Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number | Candidate Number

Mathematics

Model Solutions

Paper 3 (Calculator)

Higher Tier

4BNQMF"TTFTTNFOU.BUFSJBMTo*TTVF

Time: 1 hour 30 minutes

Paper Reference
1MA1/3H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
- *– there may be more space than you need*.

Calculators may be used.

- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out**.

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

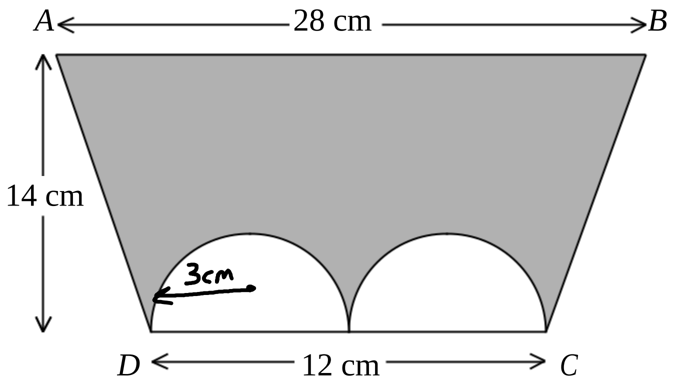
6/4/7/7/4/6/6/6/

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The diagram shows a trapezium *ABCD* and two identical semicircles.



The centre of each semicircle is on *DC*.

Work out the area of the shaded region.
Give your answer correct to 3 significant figures.

Area of trapezium $\rightarrow \frac{(a+b)}{2} \times h \rightarrow \left(\frac{12+28}{2}\right) \times 14 = \underline{280 cm^2}$

Area of Semi-circle $\rightarrow \frac{1}{2} \times \pi \times r^2 \rightarrow 2 \times \left(\frac{1}{2} \times \pi \times 3^2\right) = \underline{9\pi cm^2}$

Trapezium area − shaded area $= 280 - 9\pi = 251.726 cm^2$
$= \underline{\underline{252 cm^2}}$ (3sf)

252 cm^2

(Total for Question 1 is 4 marks)

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2 Asif is going on holiday to Turkey.

The exchange rate is £1 = 3.5601 lira.

Asif changes £550 to lira.

(a) Work out how many lira he should get.
Give your answer to the nearest lira.

$\times 550$ £1 = 3.5601 lira $\times 550$

£550 = 1958.055 lira

= 1958 to nearest lira

1958 lira

(2)

Asif sees a pair of shoes in Turkey.
The shoes cost 210 lira.

Asif does not have a calculator.
He uses £2 = 7 lira to work out the approximate cost of the shoes in pounds.

(b) Use £2 = 7 lira to show that the approximate cost of the shoes is £60

$\times 30$ £2 = 7 lira $\times 30$

£60 = 210 lira

(2)

(c) Is using £2 = 7 lira instead of using £1 = 3.5601 lira a sensible start to Asif's method to work out the cost of the shoes in pounds?

You must give a reason for your answer.

Yes, it is a sensible start because he can now do the calculation without a calculator. £2 = 7 lira so £1 = 3.5 lira
Actual conversion is £1 = 3.5601 lira. So good estimate

(1)

(Total for Question 2 is 5 marks)

3 Here are the first six terms of a Fibonacci sequence.

1 1 2 3 5 8

The rule to continue a Fibonacci sequence is,

the next term in the sequence is the sum of the two previous terms.

(a) Find the 9th term of this sequence.

7th term → 5+8=13
8th term → 8+13=21
9th term → 13+21=34

34

(1)

The first three terms of a different Fibonacci sequence are

a b $a + b$

(b) Show that the 6th term of this sequence is $3a + 5b$

4th → $(a+b)+b = a+2b$
5th → $(a+2b)+(a+b) = 2a+3b$
6th → $(2a+3b)+(a+2b) = 3a+5b$

(2)

Given that the 3rd term is 7 and the 6th term is 29,

(c) find the value of a and the value of b.

