A Level DT Maths lessons

Red text and boxes indicate the correct methods of working out and the answers

AQA specification (content to be learnt for the exam)

7.1 Maths

Ref	Maths skills requirement	Potential applications: product design
a	Confident use of number and percentages	Calculation of quantities of materials, costs and sizes
b	Use of ratios	Scaling drawings
c	Calculation of surface areas and/or volumes	Determining quantities of materials
d	Use of trigonometry	Calculation of sides and angles as part of product design
e	Construction, use and/or analysis of graphs and charts	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research
f	Use of coordinates and geometry	Use of datum points and geometry when setting out design drawings
g	Use of statistics and probability as a measure of likelihood	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine product scale and dimensions

First Question

7. A lounge chair is to be manufactured by laminating seven layers of 1.5mm thick, 100mm wide ash veneer together to form each side of the chair frame.

Figure 1 below shows detail of the side profile for each side frame used in the assembly of the chair.

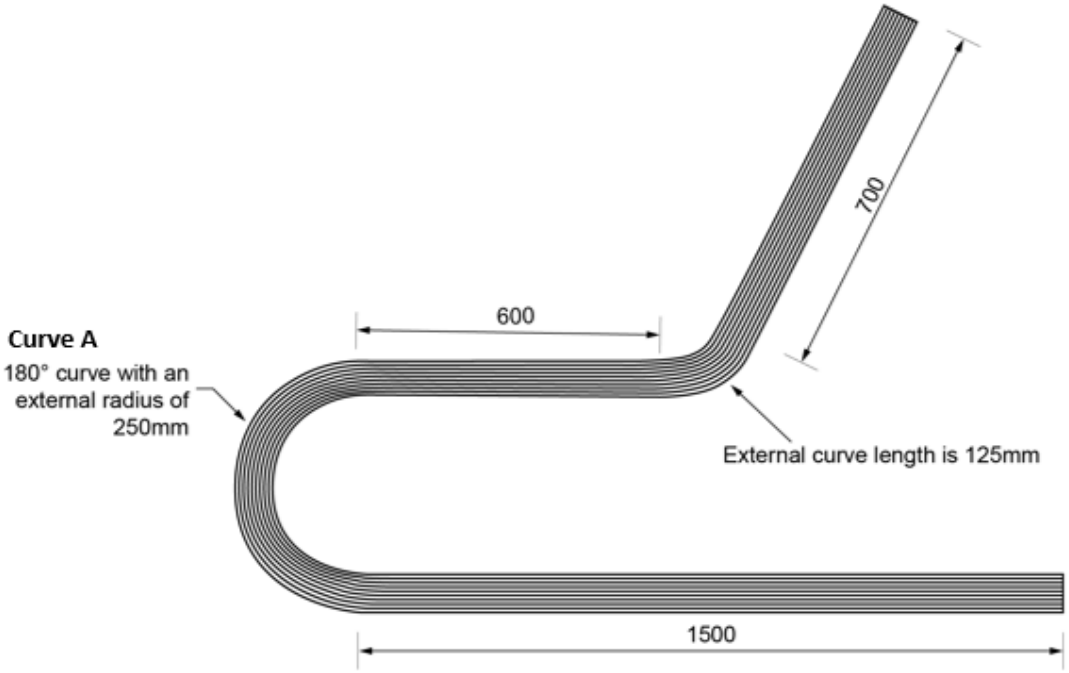

Figure 1

(a) The manufacturer cuts all seven veneers to the same length; the sum of the chair's three straight sections, added to the length of both external curves. Assume no excess will be needed for trimming on the width of the laminated framework.

i) Determine the length of the external curve A shown in **Figure 1.**
Give your answer to the nearest whole number. **[3 marks]**

7. **Award marks as stated**

(a) Mathematical calculations

i) **[3 marks]**

1 mark	Use of correct formula and correct substitution: Circumference of external curve as a full circle $C = \pi \times D$ $C = \pi \times 500$, or $2 \times \pi \times 250$ C = 1,571 mm (or equivalent)
1 mark	Length of 180° of external curve: 180 / 360 × 100 = 50% of full circle circumference
1 mark	Length of external curve: 1,571 × 50 / 100 = 785.5 mm. Rounded to 786mm.

7. **Award marks as stated**

(a) Mathematical calculations

i) **[3 marks]**

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1 mark	Length of external curve: 1,571 × 50 / 100 = 785.5 mm. Rounded to 786mm.

https://corbettmaths.com/2013/12/21/circumference-video-60/

ii) Determine the total length of veneer used in the construction of the **two** side frames for the chair. **[2 marks]**

(b) Ash veneer for constructional purposes retails at £20.45 per metre square (m^2). Calculate the cost of the veneer needed to manufacture two side frames for the chair. Include an additional 15% of veneer to allow for waste/trimming. Give your answer in pounds and pence. **[2 marks]**

ii) **[2 marks]**

1 mark	Adding component lengths together: 1500 + 786 + 600 + 125 + 700 = 3,711 mm
1 mark	Two side frames each with 7 veneers: 3711 × 7 × 2 = 51,954 mm. Accept answer in metres e.g. 51.95m

(b) Mathematical calculations **[2 marks]**

1 mark	Area of veneer: 51.95m × 0.1m wide = 5.195 m² Plus 15 %: 5.195 × 1.15 = 5.97425 = 5.97 m²
1 mark	£20.45 × 5.97 = 122.0865 = £122.09

ii) **[2 marks]**

1 mark	Adding component lengths together: 1500 + 786 + 600 + 125 + 700 = 3,711 mm
1 mark	Two side frames each with 7 veneers: 3711 × 7 × 2 = 51,954 mm. Accept answer in metres e.g. 51.95m

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1 mark	£20.45 × 5.97 = 122.0865 = £122.09

Next Question – Box Plots

2019 DT Paper 2

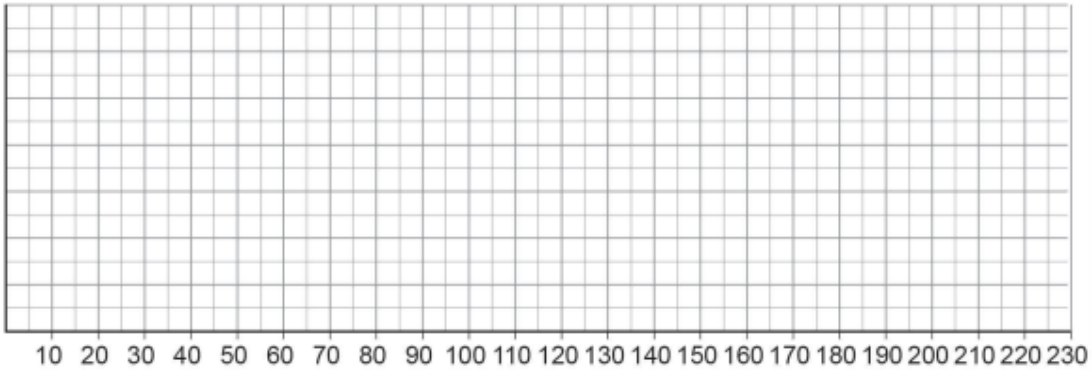
0 4 The battery life of a rechargeable battery was tested in a handheld electronic device. The test was repeated 11 times with a new battery each time.

The results are shown in the table below.

	1	2	3	4	5	6	7	8	9	10	11
Battery life (in minutes)	65	110	180	130	90	220	150	75	90	190	210

On the grid below draw a box plot to show the results.

