5.10 Drawing Other Graphs: Cubic/Reciprocal: 1-hour Pack

Total Marks

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Work out the value of y for y = 1/x when x = 5 and when x = -5. Give exact values as fractions or decimals.

(a) x = 5, y = _____ **(1)**

.....

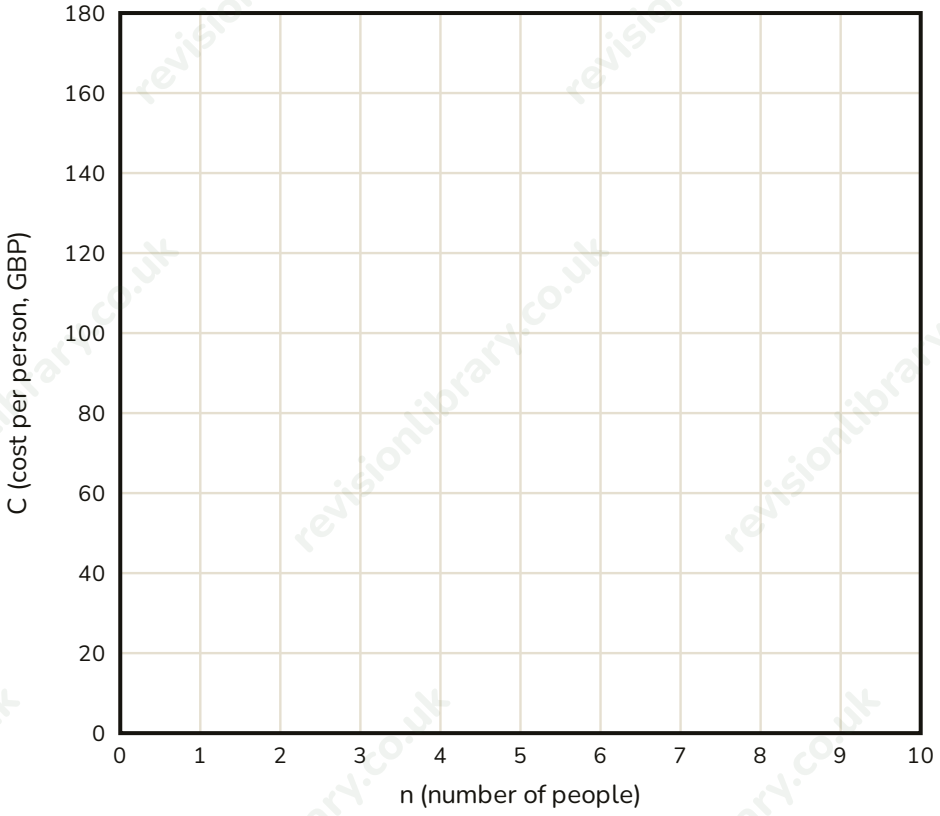
(b) x = -5, y = _____ **(1)**

.....

(Total for Question 1 is 2 marks)

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2 A minibus costs a total of £180 to hire. The cost per person, C pounds, when the cost is shared equally between n people is given by C = 180/n.



(a) Complete the table of values for C = 180/n. **(3)**

n	1	2	3	4	5	6	9	10
C	180	_	60	_	36	_	20	_

(b) On the grid, plot the points from the table and draw a smooth curve for C against n. **(2)**

(c) Use the graph, or otherwise, to estimate the cost per person if 8 people share the minibus. **(1)**

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(d) Find the least number of people needed to share the minibus so that the cost per person is below £15. **(2)**

(Total for Question 2 is 8 marks)

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3 For each statement, state whether it is True or False, giving a brief reason.

(a) The graph of $y = 1/x$ has a value when $x = 0$. **(1)**

(b) A cubic graph can cross the x-axis at most three times. **(1)**

(c) The graph of $y = x^3$ is symmetrical about the y-axis. **(1)**

(d) For $a>0$, the two branches of the graph $y = a/x$ lie in opposite quadrants. **(1)**

(e) As x gets very large, the value of $1/x$ gets closer to 0. **(1)**

(f) Every cubic graph has a turning point (a local maximum or minimum). **(1)**

(Total for Question 3 is 6 marks)

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4 Here are four equations.

A: $y = x^3$

B: $y = 5/x$

C: $y = 2x^2 - 3$

D: $y = 4x + 1$

(a) Which equation represents a cubic graph? **(1)**

(b) Which equation represents a reciprocal graph made of two curved branches that never touch the x-axis or the y-axis? **(1)**

(c) Which equation represents a graph with exactly one turning point? **(1)**

(Total for Question 4 is 3 marks)

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5 Sketch the reciprocal curve $y = 2/x$ for $-6 \leq x \leq 6$, excluding $x = 0$. On the axes, indicate clearly the vertical and horizontal asymptotes and state their equations.

(a) Indicate the vertical and horizontal asymptotes and give their equations. **(2)**

(b) State the coordinates of the point where the curve crosses the line $y = 1$. **(2)**

(Total for Question 5 is 4 marks)

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6 The pressure, P pascals, of a fixed mass of gas is inversely proportional to its volume, V m^3, so that $P = k/V$ for a constant k. When $V = 2$, $P = 150$.

(a) Find the value of k. **(2)**

(b) Find the value of P when $V = 5$. **(2)**

(c) Describe the shape of the graph of P against V for $V > 0$. **(1)**

(d) State what happens to the pressure P if the volume V is doubled. **(1)**

(Total for Question 6 is 6 marks)

7 The graphs of $y = x^3 - 4x$ and $y = x$ intersect at three points.

(a) Show that the x-coordinates of the points of intersection satisfy $x^3 - 5x = 0$. **(1)**

(b) Use the graphs, or otherwise, to find the three solutions of $x^3 - 5x = 0$. **(2)**

(c) Verify that $x = 0$ is a solution by substituting it into both $y = x^3 - 4x$ and $y = x$. **(1)**

(d) Write down the y-coordinate of the intersection point where x is positive, giving your answer to 1 decimal place. **(1)**

(Total for Question 7 is 5 marks)

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8 The graph of $y = x^3$ is reflected to give the graph of $y = -x^3$.

(a) Describe the single transformation that maps the graph of $y = x^3$ onto the graph of $y = -x^3$. **(1)**

(b) Write down the coordinates of the y-intercept of the graph of $y = -x^3$. **(1)**

(c) State whether $y = -x^3$ is increasing or decreasing as x increases, giving a reason. **(1)**

(Total for Question 8 is 3 marks)

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9 The time, t hours, taken to fill a water tank is inversely proportional to the number of pumps, n, used. When n = 4, t = 3.

(a) Find a formula for t in terms of n. **(2)**

.....

(b) Complete the table of values for t = 12/n. **(4)**

n	1	2	3	4	6
t	_	_	_	3	_

(c) State one feature of the graph of t against n, for n > 0. **(1)**

(Total for Question 9 is 7 marks)

10 The graph of $y = x^3 - 7x$ passes through the point (2, -6).

(a) Show that (2, -6) lies on the curve. **(1)**

(b) Use the symmetry of the graph to write down another point on the curve. **(1)**

.....

(Total for Question 10 is 2 marks)

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Mark scheme · 5.10 Drawing Other Graphs: Cubic/Reciprocal: 1-hour Pack

Question 1

(a) 1/5 or 0.2 cao **B1**

(a) Answer: 1/5

(b) -1/5 or -0.2 cao **B1**

(b) Answer: -1/5

Question 2

(a) at least one correct calculation shown, e.g. 180 / 4 = 45 **M1**

(a) at least two of the four missing values correct **A1**

(a) all four missing values correct: 90, 45, 30, 18 **A1**

(a) Answer: n=2: 90, n=4: 45, n=6: 30, n=10: 18

(b) all 8 points plotted correctly ft from table **B1**

(b) smooth decreasing curve drawn through all points, getting closer to the n-axis but never touching it **B1**