① $a+b=7$
② $3a+5b=29$

① ×3 → $3a+3b=21$
② → $3a+5b=29$
$0a-2b=-8$
$b=4$

$a+b=7$
$a+4=7$
$a=3$

$a=3$, $b=4$

(3)

(Total for Question 3 is 6 marks)

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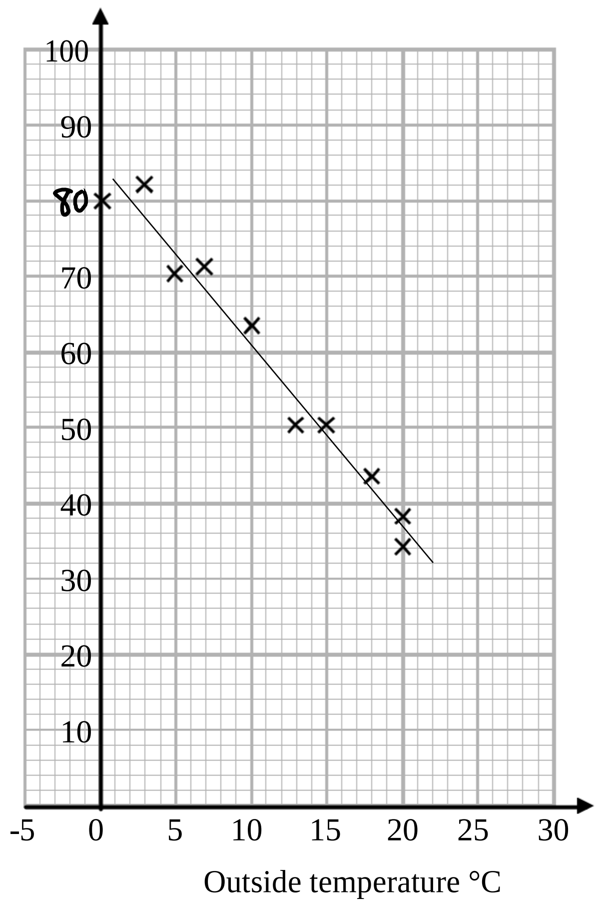
4 In a survey, the outside temperature and the number of units of electricity used for heating were recorded for ten homes.

The scatter diagram shows this information.



Molly says,

"On average the number of units of electricity used for heating decreases by 4 units for each °C increase in outside temperature."

(a) Is Molly right?
Show how you get your answer.

(2,80) (18,44) → $\frac{44-80}{18-2} = \frac{-36}{16} = -2.25$ units per °C

She is incorrect because the number of unit of electricity used decreases by 2.5 units each time there is a 1°C increase. Not 4 units.

(3)

(b) You should **not** use a line of best fit to predict the number of units of electricity used for heating when the outside temperature is 30 °C.

Give one reason why.

Its extrapolation. The line of best fit dosent reach 30°C. Since it is outside the range of data available it will be unreliable to use the line of best fit for this.

(1)

(Total for Question 4 is 4 marks)

5 Henry is thinking of having a water meter.

These are the two ways he can pay for the water he uses.

Water Meter	**No Water Meter**
A charge of £28.20 per year **plus** 91.22p for every cubic metre of water used 1 cubic metre = 1000 litres	A charge of £107 per year

Henry uses an average of 180 litres of water each day.

Use this information to determine whether or not Henry should have a water meter.

180 × 365 days = 65,700 litres used per year.

$\frac{65,700}{1000}$ = 65.7 cubic meters → $65.7 m^3$

With meter → £28.20 + (65.7 × £0.9122) = £88.13154

without meter → £107

So its better to have a meter as it works out cheaper.

(Total for Question 5 is 5 marks)

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6 Liz buys packets of coloured buttons.

There are 8 red buttons in each packet of red buttons.
There are 6 silver buttons in each packet of silver buttons.
There are 5 gold buttons in each packet of gold buttons.

