National Qualifications

Mock Exam
Applications of Mathematics
Paper 2

Duration – 1 hour 40 minutes

Fill in these boxes and read what is printed below.

Full name of centre: SOLUTIONS

Town:

Forename(s):

Surname:

Number of seat:

Date of birth

Day | Month | Year

Scottish candidate number

Total marks – 55

Attempt ALL questions.

You may use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

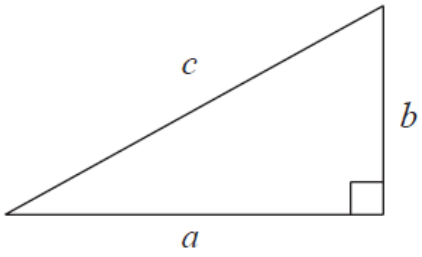
Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

FORMULAE LIST

Circumference of a circle $C = \pi d$

Area of a circle $A = \pi r^2$

Theorem of Pythagoras



$a^2 + b^2 = c^2$

Volume of a cylinder $V = \pi r^2 h$

Volume of a prism $V = Ah$

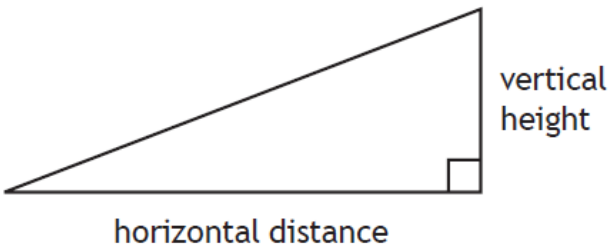
Volume of a cone $V = \frac{1}{3}\pi r^2 h$

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

Standard deviation $s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$

or $s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$, where n is the sample size.

Gradient



$$\text{gradient} = \frac{\text{vertical height}}{\text{horizontal distance}}$$

Total marks – 55

Attempt ALL questions

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MARKS

1. Iain bought a new car for £15 000 in January 2020.

In January 2021 and January 2022, the value of the car depreciated by 3.5%.
In January 2023, the value of the car appreciated by 1.3%.

(a) Calculate the value of the car in January 2023.

Give your answer to **3 significant figures**. **4**

$15000 \times 0.965^2 \times 1.013$ ✓1 ✓2 ✓3

$= £14149.96$

$= £14100$ (3 sf) ✓4

Year by year:

Jan 2021: 14475

Jan 2022: 13968.38

Jan 2023: 14149.96

Iain sells his car in March 2023 for £8 500.

(b) Calculate the percentage loss Iain has made on the car. **2**

Loss = £6500 ✓5

$\frac{6500}{15000} \times 100 = 43.3...\%$ ✓6

[Turn over

2. A fast food restaurant is recording how long it takes, in seconds, for customers to place their order.

The times for 6 customers are as follows.

83 87 88 90 85 86

For these times, calculate:

(a) (i) the mean

$\bar{x} = \frac{519}{6} = 86.5$ ✓1 **1**

(ii) the standard deviation **3**

x	$x - \bar{x}$	$(x - \bar{x})^2$
83	$83 - 86.5 = -3.5$	$(-3.5)^2 = 12.25$
85	$85 - 86.5 = -1.5$	$(-1.5)^2 = 2.25$
86	$86 - 86.5 = -0.5$	$(-0.5)^2 = 0.25$ ✓2
87	$87 - 86.5 = 0.5$	$0.5^2 = 0.25$
88	$88 - 86.5 = 1.5$	$1.5^2 = 2.25$
90	$90 - 86.5 = 3.5$	$3.5^2 = 12.25$

$\Sigma (x - \bar{x})^2 = 29.5$

SD

$\sqrt{\frac{29.5}{6-1}}$ ✓3

$= 2.4$ ✓4

The fast food restaurant decides to install self-service machines to help improve the time it takes for customers to place their order.

The mean time to place an order is now 78 seconds and the standard deviation is 3.2 seconds.

(b) Make two valid comments comparing the order times before and after the self-service machines are installed. **2**

On average, the order times after the self-service ✓5 machines are installed are faster.

The order times after the self-service machines are installed are less spread / less varied. ✓6

3. Liza had a work meeting in Manchester.

(a) She travelled from home to her meeting by car.