[4 marks]



https://corbettmaths.com/wp-content/uploads/2013/02/box-plots-pdf.pdf

https://corbettmaths.com/2013/05/15/drawing-and-reading-box-plots/

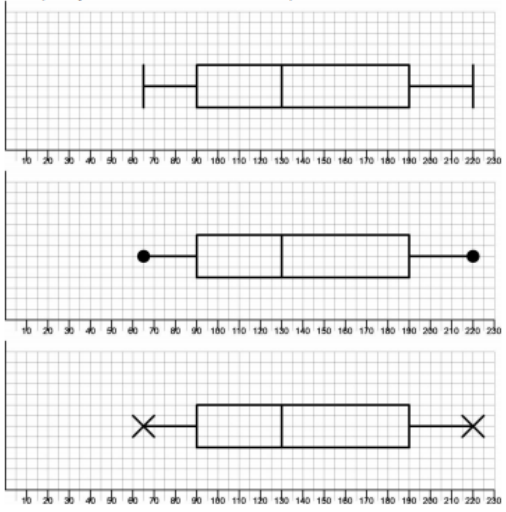
4		The battery life of a rechargeable battery was tested in a handheld electronic device. The test was repeated 11 times with a new battery each time. The results are shown in the table below. On the grid below draw a box plot to show the results.	4 marks	AO42C

	1	2	3	4	5	6
Battery Life (in minutes)	65	110	180	130	90	220

	7	8	9	10	11
Battery Life (in minutes)	150	75	90	190	210

Calculation of median	130	B1 (Value seen) (written or plotted)
Calculate Lower quartile	90	B2 (Value seen) (written or plotted)
Calculate upper quartile	190	B3 (Value seen) (written or plotted)
Correct box plot	SEE Box plot below	A1 (follow through)
For the correct box plot award full marks		4 marks

Accept any of the three alternative box plots:



Next Question - Probability

2019 DT Paper 2

0 5 When producing a die cut package, three different, independently occurring faults are possible with these probabilities:

Fault A: 1/100
Fault B: 1/100
Fault C: 1/500

A and **B** are minor faults which must be monitored but will only fail quality control if both faults are seen on a single product.

C is a critical fault and any product suffering from this fault will fail quality control.

If a batch of 10 000 packages are produced, calculate how many products would be expected to fail quality control.

[3 marks]

https://corbettmaths.com/wp-content/uploads/2014/08/probability-pdf.pdf

5		When producing a die cut package three different, independently occurring faults are possible with these probabilities: **Fault A**: 1/100 **Fault B**: 1/100 **Fault C**: 1/500 **A** and **B** are minor faults which must be monitored but will only fail Quality Control if both faults are seen on a single product. **C** is a critical fault and any product suffering from this fault will fail quality control. If a batch of 10 000 packages are produced, calculate how many products would be expected to fail quality control.	3 marks	AO42C

Calculate probability of Fault A and B	1/100 × 1/100 or 0.01 × 0.01 = 1/10000 or 0.0001	M1
Calculate probability of Fault A and B or C	1/100 × 1/100 + 1/500 = 21/10000 or 0.01 × 0.01 + 0.005 = 0.0021 or 2.1×10^{-3} 1/10000 + 1/500 = 21/10000	M2
Calculate expected number of failures	21 products or 21	M3
For the correct answer award full marks		3 marks

5		When producing a die cut package three different, independently occurring faults are possible with these probabilities: **Fault A**: 1/100 **Fault B**: 1/100 **Fault C**: 1/500 **A** and **B** are minor faults which must be monitored but will only fail Quality Control if both faults are seen on a single product. **C** is a critical fault and any product suffering from this fault will fail quality control. If a batch of 10 000 packages are produced, calculate how many products would be expected to fail quality control.	3 marks	AO42C

Calculate probability of Fault A and B	1/100 × 1/100 or 0.01 × 0.01 = 1/10000 or 0.0001	M1
Calculate probability of Fault A and B or C	1/100 × 1/100 + 1/500 = 21/10000 or 0.01 × 0.01 + 0.005 = 0.0021 or 2.1×10^{-3} 1/10000 + 1/500 = 21/10000	M2
Calculate expected number of failures	21 products or 21	M3
For the correct answer award full marks		3 marks

Next Question - Volumes

2019 DT Paper 2

1 2 **Figure 4** shows a low carbon steel component with a volume of 11 100 mm^3

The density of low carbon steel is 7.85 g/cm^3

The component is to be hot dip galvanised.

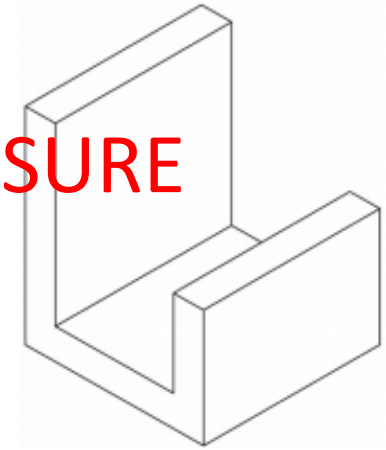
The galvanising process increases the mass of the component by 5%

Calculate the mass of the galvanised component in grams.

Show your working out.

[3 marks]

Figure 4
Isometric view



UNSURE

https://www.youtube.com/watch?v=sv7zflLeduM

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Figure 4 shows a low carbon steel component with a volume of 11 100 mm^3 — 3 marks

The density of low carbon steel is 7.85 g/cm^3

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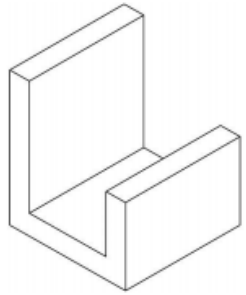


Conversion of density into g/mm^3 or Conversion of volume into cm^3	$7.85g/cm^3 = 0.00785g/mm^3$ or 7.85×10^{-3} or 11 100 = $11.1cm^3$	M1
Calculate the mass prior to galvanising *(application of volume x density calculation)*	11 100 x their 0.007 85 = their 87.135 grams	M2
Calculate the mass once galvanised	87.135 x 1.05 = [91, 91.5] grams	A1
For the correct answer award full marks		3 marks

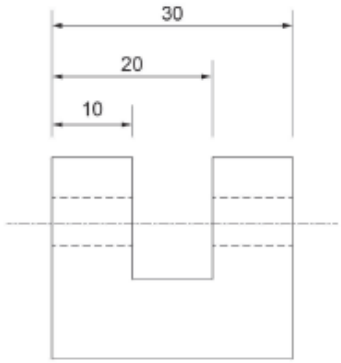
https://corbettmaths.com/wp-content/uploads/2013/02/density-pdf.pdf

Next Question – Volumes, Mass and Density

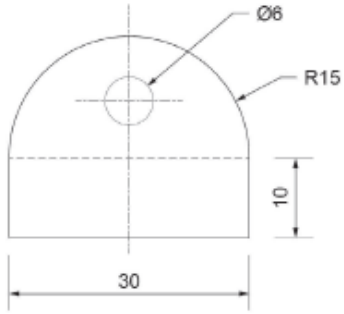
0 8 **Figure 4** shows the dimensions of a component to be made using 3D printing.

Figure 4
All dimensions in mm
Not drawn to scale

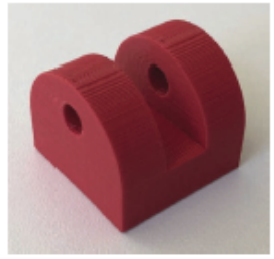
Front view



Side view



Completed component



	Material costs	
Material	**Printed density (grams per mm³)**	**Cost per 500 g**
ABS	0.000 448 g	£18

Calculate the material cost of manufacturing 50 units.

Show your working out.