Liz buys equal numbers of red buttons, silver buttons and gold buttons.

How many packets of each colour of buttons did Liz buy?

Work out LCM of 8, 6 and 5.

8 → 2, 4; 4 → 2, 2   6 → 2, 3   5

$2 \times 2 \times 2 \times 3 \times 5 = 120$

red $\rightarrow \frac{120}{8} = 15$ packets

Silver $\rightarrow \frac{120}{6} = 20$ packets

gold $\rightarrow \frac{120}{5} = 24$ packets

15 packets of red buttons

20 packets of silver buttons

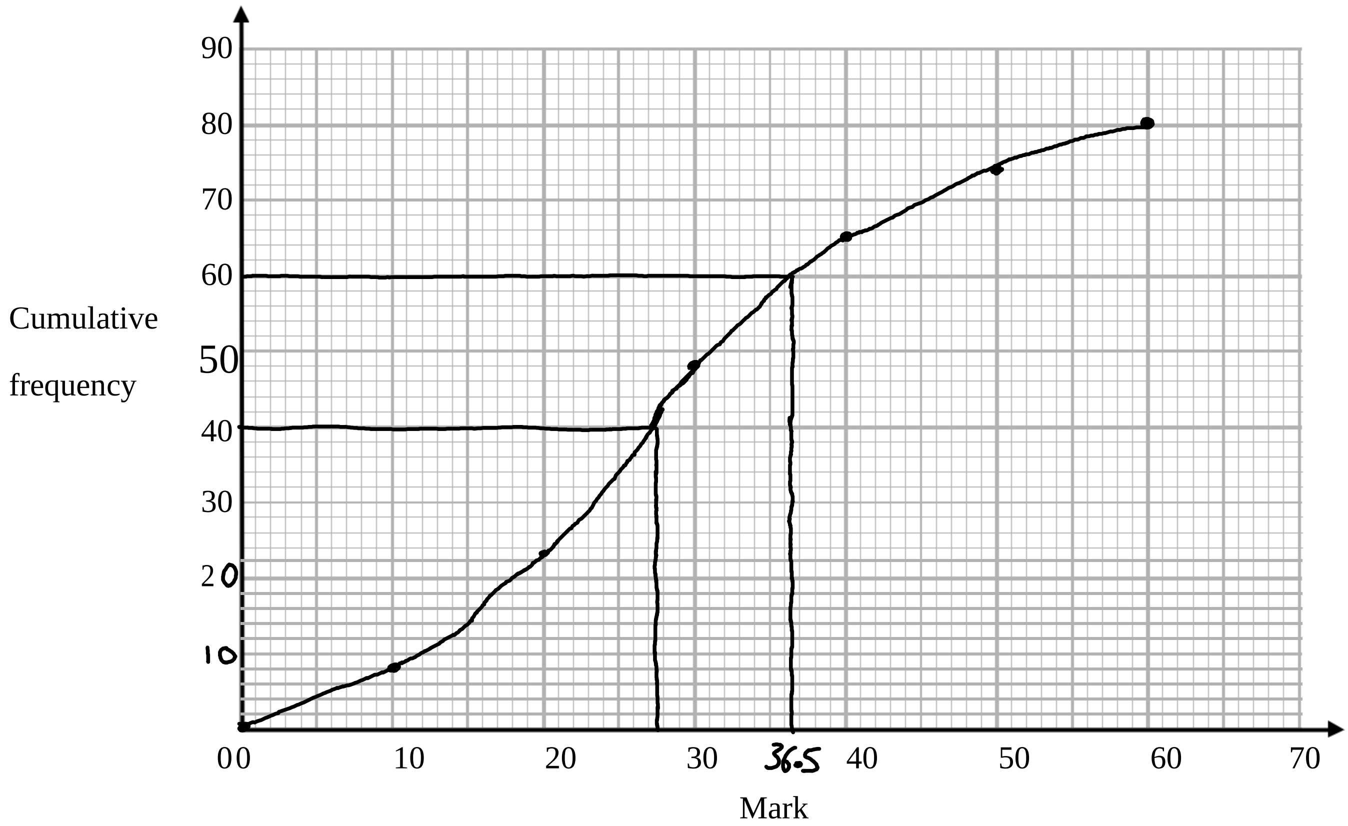
24 packets of gold buttons

(Total for Question 6 is 3 marks)