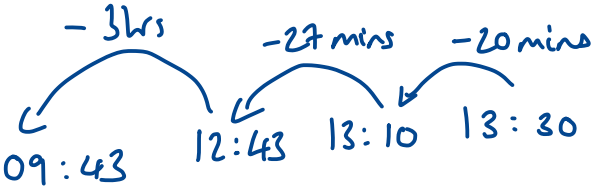
- She arrived at her meeting at 13:30
- She travelled 207 miles to her meeting at an average speed of 60 miles per hour
- She stopped for 20 minutes to get coffee

Calculate what time Liza left home. **4**

$T = \frac{207}{60}$ ✓1

$T = 3.45$ hrs ✓2

$T = 3$ hrs 27 mins ✓3



Liza left home at 09:43 ✓4

(b) Liza is planning her journey back home.

She knows that

- her house is 207 miles away from where her meeting is being held
- her car will cover an average of 60 kilometres per gallon of fuel
- her car has 25 litres of fuel in its tank.

Determine whether Liza has enough fuel to make the journey back home without stopping for fuel on the way.

1 mile = 1.609 km

1 gallon = 4.545 litres

4

$207 \times 1.609 = 333$ km ✓1 (miles → km)

$1 \div 4.545 = 0.22$ gallons

$0.22 \times 25 = 5.5$ gallons ✓2 (litres → gallons)

$60 \times 5.5 = 330$ km ✓3

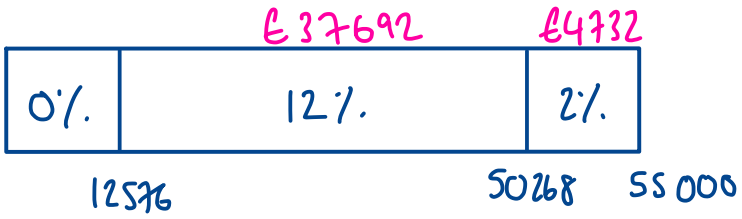
Liza will need to stop for fuel as she needs to travel 3km more than she is able to. ✓4

4. Brian earns £55,000 per annum.

National Insurance is calculated on a person's salary **before** deductions such as pension contributions.

National Insurance rates	
Up to £12,576	0%
From £12,576 to £50,268	12%
Over £50,268	2%

(a) Calculate Brian's annual National Insurance payment. **3**



12% of 37692 = £4523.04 ✓1

2% of 4732 = £94.64 ✓2

total NI = £4617.68 ✓3

Brian pays 10.9% of his annual salary into his pension.
His annual income tax is £9501.24.

Brian is paid in 12 equal monthly instalments.

(b) Calculate Brian's monthly net pay. **2**

Pension

10.9% of 55000

= £5995 ✓4

total deductions

5995 + 4617.68 + 9501.24

= £20113.92

Net pay

Annual: 55000 − 20113.92 = 29886.08

Monthly: 29886.08 ÷ 12 = £2490.51 ✓5

5. Boxes are loaded into a shipping container.

The dimensions of each box and the internal dimensions of a large cardboard box are shown below in the diagrams.

The boxes must be **packed upright** in the shipping container and must all be aligned in the same direction.

(a) Calculate the maximum number of boxes that can be packed into the shipping container. **3**

	L 250cm	B 900cm	H 150cm	total
①	250 ÷ 35 = 7.1...	900 ÷ 40 = 22.5	150 ÷ 25 = 6	7 x 22 x 6 = 924
②	250 ÷ 40 = 6	900 ÷ 35 = 25.7...	150 ÷ 25 = 6	6 x 25 x 6 = 900

✓1 ✓2

Max = 924 boxes ✓1

5. (continued)

(b) It takes 5 people 4 hours to pack the boxes into the shipping container.
The boxes are packed into the shipping container at the same rate.

Calculate how long it will take 8 people to pack the boxes into the shipping container.
Give your answer in **hours and minutes**.

3

5 people → 4 hours

1 person → 4 × 5 = 20 hours ✓2

8 people → 20 ÷ 8 = 2.5 hrs ✓1

2 hrs 30 mins. ✓3

6. A 4-pint carton of milk is equivalent to 2.272 litres.

Complete the label below to show how many litres are in a 6-pint carton of milk.

4 pints 2.272 litres	equivalent to	6 pints 3.408 L ✓2

2

1 pint = 0.568 litres ✓1

6 pints = 0.568 × 6 = 3.408 litres

7. Gillian is hosting a party for her son.

She buys a 2 litre bottle of **undiluted** orange juice.

- The 2 litre bottle of undiluted orange juice has to be mixed with **4 times** the amount of water
- The **diluted** juice is poured into cylindrical glasses with a radius of 5 centimetres and height 9 centimetres
- A 1 centimetre **gap** is left at the top of each glass.