[5 marks]

8		**Figure 4** shows the dimensions of a component to be made using 3D printing. (Shown in Question Paper) Calculate the material cost of manufacturing 50 units.	5 marks	AO41C

Cuboid Volume	30 × 30 × 10 = 9000 mm³	1 mark (M1)
Cross Section of semi circle	½ × π × 15² – π × 3² = 103.5 π Or = 353.25 – 28.26 = [324.99, 325.197]	1 mark (M1)
Total Volume	Cross section × 20 + base Their [324.99, 325.197] × 20 + 9000 = [15499.8, 15503.94]	1 mark (A1)
Mass of Shape	Density × Volume 0.000448 × their [15499.8, 15503.94] mm³ = [6.944, 6.946 g]	1 mark (M1)
Cost of 50 units	mass × 50 units their [6.944, 6.946g] × 50 =[347.26, 347.3] / 500g × 18 = £12.50	1 mark (A1)
Cost of 50 units Where no working has been shown but final answer is accurate	= £12.50	5 marks

Next Question -

2019 DT Paper 1

1 1 **Figure 5** shows an aluminium seat clamp. **Figure 6** shows the dimensions of a block of aluminium.

Figure 5

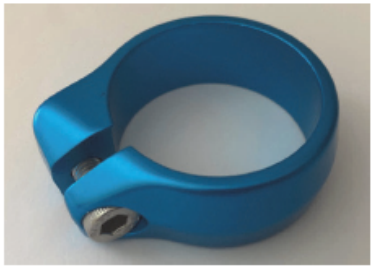
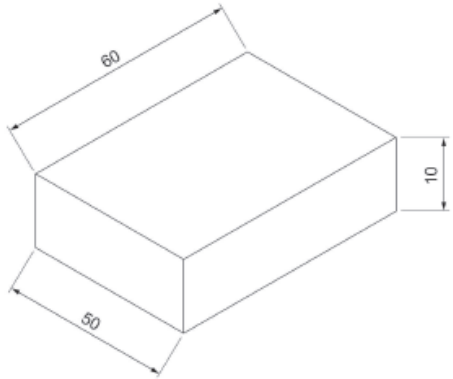


Figure 6
All dimensions in mm
Not drawn to scale



The seat clamp is currently manufactured by wastage from the aluminium block shown in **Figure 6**.

The manufacturer wants to produce the clamp using a redistribution process.

Compare the cost of each manufacturing process if 5000 units are to be produced.

Show your working out.

Volume of the seat clamp	7280 mm^3
Cost of aluminium	£4 per 100 000 mm^3
Cost of manufacturing a mould for the redistribution process	£3000

[6 marks]

11		**Figure 5** shows an aluminium seat clamp. **Figure 6** shows the dimensions of a block of aluminium. (Shown in the Question Paper) Compare the cost of each manufacturing process if 5000 units are to be produced. Show your working out.	6 marks	AO41C

The volume of the seat clamp	7280 mm^3
The cost of aluminium	£4 per 100 000 mm^3
The cost of manufacturing a mould for the redistribution process	£3000

Machined seat clamp		
Block volume	10 × 50 × 60 =30 000 mm^3	1 mark (M1)
Recognition of correct equation	Block volume ÷ cost of aluminium	1 mark (M1)
Cost for one machined seat clamp	Their 30 000 ÷ 100 000 × £4 = £1.20 per clamp	1 mark (M1)
Cost of 5000 machined seat clamps	Their 1.20 X 5000 = £6000	1 mark (A1)
Cost of 5000 machined seat clamps Where no working has been shown but final answer is accurate	£6000	4 marks

Redistribution seat clamp		
Cost for one redistribution seat clamp (without mould factored in)	7280 ÷ 100 000 × 4 = [£0.29, £0.292]	1 mark (A1)
Cost of 5000 redistribution seat clamps	Their [£0.29, £0.292] × 5000 + 3000 = [£4450, £4460]	1 mark (A1)
Cost of 5000 redistribution seat	= [£4450, £4460]	2 marks

Next Question – Volumes and cost

1 5 A manufacturer is producing a glass reinforced plastic (GRP) moulding.

Calculate the volume of hardener needed.

Show all of your working.

Size of GRP mat needed for moulding	2 metres × 5 metres
Ratio of resin to hardener	3 : 2
Total volume of liquid (resin and hardener) needed per m^2 of GRP matting	3 litres per m^2

[4 marks]

15		A manufacturer is producing a glass reinforced plastic (GRP) moulding. Calculate the volume of hardener needed. Show all of your working.	4 marks	AO41C

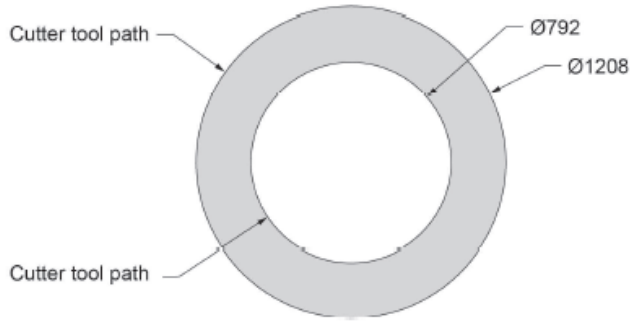
Size of GRP mat needed for moulding	2 metres × 5 metres
Ratio of resin to hardener	3 : 2
Total volume of liquid (resin and hardener) needed per m^2 of GRP matting	3 litres per m^2

Area of Matting	2 × 5 = $10m^2$	1 mark (M1)
Total volume of liquid needed	10 × 3 = 30 litres	1 mark (A1)
Ratio factor	3 + 2 = 5 parts 30 ÷ 5 = 6 litres	1 mark (M1)
Hardener needed	6l × 2 =12 litres of hardener	1 mark (A1)
Volume of hardener needed Where no working has been shown but final answer is accurate	= 12 litres of hardener	4 marks

Next question -

1 9 **Figure 10** shows a component to be cut on a computer numerically controlled (CNC) router.

Figure 10
All dimensions in mm
Not drawn to scale



Material	Depth of cut per pass	Rate of cut
12 mm MDF	6 mm	6 metres per minute
12 mm plywood	4 mm	4.5 metres per minute

Calculate how long it would take to machine the shape in each of the materials.

Show your working out.

[6 marks]

19	**Figure 10** shows a component to be cut on a computer numerically controlled (CNC) router. (Shown in Question Paper) Calculate how long it would take to machine the shape in each of the materials.	6 marks	AO41C

Circumference of circles	Outer tool path - πrd π × 1208 = [3793.12mm , 3795.54mm] Inner tool path - πrd π × 792 =[2486.88mm, 2488.46mm] Total distance of travel [3793.12mm , 3795.54mm] + =[2486.88mm, 2488.46mm] =[6280mm, 6284mm]	1 mark (M1) 1 mark (A1)
Distance of travel in MDF	Total distance × passes [6280mm, 6284mm] × 2 =[125 60mm, 125 68mm] / 1000 =12.56 meters	1 mark (M1) 1 mark (A1)
Distance of travel in Ply	Total distance × passes [6280mm, 6284 mm] × 3 =[188 40 mm,188 52] / 1000 =[18.84 meters, 18.85 meters]	
Time taken in MDF	[125 60mm, 125 68mm] ÷ 6 =2.09 minutes **or** =2 minutes 5 secs	1 mark (M1) 1 mark (A1)
Time taken in Ply	[18.84 metres, 18.85 meters]÷ 4.5 =[4.18 minutes,4.19 minutes] **or** =4 minutes 11 secs	

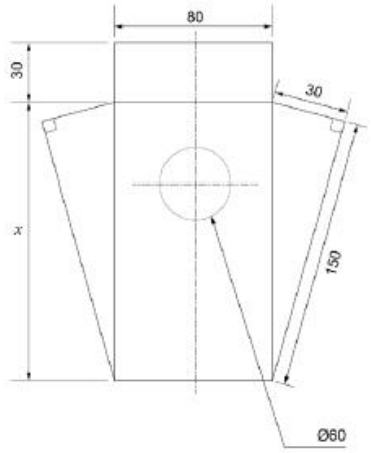
Time taken in MDF where no working has been shown but final answer is accurate	=2.09 minutes **or** =2 minutes 5 secs	3 marks

Next question -

0 2 **Figure 1** shows an image of a ceiling light.
Figure 2 shows the aluminium sheet net made for this light.

