



EP.M152 CSSE Essex Style Problem Solving Paper 1

CSSE CSSE-MOCK-1 · Calculators not allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A cake recipe makes 12 cupcakes. The ingredients include 300 g of flour, 180 g of sugar and 2 eggs. Mia wants to make 30 cupcakes for a school fair.

(a) By what factor must Mia multiply each ingredient to make 30 cupcakes? (1)

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(b) How many grams of flour does Mia need in total? (1)

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(c) How many whole eggs does Mia need? State your answer and explain briefly if any eggs must be rounded up. (2)

.....

(Total for Question 1 is 4 marks)

2 A rectangular garden measures 9 m by 12 m. A path of uniform width is to be built around the inside edge so that the remaining grass area is exactly half of the original garden area.

(a) What is the original area of the garden in square metres? (1)

(b) What must be the grass area after the path is added? (1)

(c) Let the path width be x metres. Write an expression for the grass area in terms of x . (1)

(d) Show that a path width of $x = 1.5$ m gives exactly the grass area needed from part (b). (2)

(Total for Question 2 is 5 marks)

3 A class of 28 pupils is organising teams for a quiz. They want to make teams of equal size with no pupils left over. The possible team sizes are the divisors greater than 1 of 28.

(a) List all possible team sizes greater than 1 that would allow teams with no pupils left over. (1)

(b) If they decide on teams of 7, how many teams will there be? (1)

(c) They wish to make the highest number of teams possible with at least 2 pupils in each team. Which team size will they choose and how many teams will that make? Explain why this gives the highest number of teams. (4)

(Total for Question 3 is 6 marks)

- 4** A farmer has 150 m of fencing and wants to make a rectangular enclosure next to a straight farm wall so that the wall forms one side of the rectangle. The farmer uses no fencing along the wall. The three sides to be fenced are two equal widths and one length.
- (a) If the width perpendicular to the wall is w metres and the length along the wall is L metres, write an equation connecting w , L and the total fencing used. (1)
- (b) Express the area A of the enclosure in terms of w only, and simplify. (2)
- (c) Using your formula from part (b), work out the area A for $w = 30$, $w = 35$, $w = 37.5$ and $w = 40$. Use your results to state which of these widths gives the largest enclosure area. (3)

(Total for Question 4 is 6 marks)

- 5** A shop sells packets of pencils. A small packet contains 6 pencils and costs £1.20. A medium packet contains 10 pencils and costs £1.80. A large packet contains 18 pencils and costs £3.00. Priya needs at least 100 pencils for an art club and wants to spend as little money as possible. She may buy any number of each packet.

(a) Find the cost per pencil for each packet size. Give answers in pence to 1 decimal place if necessary. (3)

(b) Using the cost per pencil, which packet should Priya favour if she wants the cheapest pencils overall? Explain briefly. (1)

(c) Find a combination of whole packets that gives at least 100 pencils for the minimum possible total cost. Show calculations and give the total cost in pounds. (4)

(Total for Question 5 is 8 marks)

- 6** A train timetable shows that a local train travels from Station A to Station B in 54 minutes. The train travels at a constant speed except for a 6 minute stop at an intermediate station. The distance between A and B along the railway line is 81 km.

(a) What is the train's average speed while it is moving (in km/h)? (3)

(b) Give the average speed for the whole journey including the stop, in km/h, to 2 decimal places. (3)

(Total for Question 6 is 6 marks)

7 A number machine performs two operations: first it subtracts 7, then it multiplies the result by 4. Olivia inputs the number n and the output is 44.

(a) Write an equation showing the machine process and the output 44. (1)

(b) Solve your equation to find n . (3)

.....
(c) Check your answer by showing the machine process with your value of n . (2)

(Total for Question 7 is 6 marks)

8 A charity organises a sponsored walk made of 3 different loops. Loop A is 2.4 km, Loop B is 3.1 km and Loop C is 4.5 km. Each walker can choose any combination of whole loops and records total distance walked. The charity sets a target to raise money from walkers who cover at least 12 km each.

(a) Show that two loops of type C plus two loops of type A exceed the 12 km target. (2)
Give the total distance.

(b) Give one combination of loops that gives exactly or just above 12 km using the (4)
fewest loops possible. Explain briefly why your choice uses the fewest loops.

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(c) The charity asks walkers to try to reach or exceed 15 km. Suggest a combination (3)
of loops that gives at least 15 km using as few loops as possible. Give the total
distance and explain briefly.

(Total for Question 8 is 9 marks)

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Question 1

- (a) **B1** $30/12 = 2.5$ stated as the multiplier cao
- (a) **Answer: 2.5**
- (b) **B1** $300 \times 2.5 = 750$ g cao
- (b) **Answer: 750 g**
- (c) **M1** Scaling 2 eggs by 2.5 seen: $2 \times 2.5 = 5$
- (c) **A1** Answer 5 eggs with brief statement that 5 is whole so no rounding needed cao
- (c) **Answer: 5 eggs**

Question 2

- (a) **B1** $9 \times 12 = 108$ m² cao
- (a) **Answer: 108 m²**
- (b) **B1** Half of 108 = 54 m² cao
- (b) **Answer: 54 m²**
- (c) **B1** Expression $(9-2x)(12-2x)$ cao
- (c) **Answer: $(9 - 2x)(12 - 2x)$**
- (d) **M1** Substitute $x = 1.5$ into $(9-2x)(12-2x)$: $(9-3)(12-3)$ seen
- (d) **A1** $= 6 \times 9 = 54$ m², which equals half of 108 m², so $x = 1.5$ m works cao
- (d) **Answer: $x = 1.5$ m gives grass area 54 m², which is exactly half of the garden (108 m²).**

