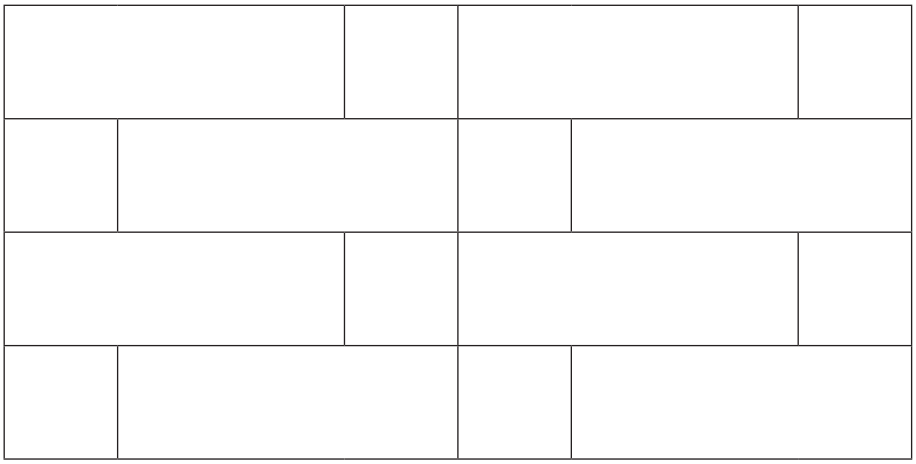
(ii) The range will increase / decrease / (stay the same) [1]

(iii) The median will (increase) / decrease / stay the same [1]

6 A garden table is tiled using square tiles and rectangular tiles, as shown below.



The tiled table looks like this.



Work out the **perimeter** of the table.

Give your answer in **metres**.

Length = 60 + 20 + 60 + 20 = 160 cm

Width = 4 × 20 = 80 cm

Perimeter = 160 + 160 + 80 + 80 = 480 cm

480 cm ÷ 100 = 4.8 m

Answer 4.8 m [3]

[Turn over

7 Louise normally works 38 hours per week and is paid £9.80 per hour.

If she works any extra hours, she is paid at the overtime rate of £14.50 for each extra hour.

Last week her total earnings were £473.90

How many **extra** hours did she work last week?

Normal pay: 38 × 9.80 = £372.40

Overtime pay: 473.90 − 372.40 = £101.50

Extra hours: 101.50 ÷ 14.50 = 7

Answer 7 [3]

8 Wayne wants to travel from Glasgow to Carlisle by train.

Glasgow	Depart	17:42
Carlisle	Arrive	20:11

How long will this journey take?

17:42 to 18:00 = 18 minutes

18:00 to 20:00 = 2 hours

20:00 to 20:11 = 11 minutes

18 min + 2 h + 11 min = 2 hours 29 minutes

Answer 2 hours 29 minutes [3]

9 Suzie notices this sign in her local takeaway.

5% charge on card payments
for orders under £15

She orders food costing £12.80 and decides to pay by card.

How much will she have to pay in total?

£12.80 < £15, so 5% charge applies

5% of 12.80 = 12.80 ÷ 100 × 5 = £0.64

Total = 12.80 + 0.64 = £13.44

Answer £ 13.44 [3]