Calculate the maximum number of glasses of juice Gillian can fill with juice. **5**

2 litres undiluted juice + 8 litres water

= 10 litres diluted juice. ✓1

$V = \pi \times 5^2 \times 8$ ✓2

$V = 628.3\ cm^3$ ✓3

628.3 ml of juice in one glass

10 litres = 10 000ml

$10000 \div 628.3 = 15.9...$ ✓4

Max no of glasses = 15. ✓5

MARKS

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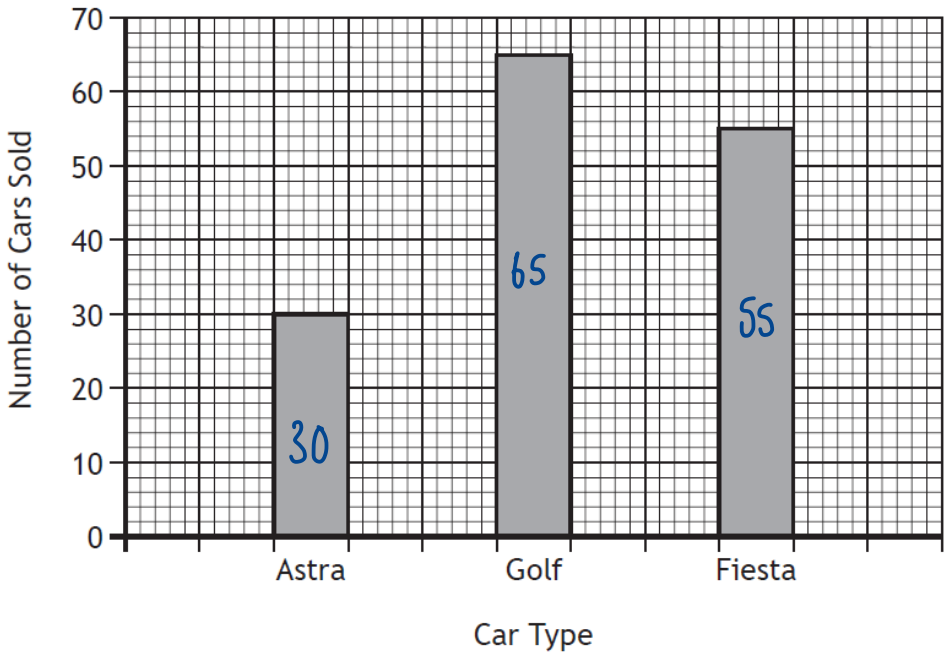
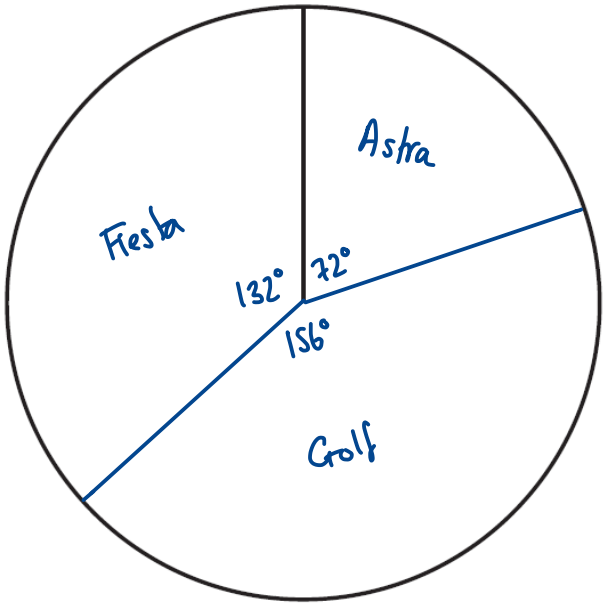
8. A garage sells 150 cars in a given month.

The bar chart below shows how many cars of each type are sold.



Construct a pie chart to show this information. **3**

Types of cars sold



✓3

Astra

✓1 $\frac{30}{150} \times 360 = 72°$

Golf

$\frac{65}{150} \times 360 = 156°$

Fiesta

$\frac{55}{150} \times 360 = 132°$ ✓2

[Turn over

9. Claire makes and sells bars of soap.

At a local market, Claire sells 50 bars of soap.

Each bar of soap costs £5.25.

The materials to make the 50 bars of soap cost £70.

Claire must pay for her stall at the market. Her fee is 6% of her total sales.