(b) Answer: Smooth decreasing reciprocal-shaped curve through the 8 points

(c) awrt £22.50 (range 22 to 23), ft from candidate's graph **B1**

(c) Answer: £22.50

(d) sets up and tests 180/n < 15, e.g. checking n=12 gives exactly 15 and n=13 gives below 15 **M1**

(d) n = 13 cao **A1**

(d) Answer: 13 people

Question 3

(a) False, because division by zero is undefined oe **B1**

(a) Answer: False

(b) True, because a cubic equation has at most three real roots oe **B1**

(b) Answer: True

(c) False, it has rotational symmetry about the origin, not reflective symmetry in the y-axis oe **B1**

(c) Answer: False

(d) True, one branch lies in the first quadrant and the other in the third quadrant oe **B1**

(d) Answer: True

(e) True oe **B1**

(e) Answer: True

(f) False, e.g. $y=x^3$ has no turning point oe **B1**

(f) Answer: False

Question 4

(a) A cao **B1**

(a) Answer: A

(b) B cao **B1**

(b) Answer: B

(c) C cao **B1**

(c) Answer: C

Question 5

(a) vertical asymptote x = 0 stated **B1**

(a) horizontal asymptote y = 0 stated **B1**

(a) Answer: Vertical asymptote x = 0. Horizontal asymptote y = 0.

(b) solve 2/x = 1 or equivalent **M1**

(b) (2, 1) cao **A1**

(b) Answer: (2, 1)

Question 6

(a) substitutes P=150 and V=2 into P=k/V, e.g. 150=k/2 **M1**

(a) k = 300 cao **A1**

(a) Answer: k = 300

(b) substitutes k=300 and V=5 into P=k/V **M1**

(b) P = 60 cao (units: pascals) **A1**

(b) Answer: P = 60 pascals

(c) a curve that continually decreases as V increases, getting closer to but never touching either axis oe **B1**

(c) Answer: A decreasing reciprocal-shaped curve that never touches the axes

(d) P is halved oe **B1**

(d) Answer: P is halved

Question 7

(a) $x^3-4x=x \Rightarrow x^3-4x-x=0 \Rightarrow x^3-5x=0$ cso **B1**

(a) Answer: $x^3 - 5x = 0$ (shown)

(b) x = 0 cao **B1**

(b) x = awrt 2.2 and x = awrt -2.2 (range 2.1 to 2.3 and -2.3 to -2.1), both required, ft **B1**

(b) Answer: x = 0, x = awrt 2.2, x = awrt -2.2

(c) $y=0^3-4(0)=0$ and y=0, both equal 0 cao **B1**

(c) Answer: Both give y = 0, confirming x = 0 is a solution

(d) y = awrt 2.2, ft from part (b) **B1**

(d) Answer: y = 2.2

Question 8

(a) reflection in the x-axis or reflection in the y-axis oe **B1**

(a) Answer: Reflection in the x-axis

(b) (0, 0) cao **B1**

(b) Answer: (0, 0)

(c) decreasing throughout, e.g. because $y=x^3$ is increasing and it has been reflected in the x-axis oe **B1**

(c) Answer: Decreasing throughout

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Question 9

(a) sets up t = k/n and substitutes n=4, t=3 to find k=12 **M1**

(a) t = 12/n oe **A1**

(a) Answer: t = 12/n

(b) t = 12 at n = 1 **B1**

(b) t = 6 at n = 2 **B1**

(b) t = 4 at n = 3 **B1**

(b) t = 2 at n = 6 **B1**

(b) Answer: n=1: t=12; n=2: t=6; n=3: t=4; n=6: t=2

(c) any correct feature, e.g. as n increases t decreases; or the curve gets closer to the n-axis but never touches it; or the graph only exists for n > 0 in this context **B1**

(c) Answer: As the number of pumps increases, the time taken decreases (the curve approaches but never touches the n-axis)

Question 10

(a) substitutes x=2 to get y = 8-14 = -6, confirming the point lies on the curve **B1**

(a) Answer: 2^3 - 7(2) = 8 - 14 = -6, so (2,-6) lies on the curve

(b) (-2, 6), by the rotational symmetry of a cubic of this form about the origin, oe **B1**

(b) Answer: (-2, 6)

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