Figure 1

Figure 2



All dimensions in mm
Not to scale

0 2 . 1 Calculate the length of side X.

Show your answer to two decimal places.

[2 marks]

0 2 . 2 Calculate the surface area of the net shown in Figure 2, with the circular hole removed.

Show your answer to two decimal places.

[3 marks]

0 2 . 3 Calculate the percentage reduction in surface area caused when the circular hole was cut out.

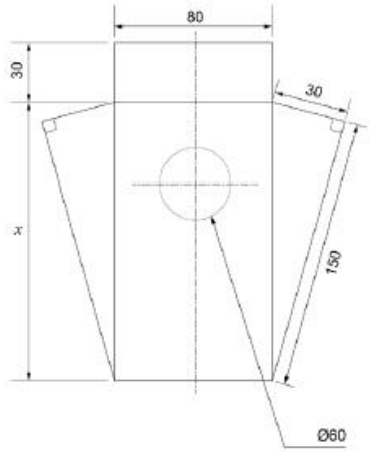
Show your answer to two decimal places.

[2 marks]

0 2 **Figure 1** shows an image of a ceiling light.
Figure 2 shows the aluminium sheet net made for this light.

Figure 1

Figure 2



All dimensions in mm
Not to scale

AO4 = 1C

Substitute measurements in to Pythagoras theorem equation	$x^2 = 30^2 + 150^2$	1 mark
Correct calculation of side 'x'	x = 152.97 (2dp)	1 mark

If the correct answer is seem, award full marks (use wording of live papers)

0 2 . 2 Calculate the surface area of the net shown in Figure.2, with the circular hole removed.
Show your answer to two decimal places.

[3 marks]

AO4 = 1C

Calculate area of circle	$=\pi r^2$ $=\pi$ x (30 x 30) =2826 [2826, 2827.8]	1 mark
Calculate area of triangular sides	Area of triangle = ½ x base x height = ½ x 30 x 150 = 2250 2250 x 2 = 4500	1 mark
Calculate area of large rectangle	Area of rectangle = 80 x 152.97 (or their 2ai) = 12 237.6	
Calculate area of smaller rectangle	Area of rectangle = 80 x 30 = 2400	
Total area	= 4500 + 12 237.6 + 2400 – 2826 [16 310, 16 311.6]	1 mark

0 2 . 3 Calculate the percentage reduction in surface area caused when the circular hole was cut out.
Show your answer to two decimal places.

[2 marks]

AO4 = 1C

Set out equation	Percentage area removed = Area of circle ÷ Area of net x 100%	1 mark
Calculate percentage area removed	= 2827.8 ÷ 19 137.6 x 100 =[14.77%, 14.78%]	1 mark

Next question -

0 9

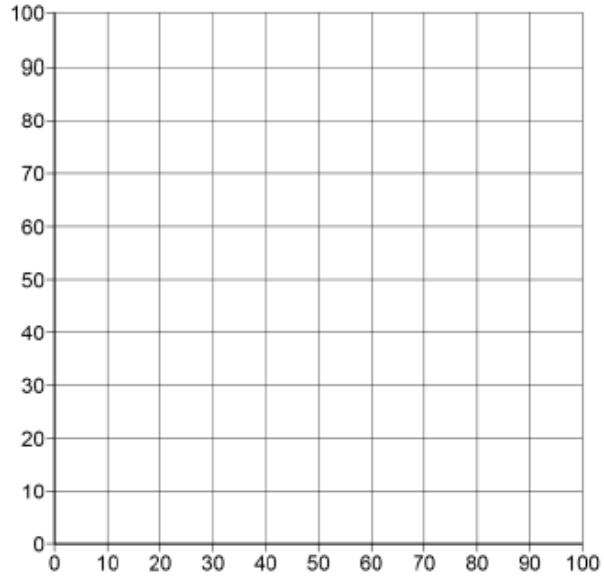
CNC coordinates have been used to create the program required to laser cut a part from sheet aluminium.

Plot the coordinates on the grid below and use this to calculate the total area of the part.

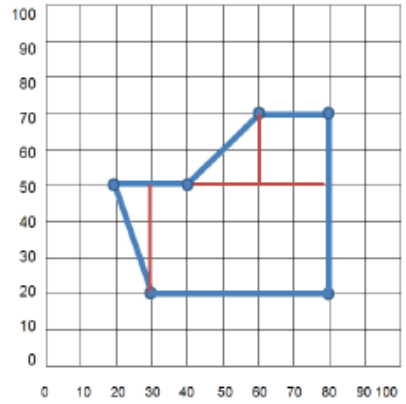
[5 marks]

CNC coordinates:
(30,20)
(80,20)
(80,70)
(60,70)
(40,50)
(20,50)
(30,20)

All dimensions in mm



AO4 = 1C



Plot coordinates correctly	See image above	1 mark
Draw lines to define shape	See image above	1 mark
Any rectangular area calculated correctly	e.g. Area1 = 50 x 30 = 1500 Area 2 = 20 x 20 = 400	1 mark
Any triangular or trapezoidal area calculated correctly	e.g. Area 3 = ½ x 10 x 30 = 150 Area 4 = ½ x 20 x 20 = 200 Area of trapezoid = $\frac{a + b}{2} \times h$ = $\frac{60 + 50}{2} \times 30$ =1650mm^2	1 mark
Calculate total area	Total area = 1500 + 400 + 150 + 200 =2250mm^2	1 mark

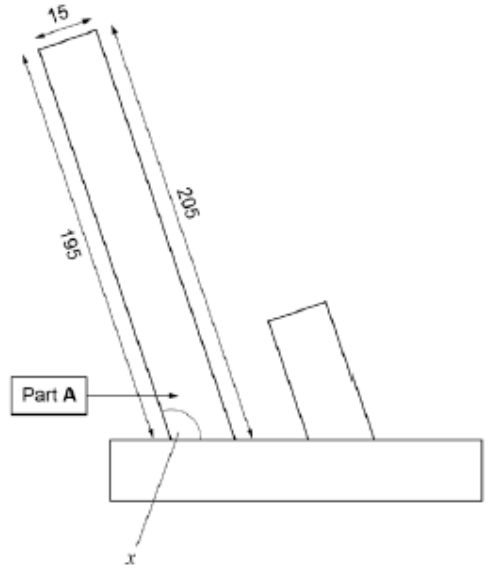
Next question -

1 0 **Figure 7** shows a dimensioned side view of a prototype for a menu holder.

Using the information provided, calculate the angle of x

[4 marks]

Figure 7



All dimensions in mm.
Not to scale.