Calculate Claire's total profit. **3**

Sales = 5.25 x 50 = £262.50 ✓1

Fee = 6% of 262.50 = £15.75 ✓2

Cost to make soap = £70

Total profit

= 262.50 − 15.75 − 70

= £176.75. ✓3

10. A laptop in the UK costs £499.

In the United States, the same laptop costs $549 + sales tax.

The sales tax in the United States is approximately 5.1%.
Postage from the United States costs approximately $80.

Determine whether it would be cheaper to buy the laptop in the UK or in the United States.

Justify your answer by calculation.

£1 = $1.24 **3**

Sales tax = 5.1% of 549 = $28

total cost = 549 + 28 + 80 = $657. ✓1

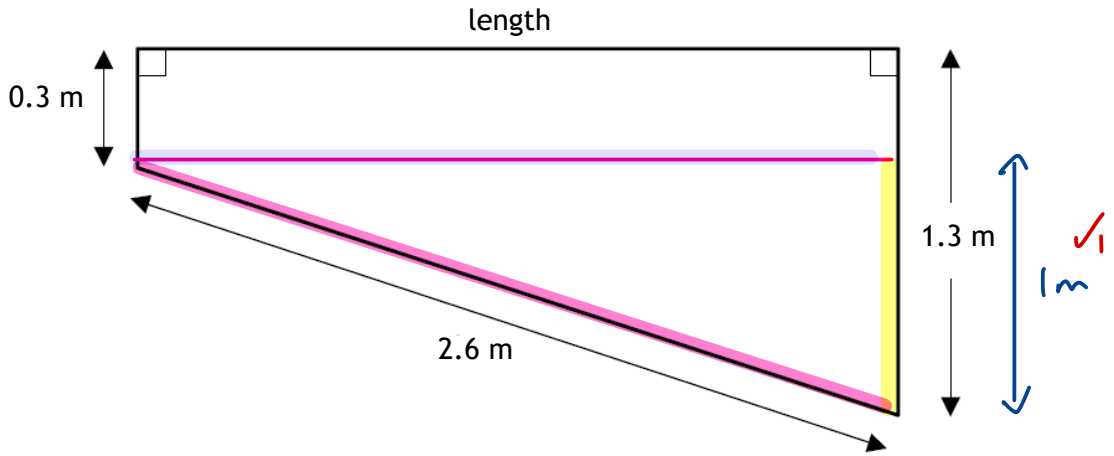
657 ÷ 1.24 = £529.84 ✓2

It is £30.84 cheaper to buy the laptop in the UK ✓3

[Turn over

11. A homeowner is building an extension to her house by building a room in the loft and adding a window.

A cross section of the window is shown below.



Calculate the perimeter of the loft window. **4**

$l^2 = 2.6^2 - 1^2$ ✓2

$l^2 = 5.76$

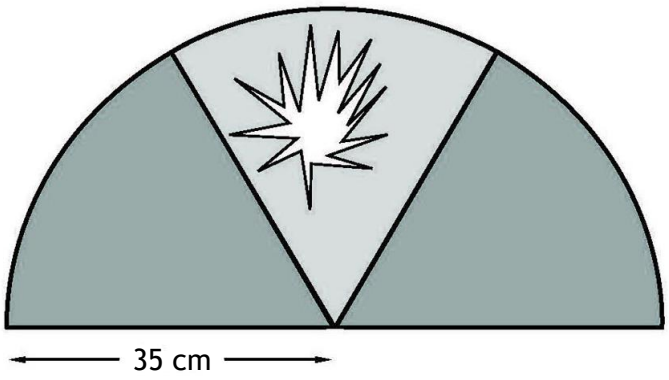
$l = 2.4\text{m}$ ✓3

Perimeter of window $= 2.6 + 0.3 + 2.4 + 1.3$

$= 6.6\text{ m}.$ ✓4

12. A semi-circular window in a church is made from **three identical panes** of glass.

One pane of glass is damaged as shown in the diagram below.



The specialist glass required can only be bought in multiples of 10 cm^2 and costs £4.80 per 10 cm^2.

Calculate the cost of replacing the damaged panel. **4**

$A = \pi \times 35^2 \div 2$ ✓1

$A = 1924.2\ cm^2$

Area of damaged panel

$= 1924.2 \div 3$

$= 641.4\ cm^2$ ✓2

↳ $650\ cm^2$ needed.

65 parts of specialist glass needed

✓3

$65 \times 4.80 = £312$ ✓4

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN