

# IB Mathematics

## Ratio & Graphs — Exam Practice

Years 6–7 · High-Frequency Questions · Print Edition

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Class: \_\_\_\_\_

Score: \_\_\_\_ / 20

### Instructions:

- Each question has 3 parts. Circle your answer for each part.
- Read the Concept and Worked Example before attempting each question.
- Use the working space provided. Show all steps for full marks.
- Difficulty: Easy ♦ Medium ♦♦ Hard ♦♦♦

### Question 1

### Ratio Simplification

♦ Easy

■ **Concept:** A ratio compares two quantities. To simplify, divide both parts by their GCD (Greatest Common Divisor). Formula:  $a:b \rightarrow (a/\text{GCD}):(b/\text{GCD})$ . Ratios can also be written as fractions.

■ **Example:** Simplify 24:36.  $\text{GCD}(24,36)=12$ . Answer: 2:3

#### Part 1 of 3

#### 1a. Simplify 48:72.

- A) 2:3
- B) 3:4
- C) 4:6
- D) 6:8

Working space:

#### Part 2 of 3

#### 1b. Express 35:56 in simplest form.

- A) 7:8
- B) 5:8
- C) 5:7
- D) 7:10

Working space:

Part 3 of 3

1c. Which ratio is equivalent to 3:5?

- A) 9:20
- B) 12:20
- C) 6:9
- D) 15:30

Working space:

Question 2

Dividing in a Ratio

◆ Easy

■ **Concept:** To divide quantity in ratio a:b: Total parts = a+b. Each share =  $(\text{Total} \div \text{total parts}) \times a$  or  $\times b$ .

■ **Example:** Divide \$120 in ratio 3:5. Total parts=8. Each part=\$15. Shares: \$45 and \$75.

Part 1 of 3

2a. Divide \$200 in ratio 3:7.

- A) \$60 and \$140
- B) \$70 and \$130
- C) \$80 and \$120
- D) \$50 and \$150

Working space:

Part 2 of 3

2b. Three friends share 360 sweets in ratio 2:3:4. Second friend gets:

- A) 80
- B) 100
- C) 120
- D) 140

Working space:

Part 3 of 3

2c. Line 45cm divided in ratio 2:7. Shorter part length:

- A) 8cm
- B) 10cm

- C) 12cm
- D) 9cm

Working space:

**Question 3**      **Direct Proportion**      **◆ Easy**

■ **Concept:** In direct proportion:  $y = kx$  ( $k = \text{constant}$ ). As one increases, the other increases at the same rate.  
Cross-multiply to solve:  $a/b = c/d \rightarrow ad = bc$ .

■ **Example:** 5 pens cost \$3.50. Cost of 8 pens:  $k=0.70$ .  $\text{Cost}=0.70 \times 8 = \$5.60$

**Part 1 of 3**

**3a.  $y$  directly proportional to  $x$ .  $y=15$  when  $x=3$ . Find  $y$  when  $x=7$ .**

- A) 25
- B) 30
- C) 35
- D) 45

Working space:

**Part 2 of 3**

**3b. Car travels 120km in 1.5 hours. Distance in 4 hours:**

- A) 240km
- B) 300km
- C) 320km
- D) 360km

Working space:

**Part 3 of 3**

**3c.  $y$  proportional to  $x$ , passes through (4,20). Find  $y$  when  $x=11$ .**

- A) 44
- B) 50
- C) 55
- D) 60

Working space:

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**Question 4****Inverse Proportion**

◆◆ Medium

■ **Concept:** In inverse proportion:  $y = k/x$  (or  $xy = k$ ). As one increases, the other decreases. The graph is a hyperbola.

■ **Example:** 5 workers build a wall in 12 days. 3 workers:  $k=60$ .  $\text{Time}=60/3=20$  days.

**Part 1 of 3**

**4a.  $y$  inversely proportional to  $x$ .  $y=8$  when  $x=6$ . Find  $y$  when  $x=12$ .**

- A) 2
- B) 4
- C) 16
- D) 3

Working space:

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**Part 2 of 3**

**4b. Journey takes 3h at 60mph. Speed for 2 hours:**

- A) 80mph
- B) 90mph
- C) 100mph
- D) 120mph

Working space:

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**Part 3 of 3**

**4c. Hyperbola passes through (3,8). Find  $y$  when  $x=6$ .**

- A) 2
- B) 4
- C) 12
- D) 16

Working space:

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**Question 5****Gradient of a Line**

◆ Easy

■ **Concept:** Gradient (slope):  $m = (y_2 - y_1) / (x_2 - x_1) = \text{rise/run}$ . Positive gradient: goes up. Negative: goes down. Steepness =  $|m|$ .

■ **Example:** Line through (1,3) and (4,9):  $m = (9 - 3) / (4 - 1) = 6/3 = 2$

**Part 1 of 3****5a. Gradient of line through (2,5) and (6,13):**

- A)  $3/2$
- B) 2
- C)  $8/4$
- D) 3

Working space:

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**Part 2 of 3****5b. Gradient = -3, passes through (0,7). Find y when x=4:**

- A) -5
- B) 4
- C) 7
- D) 19

Working space:

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**Part 3 of 3****5c. Which is steeper: gradient 2.5 or gradient -4?**

- A) Gradient 2.5
- B) Gradient -4
- C) Equal
- D) Cannot compare

Working space:

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**Question 6**

$y = mx + c$

◆ Easy

■ **Concept:** Equation of a line:  $y = mx + c$ .  $m$  = gradient,  $c$  = y-intercept. To find equation: (1) find  $m$ , (2) substitute a point to find  $c$ .