7 The cumulative frequency table shows the marks some students got in a test.

Mark (m)	**Cumulative frequency**
$0 < m \leqslant 10$	8
$0 < m \leqslant 20$	23
$0 < m \leqslant 30$	48
$0 < m \leqslant 40$	65
$0 < m \leqslant 50$	74
$0 < m \leqslant 60$	80

(a) On the grid, plot a cumulative frequency graph for this information.



(2)

(b) Find the median mark.

Median cumulative frequency = 40
Median = 27.5

27.5

(1)

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Students either pass the test or fail the test.
The pass mark is set so that 3 times as many students fail the test as pass the test.

(c) Find an estimate for the lowest possible pass mark.

Pass : fail = 1 : 3
20 : 60 because total 80 students

Only top 20 pass, so marks above cumulative frequency = 60
Pass mark = 36.5

36.5

(3)

(Total for Question 7 is 6 marks)

8 Write 0.000068 in standard form.

0.000068 → 6.8×10^{-5}

6.8×10^{-5}

(Total for Question 8 is 1 mark)

9 (a) Factorise $y^2 + 7y + 6$

$y^2 + 7y + 6 \rightarrow (y+1)(y+6)$

$1 \times 6 = 6$
$1 + 6 = 7$

$(y+1)(y+6)$
(2)

(b) Solve $6x + 4 > x + 17$

$6x + 4 > x + 17$
$5x > 13$
$x > \frac{13}{5}$

$x > 13/5$
(2)

(c) n is an integer with $-5 < 2n \leq 6$

Write down all the values of n

$\div 2$ $-5 < 2n \leq 6$ $\div 2$
$-2.5 < n \leq 3$
so values of $n \rightarrow -2, -1, 0, 1, 2, 3$

$-2, -1, 0, 1, 2, 3$
(2)

(Total for Question 9 is 6 marks)

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10 The function f is such that

$$f(x) = 4x - 1$$

(a) Find $f^{-1}(x)$

$y = 4x - 1 \rightarrow y + 1 = 4x \rightarrow \frac{y+1}{4} = x \rightarrow f^{-1}(x) = \frac{x+1}{4}$

$f^{-1}(x) = \frac{x+1}{4}$
(2)

The function g is such that

$$g(x) = kx^2 \text{ where } k \text{ is a constant.}$$

Given that $fg(2) = 12$

(b) work out the value of k

$g(2) \rightarrow k(2)^2 = 4k$
$f(4k) \rightarrow 4(4k) - 1 = 12$
$16k - 1 = 12$
$16k = 13$
$k = 13/16$

$k =$ 13/16
(2)

(Total for Question 10 is 4 marks)

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11 Solve $x^2 - 5x + 3 = 0$

Give your solutions correct to 3 significant figures.

Quadratic formula $\rightarrow \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

$a=1 \quad b=-5 \quad c=3$

$\dfrac{--5 \pm \sqrt{(-5)^2-4\times1\times3}}{2\times1} \rightarrow \dfrac{5\pm\sqrt{13}}{2}$

$x = \dfrac{5+\sqrt{13}}{2} = \underline{\underline{4.30}} \qquad x = \dfrac{5-\sqrt{13}}{2} = \underline{\underline{0.697}}$

$x=0.697,\ x=4.30$

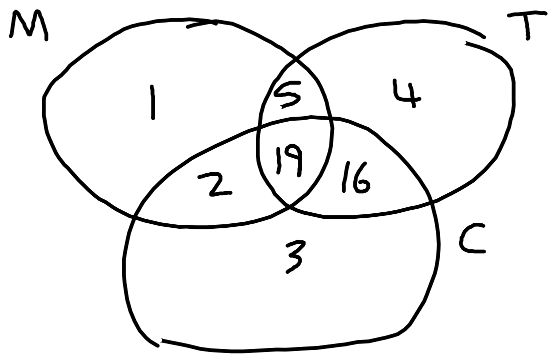
(Total for Question 11 is 3 marks)