1 0 **Figure 7** shows a dimensioned side view of a prototype for a menu holder.
Using the information provided, calculate the angle of x

[4 marks]

AO4 = 1C

Set out equation	tan a = opposite ÷ adjacent	1 mark
Substitute values	tan a = 15/10	1 mark
Calculate angle	a = $\tan^{-1}$1.5 a = 56.3°	1 mark
Cutting angle	180-56.3 = 123.7°	1 mark

Alternative method

Set out equation	tan b = opposite ÷ adjacent	1 mark
Substitute values	tan b = 10/15	1 mark
Calculate angle	b = $\tan^{-1}$0.666 b = 33.7°	1 mark
Cutting angle	180 – 90 - 33.7 = 56.3° 180 – 56.3 = 123.7°	1 mark

Next Question – Volume of Sphere

Figure 4 shows a tea infuser designed by Marianne Brandt.

Analyse and evaluate how well the tea infuser follows the principles and ethos of the Bauhaus Design School.

[6 marks]

Figure 4

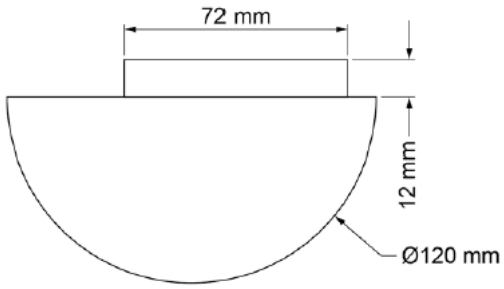
0 2 . 2 The volume of a sphere is $4/3\pi r^3$

Figure 5 shows a side view of the hemispherical base and cylindrical top section of Marianne Brandt's tea infuser.

Calculate the total volume of these parts of the tea infuser.

[4 marks]

Figure 5



Specimen 2019 DT Paper 2

0 2 . 2 The volume of a sphere is $4/3\pi r^3$
Figure 5 shows a side view of the hemispherical base and cylindrical top section of Marianne Brandt's tea infuser.
Calculate the total volume of these parts of the tea infuser.

[4 marks]

AO4 = 2C

Calculate volume of cylinder	$\pi r^2 h$ =3.14 x 36 x 36 x 12 =48 833.28mm^3 OR =3.142 x 36 x 36 x 12 =48 864.38mm^3 (2dp) **[48 833.28mm^3, 48 864.38 mm^3]**	**1 mark**
Substitute values in to volume of sphere equation	$2/3\pi r^3$ $=^2/_3$ x 3.14 x (60 x 60 x 60) OR $\frac{1}{2}$ x 4/3 πr^3 $=^1/_2 \times ^4/_3$ x 3.142 x 60 x 60 x 60	**1 mark**
Correct volume of hemisphere	**[452 160mm^3, 452 448mm^3]**	**1 mark**
Calculate total volume	48833.28,48864.38 + 452160,452448 **[500 993.28 mm^3, 501 312.38 mm^3]**	**1 mark**

Next question -

0 4 . 1 **Figure 6** shows a standing workstation. The ideal height for the desk top is level with the elbow height of the user as shown in **Figure 7**.

Calculate the range of height adjustment required to accommodate the 15th to 85th percentiles of the sample shown in **Table 1**.

[2 marks]

Figure 6

Figure 7

Standing elbow height

Table 1 shows the ideal elbow height from a range of users.

Standing elbow height	Number in sample
937	5
962	12
987	17
1012	23
1037	30
1062	38
1087	32
1112	26
1137	19
1162	14
1187	4

0 4 . 1 Calculate the range of height adjustment required to accommodate the 15th to 85th percentiles of the samples shown in **Table 1**.

[2 marks]

AkO4 = 2C

Calculate 15th percentile	Calculate total in sample = 220 Calculate 15th %ile (220÷100)x15=**33**	1 mark
Calculate 85th percentile	Calculate 85th %ile (220÷100)x85=**187**	
Give maximum and minimum heights based on data from original table	Range **from 987mm to 1137mm** or 150mm with working seen.	1 mark

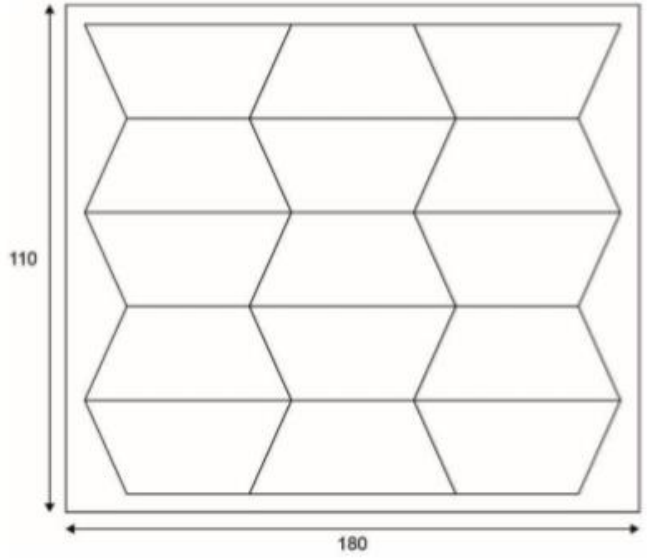
Next Question

0 7 . 1 **Figure 3** shows a craft knife blade.

The craft knife blade is manufactured from stainless steel in the shape of a trapezium.

Figure 3
All dimensions in mm
Not drawn to scale

The craft knife blades are cut from a sheet of stainless steel:



Calculate the percentage of the sheet that is wasted when **15** craft knife blades have been cut out.

Show your working out.

[3 marks]

Answers

0 7 . 1 **Figure 3** shows a craft knife blade.

The craft knife blade is manufactured from stainless steel in the shape of a trapezium.

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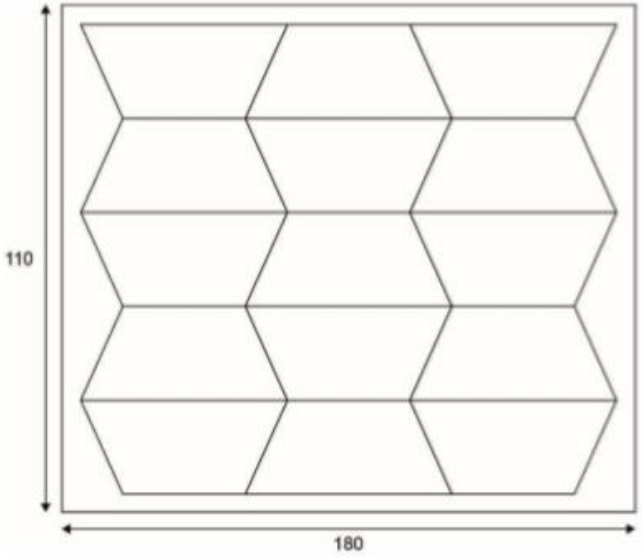
All dimensions in mm
Not drawn to scale

The craft knife blades are cut from a sheet of stainless steel:



Calculate the percentage of the sheet that is wasted when **15** craft knife blades have been cut out.

Show your working out.