Question 3

- (a) **B1** Correct list 2, 4, 7, 14, 28 cao
- (a) **Answer: 2, 4, 7, 14, 28**
- (b) **B1** $28/7 = 4$ teams cao
- (b) **Answer: 4 teams**
- (c) **M1** Identify smallest allowed team size 2 seen
- (c) **M1** Calculate number of teams $28/2 = 14$ seen
- (c) **A1** State answer: team size 2 gives 14 teams cao
- (c) **A1** Brief explanation that smaller team size gives more teams and 2 is minimum allowable so gives highest number cao
- (c) **Answer: Team size 2, making 14 teams. 2 is the smallest allowed size so it produces the highest number of teams.**

Question 4

- (a) **B1** Equation $2w + L = 150$ or equivalent cao
- (a) **Answer: $2w + L = 150$**
- (b) **M1** Substitute $L = 150 - 2w$ into area $A = Lw$ seen
- (b) **A1** $A = w(150 - 2w) = 150w - 2w^2$ cao
- (b) **Answer: $A = 150w - 2w^2$**
- (c) **M1** At least two of $A(30) = 2700$, $A(35) = 2800$, $A(37.5) = 2812.5$, $A(40) = 2800$ correctly calculated
- (c) **M1** All four areas correctly calculated: 2700, 2800, 2812.5, 2800 m²
- (c) **A1** $w = 37.5$ m gives the largest area (2812.5 m²) cao
- (c) **Answer: $w = 37.5$ m gives the largest area, 2812.5 m².**

Question 5

- (a) **M1** Compute costs per pencil $120/6$, $180/10$, $300/18$ or equivalent
- (a) **M1** Give values: small 20p, medium 18.0p, large 16.7p seen
- (a) **A1** All three costs correct: small 20p, medium 18.0p, large 16.67p (or 16.7p) cao
- **(a) Answer: Small 20 pence, Medium 18.0 pence, Large 16.67 pence (approx)**
- (b) **B1** State large packet is cheapest per pencil (16.67p) cao
- **(b) Answer: Large packets, because they have the lowest cost per pencil (about 16.67p).**
- (c) **M1** Candidate method to reach 100 pencils, e.g. using mostly large packets or testing combinations (e.g. $5 \times 18 = 90$ then add other packets) seen
- (c) **M1** Find valid combination with total pencils ≥ 100 seen (e.g. 5 large + 1 medium = 100 pencils) seen
- (c) **M1** Calculate total cost for chosen combination correctly (e.g. $5 \times £3.00 + £1.80 = £16.80$) seen
- (c) **A1** State minimal cost solution with correct total cost justified: £16.80, cheaper than 6 large (£18.00) or 10 medium (£18.00) cao
- **(c) Answer: Buy 5 large packets and 1 medium packet: $5 \times 18 + 10 = 100$ pencils. Cost = $5 \times £3.00 + £1.80 = £16.80$**

Question 6

- (a) **M1** Recognise moving time = $54 - 6 = 48$ minutes seen
- (a) **M1** Convert 48 minutes to hours = $48/60 = 0.8$ h seen
- (a) **A1** Compute speed = $81 / 0.8 = 101.25$ km/h cao
- **(a) Answer: 101.25 km/h**
- (b) **M1** Total time = 54 minutes = 0.9 h seen
- (b) **M1** Compute speed = $81 / 0.9$ seen
- (b) **A1** $81 / 0.9 = 90.00$ km/h cao
- **(b) Answer: 90.00 km/h**

Question 7

- (a) **B1** Equation $4(n - 7) = 44$ or equivalent cao
- **(a) Answer: $4(n - 7) = 44$**
- (b) **M1** Divide both sides by 4 or expand then solve seen: $n - 7 = 11$
- (b) **M1** Add 7 to both sides seen
- (b) **A1** $n = 18$ cao
- **(b) Answer: $n = 18$**
- (c) **M1** Substitution $18 - 7 = 11$ seen
- (c) **A1** $4 \times 11 = 44$ shown; check complete cao
- **(c) Answer: $18 - 7 = 11$; $4 \times 11 = 44$, so output 44**

Question 8

- (a) **M1** Compute $2 \times 4.5 + 2 \times 2.4$ seen
- (a) **A1** Total $9.0 + 4.8 = 13.8$ km stated cao
- **(a) Answer: $2 \times 4.5 + 2 \times 2.4 = 13.8$ km**
- (b) **M1** Find combination with total ≥ 12 km and count loops (e.g. $2 \text{ C} + 1 \text{ B} = 12.1$ km) seen
- (b) **M1** Compute total correctly (e.g. $2 \times 4.5 + 3.1 = 12.1$) seen
- (b) **M1** State number of loops used (3) and compare with any 2-loop totals to show impossible seen
- (b) **A1** Conclude minimal loops is 3 with correct justification cao
- **(b) Answer: Two C loops and one B loop: $2 \times 4.5 + 3.1 = 12.1$ km, using 3 loops which is minimal because any 2 loops give at most $4.5 + 4.5 = 9.0$ or $4.5 + 3.1 = 7.6$ etc, all below 12 km.**
- (c) **M1** Provide a valid combination with total ≥ 15 km seen (e.g. $3 \times \text{C} + 1 \times \text{A} = 3 \times 4.5 + 2.4 = 15.9$) or $4 \times \text{C} = 18.0$
- (c) **M1** Calculate total distance correctly
- (c) **A1** State minimal number of loops and justify briefly cao
- **(c) Answer: Three C loops plus one A: $3 \times 4.5 + 2.4 = 13.5 + 2.4 = 15.9$ km; uses 4 loops and is minimal because three loops give at most $3 \times 4.5 = 13.5$ which is below 15 km.**