12 Sami asked 50 people which drinks they liked from tea, coffee and milk.

All 50 people like at least one of the drinks
19 people like all three drinks.
16 people like tea and coffee but do **not** like milk.
21 people like coffee and milk.
24 people like tea and milk.
40 people like coffee.
1 person likes only milk.

Sami selects at random one of the 50 people.

(a) Work out the probability that this person likes tea.



50 − 5 − 19 − 16 − 3 − 2 − 1 = 4

Like tea → 4 + 16 + 19 + 5 = 44

$\frac{44}{50}$

44/50
(4)

(b) Given that the person selected at random from the 50 people likes tea, find the probability that this person also likes exactly one other drink.

44 people like tea, out of which 5 + 16 = 21 people only like one other drink. So 21/44

21/44
(2)

(Total for Question 12 is 6 marks)

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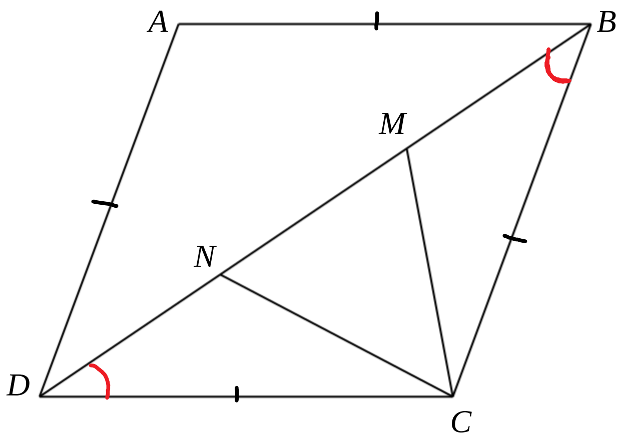
13 *ABCD* is a rhombus.



M and *N* are points on *BD* such that $DN = MB$.

m Prove that triangle *DNC* is congruent to triangle *BMC*.

$DN = MB$
$DC = BC$ because ABCD is a rhombus so all sides have equal length.

$\angle NDC = \angle MBC$ because they are base angles of triangle BCD, so equal.

The triangles NDC and BMC are ade up of two sides of same length and an equal angle.
So they are congruent because they follow the SAS rule.

(Total for Question 13 is 3 marks)

14 (a) Show that the equation $x^3 + 4x = 1$ has a solution between $x = 0$ and $x = 1$

$x^3 + 4x = 1 \rightarrow x^3 + 4x - 1 = 0$

let $f(x) = x^3 + 4x - 1$

$x = 0 \rightarrow f(0) = (0)^3 + 4(0) - 1 = -1$

$x = 1 \rightarrow f(1) = (1)^3 + 4(1) - 1 = 4$

Since there is a sign change, there must be at least one root in the interval $0 < x < 1$ as the function is continous.

(2)

(b) Show that the equation $x^3 + 4x = 1$ can be arranged to give $x = \frac{1}{4} - \frac{x^3}{4}$

$x^3 + 4x = 1 \rightarrow 4x = 1 - x^3 \rightarrow x = \frac{1}{4} - \frac{x^3}{4}$

(1)

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \frac{1}{4} - \frac{x_n^3}{4}$ twice,

to find an estimate for the solution of $x^3 + 4x = 1$

$x_0 = 0$

$x_1 = \frac{1}{4} - \frac{0^3}{4} = 1/4$

$x_2 = \frac{1}{4} - \frac{\left(\frac{1}{4}\right)^3}{4} = \frac{1}{4} - \frac{1}{256} = \frac{63}{256}$

$\frac{63}{256}$

(3)

(Total for Question 14 is 6 marks)

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15 There are 17 men and 26 women in a choir.
The choir is going to sing at a concert.