[3 marks]

METHOD ONE

Area of trapezium (M1)	Area = ½ (a + b) x h Area = ½ (40 + 60) x 19 Area = 950 (mm^2)	1 mark
Calculation of total area wasted (M2)	= 15 x their Area of trapezium = 15 x 950 = 14 250 (mm^2) Height of sheet x width of sheet – (15 x their area) = (180 x 110) – their 14 250 = 19 800 – 14 250 = 5550 (mm^2)	1 mark
Calculation of percentage wasted (A1)	= $\frac{\text{Area of sheet} - (15 \times \text{their area})}{\text{Area of sheet}} \times 100$ = $\frac{19\,800 - 14\,250}{19\,800} \times 100$ = 28.03 (%) = [28, 28.03] (%)	1 mark

METHOD TWO

Area of trapezium (M1)	Area of rectangular centre = 40 x 19 = 760 (mm^2) Area of triangular ends = ½ x base x height = 0.5 x 10 x 19 = 95 (mm^2) Area of trapezium = 760 + 95 + 95 = 950 (mm^2)	1 mark
Calculate %age of sheet used (M2)	Area used = 15 x their area of trapezium = 15 x 950 = 14250 (mm^2) Area of sheet = 180 x 110 = 19800 (mm^2) Area of sheet used = $\frac{\text{their 14 250}}{\text{their 19 800}} \times 100$ = [71.96,71.97]%	1 mark
Calculate %age wasted (A1)	= 100 – their 71.97 = 28.03	1 mark

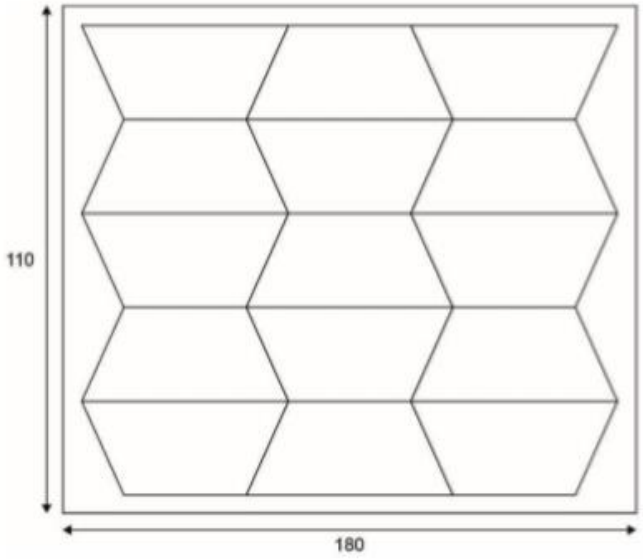
Continued…

0 7 . 1 **Figure 3** shows a craft knife blade.

The craft knife blade is manufactured from stainless steel in the shape of a trapezium.

Figure 3
All dimensions in mm
Not drawn to scale

The craft knife blades are cut from a sheet of stainless steel:



0 7 . 2 Each stainless steel sheet costs £4.25. What is the total cost of the waste material if 135 craft knife blades need to be manufactured?

Give your answer in pounds and pence. Show your working out.

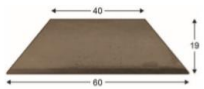
[3 marks]

Continued… answer

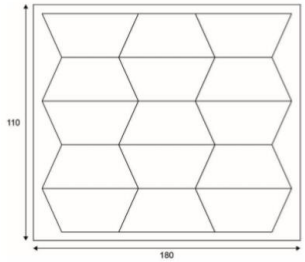
0 7 . 1 Figure 3 shows a craft knife blade.

The craft knife blade is manufactured from stainless steel in the shape of a trapezium.

Figure 3
All dimensions in mm
Not drawn to scale



The craft knife blades are cut from a sheet of stainless steel:



0 7 . 2 Each stainless steel sheet costs £4.25. What is the total cost of the waste material if 135 craft knife blades need to be manufactured?

Give your answer in pounds and pence. Show your working out.

[3 marks]

7	2	Each stainless steel sheet costs £4.25. What is the total cost of the waste material if 135 craft knife blades need to be manufactured? Give your answer in pounds and pence. Show your working out.	3 marks

METHOD ONE

Calculate number of sheets required (M1)	$\frac{135}{15} = 9$	1 mark
Total cost of sheets(M2)	their 9 × 4.25 = (£) 38.25	1 mark
Calculate cost of waste. Answer given in pounds and pence. (A1)	38.25 x $\frac{28}{100}$ (or their percentage waste from 8ai) =(£) 10.71	1 mark

METHOD TWO

Calculate cost of 1mm^2 of sheet (M1)	Area of sheet = 180 x 110 = 19 800 mm^2 4.25 ÷ 19 800 = £0.0002 146 464 (mm^2)	1 mark
Cost of waste from one sheet (M2)	0.0002 146 464 x 5550 (or their waste area from 8ai) = (£)1.1912 878 788	1 mark
Cost of waste from 9 sheets. Answer given in pounds and pence. (A1)	£1.1912 878 788 x 9 = £10.7216 = (£) 10.72	1 mark

Next question…

1 4 A video games manufacturer wants to reduce the amount of packaging for one of their products. The packaging is to keep the same proportions, but has a volume reduction of 25%.

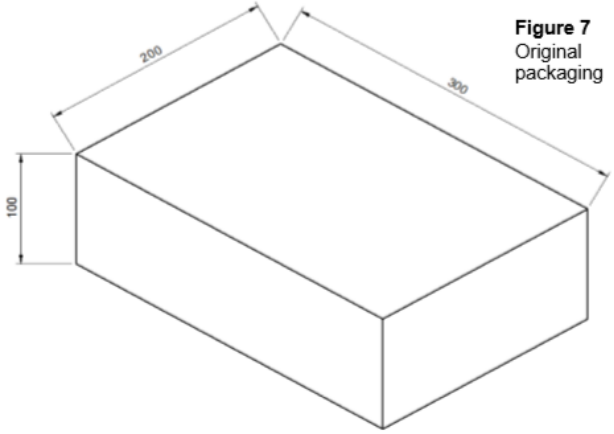


Figure 7
Original packaging

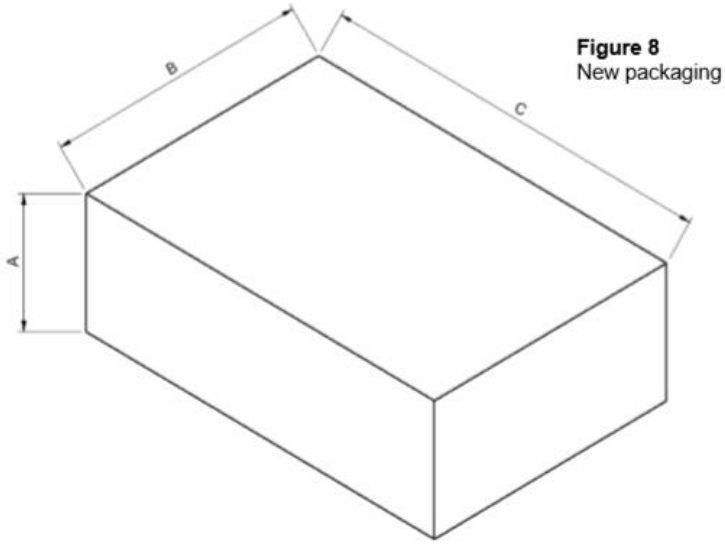


Figure 8
New packaging

Calculate the new length of each side to 2 decimal places. Show your working.

[4 marks]

A _____ mm

B _____ mm

C _____ mm

Answers

1 4 A video games manufacturer wants to reduce the amount of packaging for one of their products. The packaging is to keep the same proportions, but has a volume reduction of 25%.