[Turn over

10 A group of 10 people sat their driving theory test.

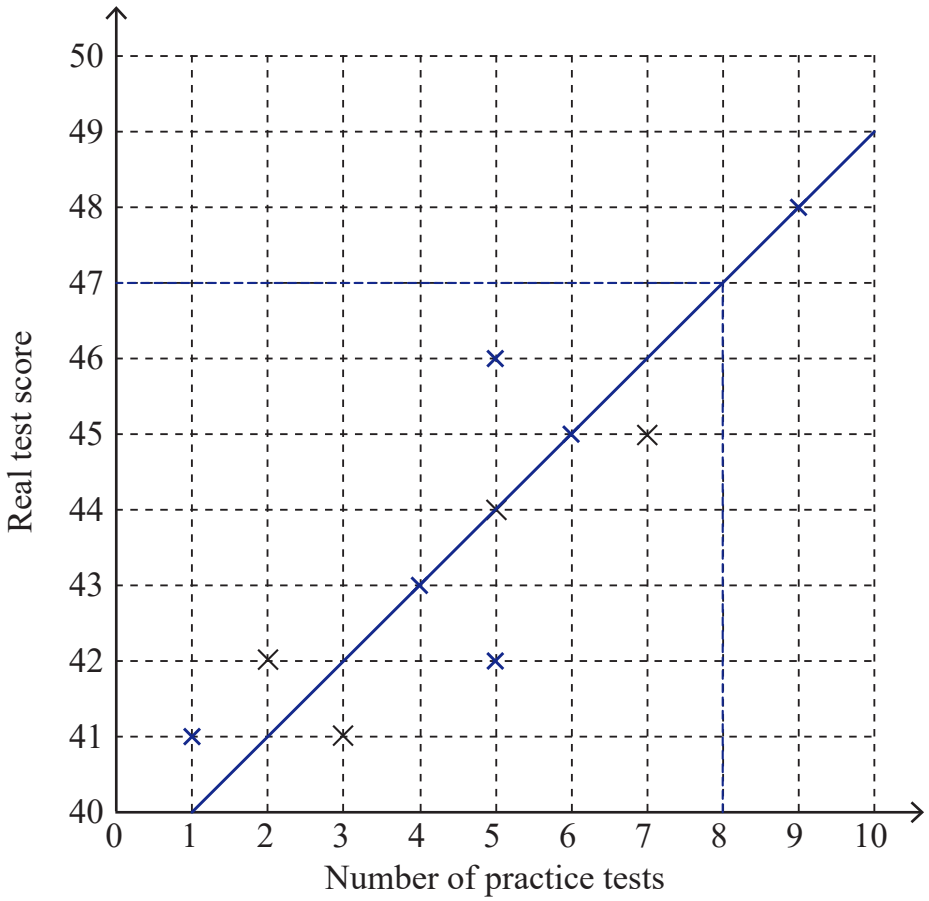
Their driving instructor recorded how many practice tests they did and their score in the real test.

The information is recorded in the table below.

Person	A	B	C	D	E	F	G	H	I	J
Number of practice tests	**2**	**5**	**3**	**7**	4	1	9	6	5	5
Real test score	**42**	**44**	**41**	**45**	43	41	48	45	46	42

(a) Show this information on the scatter graph below.

The first four points have been plotted for you. [2]



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(b) The pass mark for the test is 44

How many of the 10 people passed the test?

Scored 44 or more: B, D, G, H, I

Answer 5 [1]

(c) Complete the statement:

"In general, the more practice tests completed,

the higher the test score." [1]

(d) Draw the line of best fit. [1]

(e) Another person completed eight practice tests.

Use the graph to estimate their real test score.

From line of best fit at x = 8

Answer 47 [1]

[Turn over

11 A cinema ticket for an adult costs £t

A cinema ticket for a child costs £3

James bought four adult tickets and seven child tickets.

The total cost was £49

(a) Form an equation that can be solved to find the cost of an adult ticket.

$4 \times t + 7 \times 3 = 49$

Answer $4t + 21 = 49$ [1]

(b) Solve your equation to find the cost of an adult ticket.

$4t = 49 - 21$

$4t = 28$

$t = 28 \div 4 = 7$

Answer $t =$ 7 [2]

12 Bob is going to pave a patio. He needs 480 paving slabs.

He looks in three different stores.

Garden Store	Perfect Patio Store	Quinn's Paving Store
32 slabs in a box	**80 slabs in a box**	**16 slabs in a box**
Box price = £27	**Box price = £70**	**Box price = £17**
	10% discount on 5 or more boxes	Buy 5 boxes, get one extra box free

Which store will be the cheapest for him to buy the slabs in?

Show all your working.

Garden Store: 480 ÷ 32 = 15 boxes

15 × £27 = £405

Perfect Patio: 480 ÷ 80 = 6 boxes

6 × £70 = £420

10% discount: 420 × 0.9 = £378

Quinn's Paving: 480 ÷ 16 = 30 boxes needed

Buy 25, get 5 free: 25 + 5 = 30 boxes

25 × £17 = £425

£378 < £405 < £425

Answer Perfect Patio Store [6]

[Turn over

13 Factorise $3x + 6$

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

14

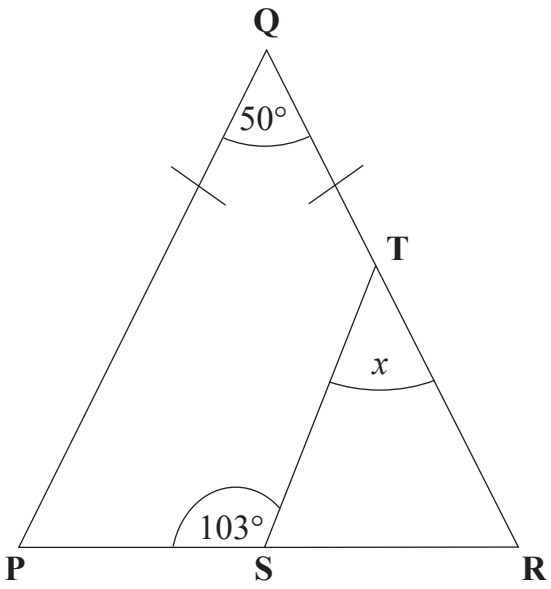


diagram
not drawn
accurately

Triangle PQR is isosceles with PQ = QR.

(a) Calculate the size of angle x

PQ = QR, so angle QPR = angle QRP = (180 − 50) ÷ 2 = 65°

Angle TSR = 180 − 103 = 77° (angles on a straight line)

x = 180 − (77 + 65) = 38° (angles in a triangle)

Answer 38 ° [3]

(b) Hence decide if the lines PQ and ST are parallel.

No because corresponding angles x and PQR are not equal

(38° ≠ 50°), so PQ and ST are not parallel [2]

[Turn over

15 Solve $2(3x - 1) + 5 = 4(x + 2)$

$6x - 2 + 5 = 4x + 8$

$6x + 3 = 4x + 8$

$6x - 4x = 8 - 3$

$2x = 5$

$x = 2.5$

Answer $x =$ 2.5 [3]

16 Data on the weights of 16 players on a sports team is recorded in the grouped frequency table.

Weight (W kg)	Frequency	Midpoint	$f \times x$
$60 < W \leq 70$	1	65	65
$70 < W \leq 80$	5	75	375
$80 < W \leq 90$	4	85	340
$90 < W \leq 100$	6	95	570

The manager states that "the estimated mean weight of the team lies within the median class".

Is his statement correct? **You must justify your answer fully.**

Median: 16 values, so between the 8th and 9th values

Cumulative frequencies 1, 6, 10, 16

so the median class is $80 < W \leq 90$

$$\text{Mean} = \frac{1 \times 65 + 5 \times 75 + 4 \times 85 + 6 \times 95}{16}$$

$$= \frac{1350}{16} = 84.375 \text{ kg}$$

84.375 kg lies in the class $80 < W \leq 90$

Yes, his statement is correct: the estimated mean lies within the median class.

[4]

[Turn over

17 Which of these numbers is prime?

Explain your reasoning clearly for each number below.

Number	11	111	1111
Yes/No	Yes	No	No
Reason	only factors are 1 and 11	111 = 3 × 37 divisible by 3	1111 = 11 × 101 divisible by 11

[2]

18 A caravan depreciates in value by 15% each year.

Two years ago Malcolm bought a new caravan costing £24 000

(a) What is its value now?

After 1 year: 24 000 × 0.85 = £20 400

After 2 years: 20 400 × 0.85 = £17 340

Answer £ 17 340 [2]

(b) Malcolm states his caravan has depreciated by 30% over the two years.

Is he correct?

Explain your answer clearly.

Depreciation = 24 000 − 17 340 = £6660

$\frac{6660}{24\,000} \times 100 = 27.75\%$

No, he is not correct. The caravan has only depreciated by 27.75%, not 30%, because the 15% in the second year is taken from the lower value of £20 400, not from £24 000.

[3]

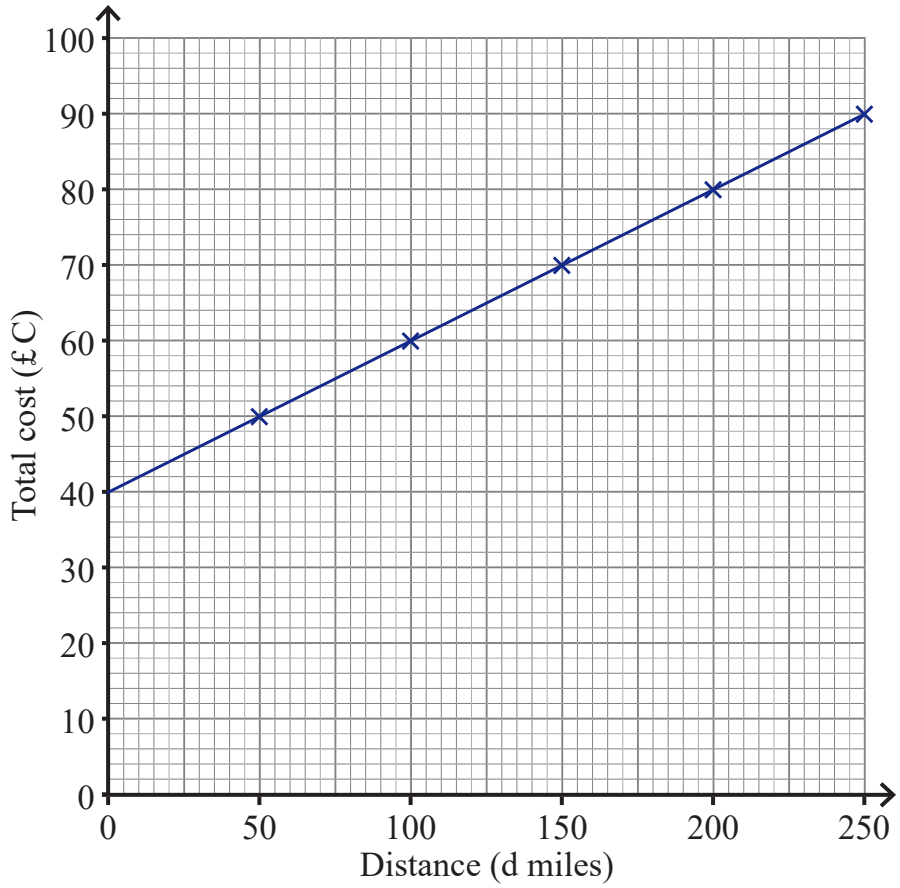
[Turn over

19 Martine wants to hire a van.

The table shows the costs for hiring the van.

Distance (d miles)	50	100	150	200	250
Total cost (£C)	50	60	70	80	90

(a) Draw a straight line graph to illustrate this information.



[2]

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(b) Use the graph to find

(i) the initial fixed charge for hiring the van,

Answer £ 40 [1]

(ii) the cost per mile, in pence, for using the van.

(90 − 40) ÷ 250 = £0.20 per mile

Answer 20 p [1]

(c) Work out the total cost if the van travels 450 miles.

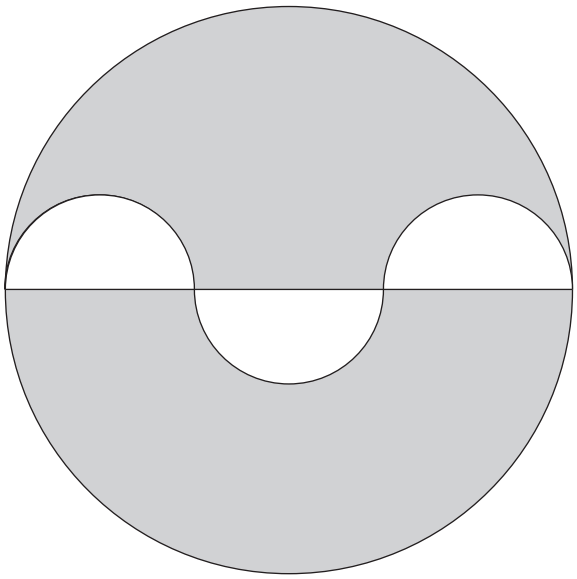
£40 + 450 × 20p

= 40 + 90 = £130

Answer £ 130 [2]

[Turn over

20



A large circle has three semicircles of equal diameters placed across its diameter as shown.

The radius of each of the small semicircles is 2 cm.

Work out the area shaded.

Large circle diameter = 3 × 4 = 12 cm, so radius = 6 cm

Large circle = $\pi \times 6^2$ = 113.0973... cm^2

Each semicircle = $(\pi \times 2^2) \div 2$ = 6.2831... cm^2

Shaded = 113.0973... − 3 × 6.2831...

= 94.2477... = 94.25 cm^2

Answer 94.25 cm^2 [5]

21 Coffee is sold in 250 gram packets and costs £4.20 a packet.

Tea is sold in 450 gram packets and costs £3.60 a packet.

Helen runs a café and buys the same number of grams of coffee and tea.

What is the least amount of money she could have spent?

LCM of 250 and 450:

250 = 2 × 5 × 5 × 5

450 = 2 × 3 × 3 × 5 × 5

LCM = 2 × 3 × 3 × 5 × 5 × 5 = 2250 g

Coffee: 2250 ÷ 250 = 9 packets

Tea: 2250 ÷ 450 = 5 packets

Cost = 9 × 4.20 + 5 × 3.60

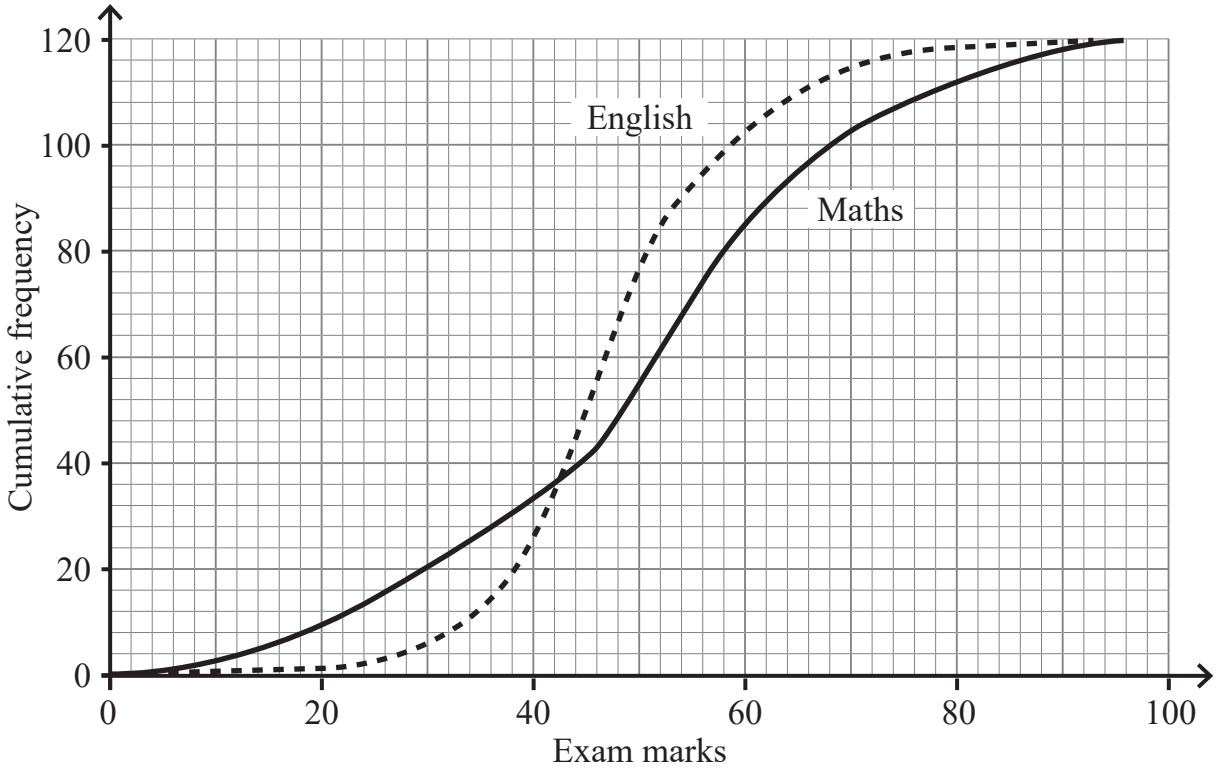
= 37.80 + 18.00 = £55.80

Answer £ 55.80 [5]

[Turn over

22 120 students sat a Maths exam and an English exam.

The cumulative frequency curves show the distribution of results.



With reference to three different statistical measures compare the two sets of results.

The median is higher in Maths (about 51) than in English (about 46). [1]

The range of marks is similar in both subjects (about 0 to 95). [1]

The IQR is greater in Maths (62 – 37 = 25) than English (53 – 41 = 12). [1]

23 Factorise

(a) $p^2 - 3p$

Answer $p(p - 3)$ [1]

(b) $100 - t^2$

Answer $(10 - t)(10 + t)$ [1]

(c) $x^2 + 2x - 15$

$5 \times (-3) = -15, \quad 5 + (-3) = 2$

Answer $(x + 5)(x - 3)$ [2]

[Turn over

24 Calculate the perimeter of the isosceles triangle.

You must show all your working.

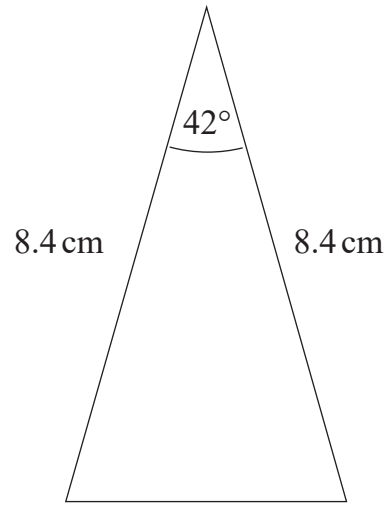


diagram not drawn accurately

Split into two right-angled triangles:

half the angle = 42 ÷ 2 = 21°

$\sin 21° = \frac{x}{8.4}$

$x = 8.4 \times \sin 21° = 3.01029...$ cm

Base = 2 × 3.01029... = 6.02058... cm

Perimeter = 8.4 + 8.4 + 6.02058...

= 22.82058... = 22.82 cm

Answer 22.82 cm [4]

25 A guitar is on sale in a shop.

The sale price is £120.96 after a 28% reduction.

What was the price of the guitar before the sale?

100% − 28% = 72%

120.96 ÷ 72 × 100 = £168

Answer £ 168 [2]

26 An elephant puts a total force of 33 000 N on its four feet.

Each foot has an area of 1500 cm^2

What is the pressure the elephant exerts on the ground?

Total area = 4 × 1500 = 6000 cm^2

Pressure = force ÷ area

= 33 000 ÷ 6000 = 5.5

Answer 5.5 N/cm^2 [2]

[Turn over

27 Find the area of the shaded sector of this circle, centre O and radius 3 cm.

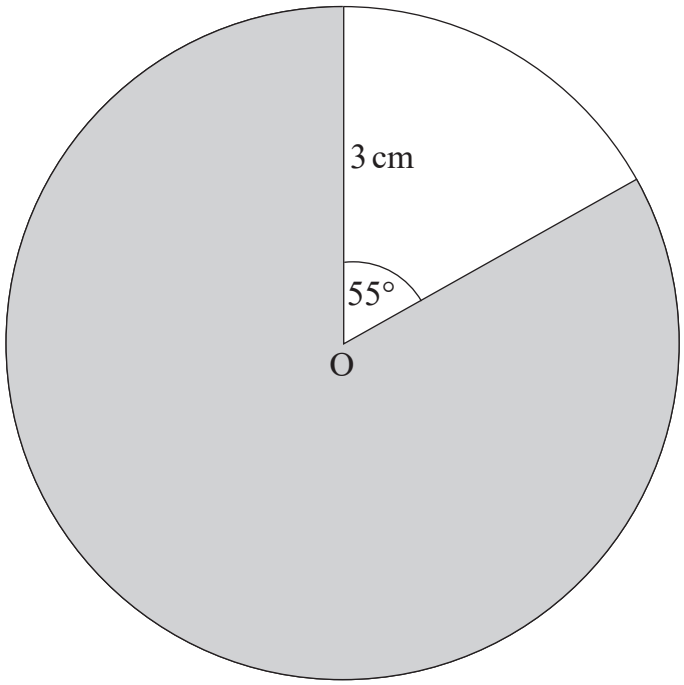


diagram not drawn accurately

Shaded angle = 360 − 55 = 305°

$A = \frac{305}{360} \times \pi \times 3^2$

$= 23.95464... = 23.95 \text{ cm}^2$

Answer 23.95 cm^2 [2]

28 Solve the equation $\frac{2(3x+2)}{5} - \frac{(3x-4)}{3} = \frac{2}{15}$

Show all your working out clearly.

A solution by trial and improvement will not be accepted.

Multiply every term by 15:

$6(3x + 2) - 5(3x - 4) = 2$

$18x + 12 - 15x + 20 = 2$

$3x + 32 = 2$

$3x = -30$

$x = -10$

Answer $x =$ -10 [4]

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Examiner Number

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