5.2 Direct and Inverse Proportion: 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A recipe for 6 portions uses 300 g of flour. Work out how much flour is needed for 15 portions, assuming the amount of flour is directly proportional to the number of portions.

(Total for Question 1 is 2 marks)

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2 y is inversely proportional to x. When x = 5, y = 12.

(a) Find a formula for y in terms of x. **(2)**

.....

(b) Work out the value of y when x = 15. **(1)**

.....

(c) Work out the value of x when y = 24. **(2)**

.....

(Total for Question 2 is 5 marks)

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3 The cost, C pounds, of tiling a floor is directly proportional to the area, A m^2, of the floor. It costs £187.50 to tile a floor with area 25 m^2.

(a) Find a formula for C in terms of A. **(3)**

.....

(b) Work out the cost of tiling a floor with area 34 m^2. **(2)**

.....

(Total for Question 3 is 5 marks)

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4 y is directly proportional to x^2. Work out the percentage increase in y when x is increased by 20%.

(Total for Question 4 is 3 marks)

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5 On a certain day, the amount received in £, P, when exchanging euros is directly proportional to the number of euros exchanged, E. Grace exchanges 250 euros and receives £215.

(a) Work out the exchange rate, in £ received per euro, giving your answer to 3 significant figures. **(2)**

.....

(b) Prisha exchanges 460 euros. Work out how many £ she receives. **(2)**

.....

(Total for Question 5 is 4 marks)

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6 The time, T hours, taken by a train to travel a fixed distance is inversely proportional to its average speed, S mph. When S = 50, T = 4.

(a) Find a formula for T in terms of S. **(2)**

.....

(b) Work out T when S = 80. **(2)**

.....

(Total for Question 6 is 4 marks)

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7 A cake recipe for 8 people uses 240 g of caster sugar and 200 g of butter. The amounts of each ingredient needed are directly proportional to the number of people.

(a) Work out the mass of caster sugar needed to make the recipe for 6 people. **(2)**

.....

(b) Nadia has 620 g of butter. Work out the maximum number of people she can make the recipe for. **(3)**

.....

(Total for Question 7 is 5 marks)

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8 y is directly proportional to x^2. When x = 4, y = 32.

(a) Find a formula for y in terms of x. **(2)**

.....

(b) Work out the value of y when x = 5. **(2)**

.....

(c) Work out the positive value of x when y = 98. **(2)**

.....

(Total for Question 8 is 6 marks)

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9 A car uses fuel at a rate directly proportional to its speed. At 40 mph the car uses 7 litres of fuel per hour. Work out the fuel used per hour at 70 mph.

(Total for Question 9 is 3 marks)

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10 y is inversely proportional to x^2. When x = 2, y = 15.

(a) Find a formula for y in terms of x. **(3)**

.....

(b) Work out the value of x when y = 2.4, given that x is positive. **(3)**

.....

(Total for Question 10 is 6 marks)

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11 y is directly proportional to $\sqrt{x}$. When x = 16, y = 20.

(a) Find a formula for y in terms of x. **(3)**

.....

(b) Work out the value of y when x = 25. **(2)**

.....

(Total for Question 11 is 5 marks)

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12 z is directly proportional to x and inversely proportional to y. When x = 6 and y = 4, z = 27.

(a) Find a formula for z in terms of x and y. **(3)**

.....

(b) Work out the value of z when x = 10 and y = 5. **(2)**

.....

(Total for Question 12 is 5 marks)

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13 The pressure, P pascals, of a fixed mass of gas at constant temperature is inversely proportional to its volume, V cm^3. When the volume is 200 cm^3, the pressure is 350 pascals.

(a) Find a formula for P in terms of V. **(3)**

.....

(b) The gas is compressed so that its volume becomes 125 cm^3. Work out the new pressure. **(2)**

.....

(c) For safety reasons, the pressure must not exceed 800 pascals. Find the minimum volume, in cm^3, that the gas can be compressed to. **(2)**

.....

(Total for Question 13 is 7 marks)

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14 The cost, C pounds, of painting a fence is directly proportional to the length, L metres, of the fence and inversely proportional to the number of painters, n, working on it. It costs £60 to paint a 20 m fence using 4 painters.

(a) Find a formula for C in terms of L and n. **(3)**

.....

(b) Work out the cost of painting a 45 m fence using 6 painters. **(2)**

.....

(c) A different fence costs £100 to paint using 8 painters. Work out the length of this fence, in metres. Give your answer correct to 1 decimal place. **(3)**

.....

(Total for Question 14 is 8 marks)

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15 y is directly proportional to $\sqrt{x}$. When x = 9, y = 15.

(a) Find a formula for y in terms of x. **(2)**

.....