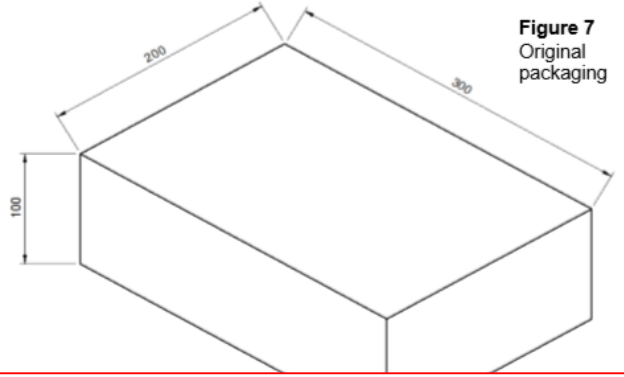


Figure 7
Original packaging

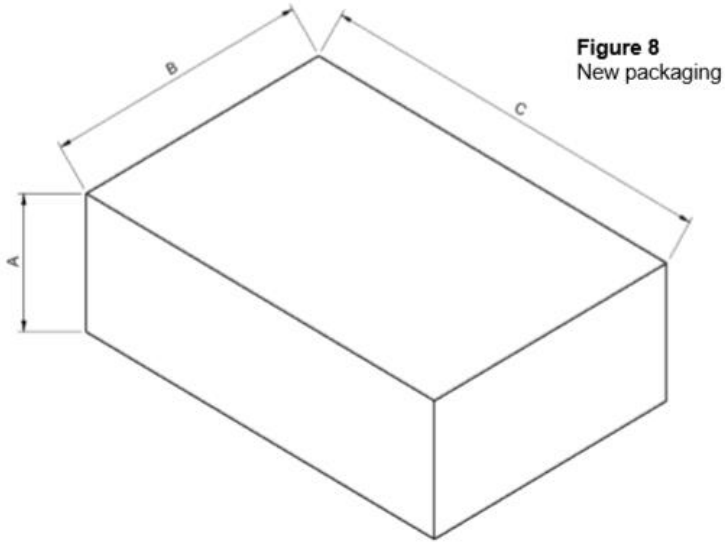


Figure 8
New packaging

14		Answer requires candidate to use a volume scale factor to calculate the answer Calculate existing volume of games console: 100x200x300 = 6 000 000 mm^3 1 b. Calculate 75% volume: 6 000 000 x .75 = 4 500 000 mm^3 Recognition of volume scale factor as 0.75 1 Application of $\sqrt[3]{}$ 0.75 to get the length scale factor: = 0.90856…. Use of $\sqrt[3]{0.75}$ to convert each length	5 marks AO42C

		A = $\sqrt[3]{0.75}$ X 100 = 90.86 mm	1
		B = $\sqrt[3]{0.75}$ X 200 = 181.71 mm	1
		C = $\sqrt[3]{0.75}$ X 300 = 272.57 mm	1

Next question…

1 5 The photograph below shows an Eames chair.

A furniture maker is manufacturing a replica of the foot stool shown above, using a one-piece foam mould and vacuum bag.

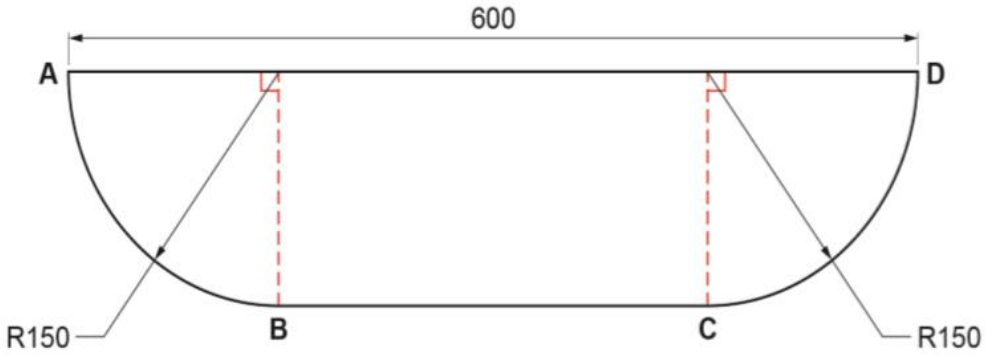


Figure 9 (foam mould)

Not drawn to scale
All dimensions in mm

It is going to be manufactured from seven layers of 1.5mm plywood. Using the dimensioned drawing (**Figure 9**), calculate the length of plywood needed for the **outside** layer of the lamination along the length ABCD to the nearest millimetre.

[4 marks]

15	The response shows a calculation to work out an arc length or the two arcs length combined $2\pi \times \frac{150}{4}$ or [235.5, 236] or $2\pi \times \frac{150}{2}$ or [471, 472]	1 mark	4 marks AO42C
	The response shows calculations to work out the total length of the inner layer touching the foam former. $2\pi \times \frac{150}{4} \times 2 + 300$ or [235.5, 236] × 2 + 300 or $2\pi \times \frac{150}{2} + 300$ or [471, 472] + 300	2 marks	
	The response shows calculations as above and some compensation for the increased radii but may use the wrong number of layers.	3 marks	
	The response shows **full** calculations to compensate for the increased radii due to seven layers of plywood R = 150 + (7 × 1.5) = 160.5 2π x 160.5/2 +300 = (504.23 + 300) $2\pi \times \frac{160.5}{2} + 300$ or [503.97, 504.3] + 300 or [803.97, 804.3] Outside length = 804mm (nearest millimetre)	4 marks	

Next question…..

0 2 **Figure 1** shows a dimension drawing of a paper weight that is to be cast in pewter.

[5 marks]

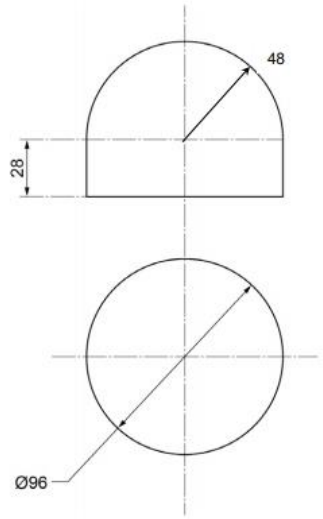


Figure 1

All dimensions in mm

The density of pewter is 7.29g/cm^3. Calculate the mass of the paper weight to the nearest whole gram.

Answer _____

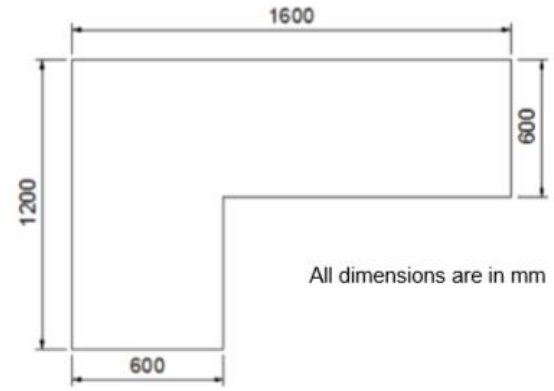
2			5 marks

Volume of cylinder	$\pi r^2 h$ 3.142 x 4.8^2 x 2.8 **202.670 (3sf)**	**1 mark**
Volume of hemisphere	$2/3\pi r^3$ 2 /3 x 3.142 x 4.8^3 **231.623(3sf)**	**2 marks**
Total volume	202.670 + 231.623 **= 434.35cm^3**	**1 mark**
Mass = Density x Volume	Mass = 7.29 X 434.35 **Mass =** 3166.412g(3sf) **3166g**	**1 mark**

Next question…

0 9

Figure 2 shows an office desk. The top of the office desk can be made from **either** solid oak or oak veneered MDF.
The dimensions of the desk top are shown below.



The stock forms and prices of solid oak, oak veneered MDF and edging tape are shown in the table below.

	Solid oak	Oak veneered MDF	Edging tape
Stock	PAR plank	Sheet	50 meter roll
Size	100 × 18	2440 × 1220 × 18	19mm thickness
Cost	£ 6.70 per metre	£46.60	£1.50 per metre

How much would it cost to make the table top in each of the two materials?