One of the men and one of the women are going to be chosen to make a pair to sing the first song.

(a) Work out the number of different pairs that can be chosen.

17 men and 26 women

Total pairs → 17 × 26 = 442

442

(2)

Two of the men are to be chosen to make a pair to sing the second song.

Ben thinks the number of different pairs that can be chosen is 136
Mark thinks the number of different pairs that can be chosen is 272

(b) Who is correct, Ben or Mark?
Give a reason for your answer.

Ben is correct, because correct calculation is (16 × 17) ÷ 2 = 136
Divide by 2 because the men are chosen to make a pair so dosent matter which order they are picked in. e.g 'man A and man B' is same as 'man B and man A'.

(1)

(Total for Question 15 is 3 marks)

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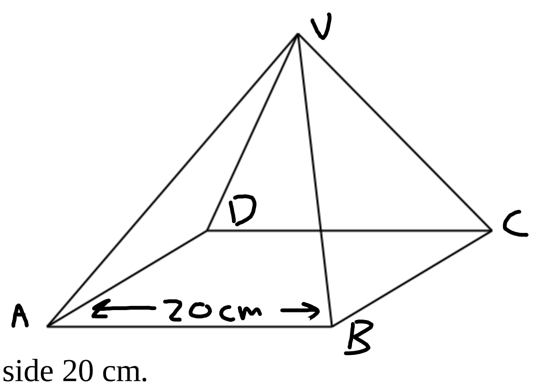
16 *VABCD* is a solid pyramid.



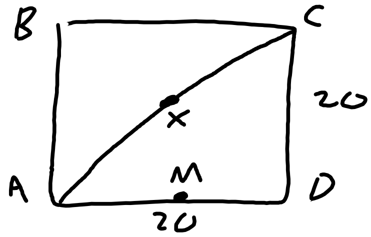
ABCD is a square of side 20 cm.

The angle between any sloping edge and the plane *ABCD* is 55°

Calculate the surface area of the pyramid.
Give your answer correct to 2 significant figures.

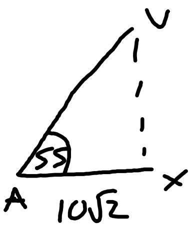
Area of square base → $20 \times 20 = \underline{400\text{ cm}^2}$

Area of 1 triangle → $1/2 \times b \times h$

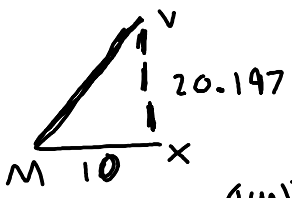


$(AC)^2 = (20)^2 + (20)^2$
$(AC)^2 = 800$
$AC = \sqrt{800}$
$AX = 1/2\sqrt{800} = 10\sqrt{2}$

X and M are midpoints



$\tan 55 = \frac{VX}{10\sqrt{2}}$
$VX = 10\sqrt{2} \times \tan 55$
$VX = 20.197\text{ cm}$



$(VM)^2 = (20.197)^2 + 10^2$
$(VM)^2 = 507.921$
$VM = 22.537\text{ cm}$
= height of triangles

area of one of the triangles $= \frac{1}{2} \times 20 \times 22.537$
$= \underline{225.371\text{ cm}^2}$

Total area = square base + 4 triangle
$= 400 + 4(225.371)$
$= \underline{1300\text{ cm}^2}$

1300 .... cm²

(Total for Question 16 is 5 marks)

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17 Louis and Robert are investigating the growth in the population of a type of bacteria. They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.
The population of bacteria grows exponentially at the rate of 50% per day.

(a) Show that the population of bacteria in flask A at the start of each day forms a geometric progression.

Day 1 = 1000 $\xrightarrow[\times 1.5]{}$ Day 2 = 1500 $\xrightarrow[\times 1.5]{}$ Day 3 = 2250

Geometric progression as common ratio is 1.5.