(b) Work out the value of y when x = 16. **(2)**

.....

(c) Work out the value of x when y = 17.5. **(2)**

.....

(Total for Question 15 is 6 marks)

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16 y is inversely proportional to x^2. When x = 3, y = 10.

(a) Find a formula for y in terms of x. **(2)**

.....

(b) Work out the value of y when x = 5, giving your answer as a decimal. **(2)**

.....

(Total for Question 16 is 4 marks)

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17 The pressure, P pascals, of a fixed mass of gas at constant temperature is inversely proportional to its volume, V cm^3. When the volume is 150 cm^3, the pressure is 240 pascals.

(a) Find a formula for P in terms of V. **(2)**

.....

(b) Work out the pressure when the volume is decreased to 100 cm^3. **(2)**

.....

(c) The volume is increased so that the pressure drops to 90 pascals. Work out the new volume. **(2)**

.....

(Total for Question 17 is 6 marks)

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18 The table shows values of x and y, where y is directly proportional to x^2.

x	1	3	5
y	4	36	100

(a) Find the value of k in $y = kx^2$. **(1)**

(b) Hence find the value of y when x = 10. **(2)**

(Total for Question 18 is 3 marks)

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19 The brightness B of a lamp varies directly as the square of the current I through it. A particular lamp has brightness 400 units when the current is 2 A.

(a) Find the constant of proportionality k in $B = k I^2$. **(2)**

(b) Use your k to find the current when the brightness is 225 units. Give your answer as a simplified surd if necessary. **(2)**

(Total for Question 19 is 4 marks)

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Mark scheme · 5.2 Direct and Inverse Proportion: 2-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

use direct proportion: 300/6 * 15 or equivalent method	**M1**
750 g cao	**A1**

Answer:750 g (grams). This is 300/6 * 15 = 50 * 15 = 750 g.
Working check: 6 portions -> 300 g, so per portion 50 g; 15 portions -> 750 g.

Question 2

(a) y = k/x and 12 = k/5 oe seen	**M1**
(a) y = 60/x oe	**A1**
(a) Answer: y = 60/x	
(b) 4 ft from their formula	**B1**
(b) Answer: 4	
(c) 24 = 60/x (or equivalent rearrangement) oe	**M1**
(c) 2.5 cao	**A1**
(c) Answer: 2.5	

Question 3

(a) C = kA oe seen	**M1**
(a) 187.50 = 25k solved (dependent on previous M1)	**dM1**
(a) C = 7.5A oe	**A1**
(a) Answer: C = 7.5A	
(b) 7.5 x 34 oe (ft their formula)	**M1**
(b) 255 (pounds) cao	**A1**
(b) Answer: £255	

Question 4

identifies the new x as 1.2x oe	**M1**
finds new y = $k(1.2x)^2 = 1.44kx^2$ oe	**M1**
44% increase cao	**A1**
Answer: 44% increase	

Question 5

(a) 215/250 oe	**M1**
(a) 0.860 awrt 3sf	**A1**
(a) Answer: £0.860 per euro	
(b) 460 x 0.86 oe (ft their rate)	**M1**
(b) £395.60 cao	**A1**
(b) Answer: £395.60	

Question 6

(a) finds k = ST = 50 x 4 = 200 oe	**M1**
(a) T = 200/S oe	**A1**
(a) Answer: T = 200/S	
(b) substitutes S = 80 into their formula	**M1**
(b) T = 2.5 hours cao	**A1**
(b) Answer: T = 2.5 hours	

Question 7

(a) finds sugar per person = 240/8 = 30 (g) oe	**M1**
(a) 180 g cao	**A1**
(a) Answer: 180 g	
(b) finds butter per person = 200/8 = 25 (g) oe	**M1**
(b) 620/25 (= 24.8) oe, dependent on the first M1	**dM1**
(b) 24 cao, rounded down to a whole number of people	**A1**
(b) Answer: 24 people	

Question 8

(a) finds $k = 32/4^2 = 32/16 = 2$ oe	**M1**
(a) $y = 2x^2$ oe	**A1**
(a) Answer: $y = 2x^2$	
(b) substitutes x = 5 into their formula	**M1**
(b) y = 50 cao	**A1**
(b) Answer: y = 50	
(c) $98 = 2x^2$ leading to $x^2 = 49$ oe	**M1**
(c) x = 7 cao (positive root only)	**A1**
(c) Answer: x = 7	

Question 9

identify direct proportion: fuel/hour = k * speed and find k = 7/40	**M1**
calculate fuel at 70 mph: (7/40) * 70	**M1**
12.25 litres per hour (or 12.3 to 3 s.f.) cao	**A1**

Answer:12.25 litres per hour.
Working check: k = 7/40 = 0.175; 0.175 * 70 = 12.25.