[6 marks]

Oak Veneered MDF desktop cost £ _____

Solid oak desktop cost £ _____

Answers

The stock forms and prices of solid oak, oak veneered MDF and edging tape are shown in the table below.

	Solid oak	Oak veneered MDF	Edging tape
Stock Size	PAR plank 100 × 18	Sheet 2440 × 1220 × 18	50 meter roll 19mm thickness
Cost	£ 6.70 per metre	£46.60	£1.50 per metre

How much would it cost to make the table top in each of the two materials?

[6 marks]

Oak Veneered MDF desktop cost £ _____

Solid oak desktop cost £ _____

9

Veneered MDF		
Area of full sheet	2440 × 1220= 2.98 m^2	1 mark
Area of table top	600 × 1600 + 600 × 600=1.32m^2	
Cost of table top	1.32 ÷ 2.98 × 46.60= £20.64	1 mark
Perimeter of table top	1600+1200+600+600+600+1000=5600 mm = 5.6m	1 mark
Edging Strip	5.6 × 1.5= £ 8.40	
Total cost	£20.64 + £8.40 = **£29.04**	1 mark

Solid Oak		
	6 planks @ 1.6m = 9.6m **6 planks @ 0.6m = 3.6m**	1 mark
Total length needed	9.6 + 3.6 = 13.2m	
Total cost	13.2 × £6.70 = **£88.44**	1 mark

6 marks **AO41C**

Next question…

5 **Figure 2** shows a 70 mm long turned aluminium component. 5 marks

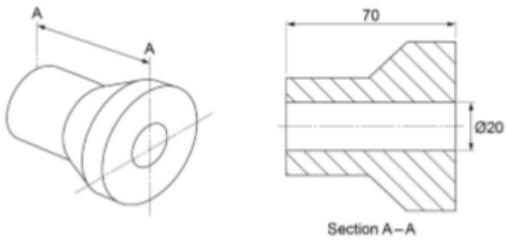
The component has a volume of 200 000 mm^3.

The diameter of the through hole is increased from 20 mm to 25 mm.

Work out how much aluminium is removed as waste as a percentage of the original component.

Give your answer to two decimal places. Show your working out.

Figure 2 – all dimensions in mm



Note
Values for π can be used in the range [3.14, 3.142]

Current volume of hole A	$\pi \times 10^2 \times 70$ or [21980, 21994] or 7000 π	1 mark
Volume of hole A with increased diameter	$\pi \times 12.5^2 \times 70$ [34343, 34366] or 21875 π /2	1 mark
Difference in volume between the holes	their [34343, 34366] – their [21980, 21994] [12349, 12386]	1 mark
Difference as a percentage of the original component volume	their [12349, 12386] ÷ 200 000) × 100 = [6.1745, 6.193] (%)	1 mark
Their answer to 2 decimal places	6.17 (%) or 6.18 (%) or 6.19 (%)	1 mark

0 5 **Figure 2** shows a 70 mm long turned aluminium component.

The component has a volume of 200 000 mm^3.

The diameter of the through hole is increased from 20 mm to 25 mm.

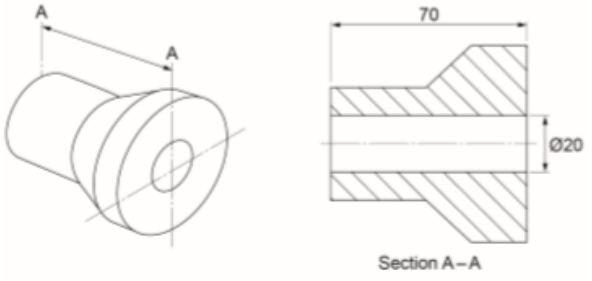
Work out how much aluminium is removed as waste as a percentage of the original component.

Give your answer to two decimal places. Show your working out.

[5 marks]

Figure 2 – all dimensions in mm

Not drawn to scale



Answer _____

Next questions…

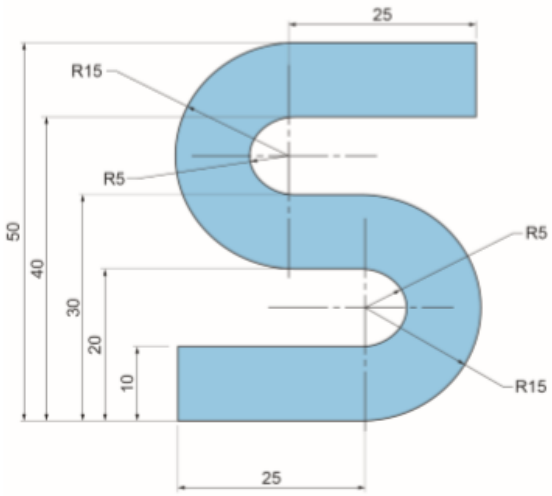
0 7 . 1 **Figure 3** shows a letter to be foil blocked onto packaging. The outline of the letter has straight lines and semi-circular arcs.

Calculate the surface area of the letter shown in **Figure 3**. Show your working out.

[2 marks]

Figure 3 – all dimensions in mm

Not drawn to scale



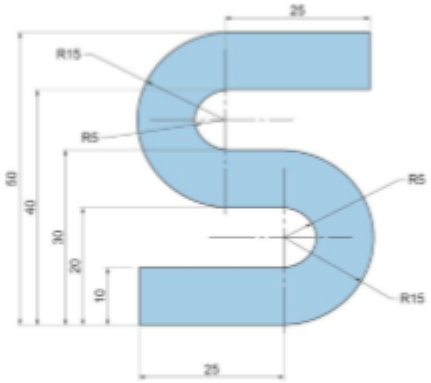
Answer _____

0 7 . 2 The dimensions of the letter shown in **Figure 3** are all increased by 50%
Work out the surface area of the enlarged letter.

Give your answer to two decimal places. Show your working out.

[2 marks]

Next question…

7	1	**Figure 3** shows a letter to be foil blocked onto packaging. The outline of the letter has straight lines and semi-circular arcs. Calculate the surface area of the letter shown in **Figure 3**. Show your working out. **Figure 3 – all dimensions in mm** Not drawn to scale  Note Values for π can be used in the range [3.14, 3.142]	2 marks

Area of curved sections	$\pi \times 15^2 - \pi \times 5^2$ or [706, 707] – [78.5, 79] or [627, 628.5] or 200 π	1 mark
Total surface area	25 × 10 + 10 × 10 + 25 × 10 + [627, 628.5] or 600 + [627, 628.5] = [1227, 1228.5] (mm^2)	1 mark

7	2	The dimensions of the letter shown in **Figure 3** are all increased by 50% Work out the surface area of the enlarged letter. Give your answer to two decimal places. Show your working out. Note Values for π can be used in the range [3.14, 3.142]	2 marks

Area of new rectangular sections or area of curved sections	(1.5 × 25) × (1.5 × 10) + (1.5 × 10) × (1.5 × 10) + (1.5 × 25) × (1.5 × 10) or 37.5 × 15 + 15 × 15 + 37.5 × 15 or 562.5 + 225 + 562.5 or 1350 or 600 × 1.5^2 or 1350 or $\pi \times 22.5^2 - \pi \times 7.5^2$ or [1589, 1591] – [176, 177] or [1412, 1415] or [627, 628.5] × 1.5^2 or [1412, 1415]	1 mark
Total surface area	1350 + [1412, 1415] = [2762, 2765] or [1227, 1228.5] × 1.5^2 = [2762, 2765]	1 mark

or

Alternative method Calculate scale factor	Scale factor = 1.5^2	1 mark
Calculate new surface area	1.5^2 x their area from 7.1 2.25 x [1227.95,1228.4] = [2762.89, 2763.9]	1 mark