(2)

The population of bacteria in flask A at the start of the 10th day is *k* times the population of bacteria in flask A at the start of the 6th day.

(b) Find the value of *k*.

6th day 7th 8th 9th 10th

n ×1.5 ×1.5 ×1.5 ×1.5 kn

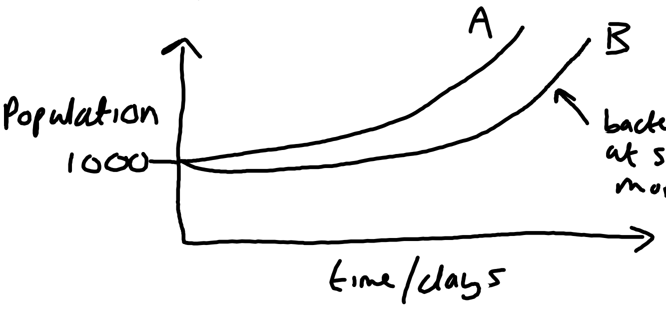
$n \times (1.5)^4 = kn \rightarrow 1.5^4 = k \rightarrow k = \underline{\underline{5.0625}}$

5.0625

(2)

At the start of day 1 there are 1000 bacteria in flask B.
The population of bacteria in flask B grows exponentially at the rate of 30% per day.

(c) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

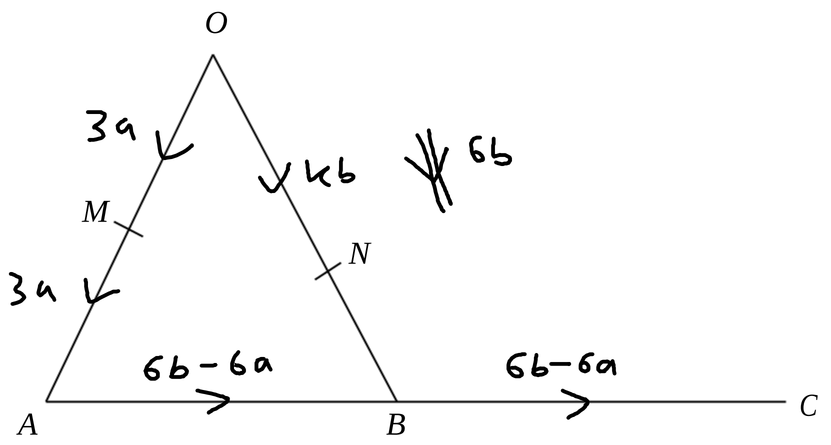


bacteria in flask B grow at slower rate so takes more time to reach same population as A

(1)

(Total for Question 17 is 5 marks)

18



OMA, *ONB* and *ABC* are straight lines.
M is the midpoint of *OA*.
B is the midpoint of *AC*.

$\overrightarrow{OA} = 6\mathbf{a}$ $\quad \overrightarrow{OB} = 6\mathbf{b}$ $\quad \overrightarrow{ON} = k\mathbf{b}$ where k is a scalar quantity.

Given that *MNC* is a straight line, find the value of k.

$\overrightarrow{OM} = \overrightarrow{MA} = 1/2\,\overrightarrow{OA} = 3a$

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB} = -6a + 6b$

$\overrightarrow{MC} = \overrightarrow{MA} + 2(\overrightarrow{AB})$

$= 3a + 2(6b - 6a) = 12b - 9a$

$\overrightarrow{MN} = \overrightarrow{MO} + \overrightarrow{ON} = -3a + kb$

as MNC is a straight line, $\overrightarrow{MC}$ is a mutiple of $\overrightarrow{MN}$

$\overrightarrow{MC} = x\,\overrightarrow{MN} \rightarrow 12b - 9a = x \times (4b - 3a)$

$12b - 9a = 3(4b - 3a)$

$x = 3$ $\quad \underline{\underline{k = 4}}$

(Total for Question 18 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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