Question 10

(a) $y = k/x^2$ oe seen	**M1**
(a) $15 = k/2^2$ (= k/4) solved (dependent on previous M1)	**dM1**
(a) $y = 60/x^2$ oe	**A1**
(a) Answer: $y = 60/x^2$	
(b) $2.4 = 60/x^2$ rearranged to $x^2 = 60/2.4$ (= 25) oe (ft their formula)	**M1**
(b) $\sqrt{25}$ taken (dependent on previous M1)	**dM1**
(b) 5 cao	**A1**
(b) Answer: x = 5	

Question 11

(a) $y = k \times \sqrt{x}$ oe seen	**M1**
(a) $20 = k \times \sqrt{16}$ (= 4k) solved (dependent on previous M1)	**dM1**
(a) $y = 5\sqrt{x}$ oe	**A1**
(a) Answer: $y = 5\sqrt{x}$	
(b) $5 \times \sqrt{25}$ oe (ft their formula)	**M1**
(b) 25 cao	**A1**
(b) Answer: 25	

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Question 12

(a) z = kx/y oe seen **M1**

(a) 27 = k x 6/4 (= 1.5k) solved (dependent on previous M1) **dM1**

(a) z = 18x/y oe **A1**

(a) Answer: z = 18x/y

(b) 18 x 10/5 oe (ft their formula) **M1**

(b) 36 cao **A1**

(b) Answer: 36

Question 13

(a) P = k/V oe seen **M1**

(a) 350 = k/200 solved (dependent on previous M1) **dM1**

(a) P = 70000/V oe **A1**

(a) Answer: P = 70000/V

(b) 70000/125 oe (ft their formula) **M1**

(b) 560 (pascals) cao **A1**

(b) Answer: 560 pascals

(c) 70000/800 oe (ft their formula) **M1**

(c) 87.5 (cm^3) cao **A1**

(c) Answer: 87.5 cm^3

Question 14

(a) C = kL/n oe seen **M1**

(a) 60 = k x 20/4 (= 5k) solved (dependent on previous M1) **dM1**

(a) C = 12L/n oe **A1**

(a) Answer: C = 12L/n

(b) 12 x 45/6 oe (ft their formula) **M1**

(b) 90 (pounds) cao **A1**

(b) Answer: £90

(c) 100 = 12L/8 set up (ft their formula) **M1**

(c) rearranged to L = 100 x 8/12 (dependent on previous M1) **dM1**

(c) awrt 66.7 cao **A1**

(c) Answer: 66.7 m (1 d.p.)

Question 15

(a) finds k = $15/\sqrt{9}$ = 15/3 = 5 oe **M1**

(a) y = $5\sqrt{x}$ oe **A1**

(a) Answer: y = $5\sqrt{x}$

(b) substitutes x = 16: y = $5\sqrt{16}$ **M1**

(b) y = 20 cao **A1**

(b) Answer: y = 20

(c) sets up 17.5 = $5\sqrt{x}$ leading to $\sqrt{x}$ = 3.5 oe **M1**

(c) x = 12.25 cao **A1**

(c) Answer: x = 12.25

Question 16

(a) finds k = 10 x 3^2 = 90 oe **M1**

(a) y = $90/x^2$ oe **A1**

(a) Answer: y = $90/x^2$

(b) substitutes x = 5 into their formula **M1**

(b) y = 3.6 cao **A1**

(b) Answer: y = 3.6

Question 17

(a) finds k = 150 x 240 = 36000 oe **M1**

(a) P = 36000/V oe **A1**

(a) Answer: P = 36000/V

(b) substitutes V = 100 into their formula **M1**

(b) 360 pascals cao **A1**

(b) Answer: 360 pascals

(c) sets up 90 = 36000/V oe **M1**

(c) 400 cm^3 cao **A1**

(c) Answer: 400 cm^3

Question 18

(a) k = 4 (from e.g. $4/1^2$, or $36/3^2$, or $100/5^2$) **B1**

(a) Answer: k = 4

(b) substitutes x = 10 into y = $4x^2$ (ft their k) **M1**

(b) y = 400 cao **A1**

(b) Answer: y = 400

Question 19

(a) substitute B=400, I=2 into B = k I^2 to get 400 = k * 4 **M1**

(a) k = 100 cao **A1**

(a) Answer: k = 100

(b) use 225 = 100 I^2 so I^2 = 225/100 = 9/4 **M1**

(b) I = 3/2 A cao **A1**

(b) Answer:I = 3/2 A.

Working check: I^2 = 9/4 so I = 3/2 (positive current).

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