■ **Example:** Line through  $(0,4)$  with gradient 3:  $y = 3x + 4$

**Part 1 of 3****6a. Line through  $(0,-2)$  with gradient 4:**

- A)  $y = -2x + 4$
- B)  $y = 4x - 2$
- C)  $y = 4x + 2$
- D)  $y = -4x - 2$

Working space:

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**Part 2 of 3****6b. Equation of line through  $(1,5)$  and  $(3,11)$ :**

- A)  $y = 2x + 3$
- B)  $y = 3x + 2$
- C)  $y = 2x + 2$
- D)  $y = 3x + 1$

Working space:

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**Part 3 of 3****6c. Line  $2y + 6x = 10$ . What is its gradient?**

- A) 6
- B) 3
- C) -3
- D) -6

Working space:

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**Question 7****Parallel & Perpendicular Lines**

◆◆ Medium

■ **Concept:** Parallel lines:  $m_1=m_2$  (equal gradients). Perpendicular lines:  $m_1 \times m_2 = -1$ . Perpendicular gradient =  $-1/m$  (negative reciprocal).

■ **Example:** Line gradient  $2/3$ . Perpendicular gradient =  $-3/2$ .

**Part 1 of 3**

**7a. Line L has gradient  $3/4$ . Perpendicular gradient:**

- A)  $3/4$
- B)  $-4/3$
- C)  $4/3$
- D)  $-3/4$

Working space:

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**Part 2 of 3**

**7b. Which line is parallel to  $y=5x-3$ ?**

- A)  $y=5x+7$
- B)  $y=-5x+3$
- C)  $y=(1/5)x+2$
- D)  $y=3x-5$

Working space:

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**Part 3 of 3**

**7c. Perpendicular bisector gradient  $=-1/2$  passes through  $(4,1)$ . Find  $k$  in  $y=-x/2+k$ .**

- A) 1
- B) 2
- C) 3
- D) 4

Working space:

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**Question 8****Distance & Midpoint**

◆ Easy

■ **Concept:** Distance:  $d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$ . Midpoint:  $M = ((x_1+x_2)/2, (y_1+y_2)/2)$ .

■ **Example:** Distance from (1,2) to (4,6):  $d = \sqrt{9+16} = \sqrt{25} = 5$

**Part 1 of 3****8a. Distance between (1,2) and (7,10):**

- A) 8
- B)  $2\sqrt{5}$
- C) 10
- D)  $\sqrt{50}$

Working space:

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**Part 2 of 3****8b. Midpoint of (-2,6) to (8,-4):**

- A) (5,1)
- B) (3,1)
- C) (3,2)
- D) (6,2)

Working space:

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**Part 3 of 3****8c. Midpoint (5,3). One endpoint (2,7). Other endpoint:**

- A) (7,-1)
- B) (8,-1)
- C) (3,10)
- D) (7,1)

Working space:

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**Question 9****Graphs of Proportional Relationships**

◆◆ Medium

■ **Concept:**  $y=kx$  (direct): straight line through origin.  $y=k/x$  (inverse): hyperbola. Key: check if graph passes through origin!

■ **Example:**  $y=3x$ : line through  $(0,0)$ .  $y=12/x$ : points  $(1,12),(2,6),(3,4),(4,3)$

## Part 1 of 3

**9a. Which graph represents  $y$  proportional to  $x$ ?**

- A) Hyperbola
- B) Straight line through origin
- C) Parabola
- D) Line not through origin

Working space:

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## Part 2 of 3

**9b.  $y=24/x$  passes through which point?**

- A)  $(3,6)$
- B)  $(4,6)$
- C)  $(6,3)$
- D)  $(8,4)$

Working space:

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## Part 3 of 3

**9c. Straight line through  $(0,0)$  with gradient 2.5. Find  $y$  when  $x=8$ :**

- A) 16
- B) 18
- C) 20
- D) 22

Working space:

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**Question 10****Reading & Interpreting Graphs**

◆◆ Medium

■ **Concept:** x-intercept:  $y=0$ . y-intercept:  $x=0$ . Gradient = rate of change. Steeper slope = faster rate.

■ **Example:**  $y=2x-6$ : x-intercept= $(3,0)$ , y-intercept= $(0,-6)$

**Part 1 of 3**

**10a. Graph  $y=3x-9$ . What is the x-intercept?**

- A)  $(-9,0)$
- B)  $(0,-9)$
- C)  $(3,0)$
- D)  $(9,0)$

Working space:

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**Part 2 of 3**

**10b. Direct proportion graph passes through  $(5,20)$ . y-value when  $x=0$ :**

- A) 20
- B) 4
- C) 0
- D) Cannot be determined

Working space:

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**Part 3 of 3**

**10c. Distance-time graph: steeper slope in second half means:**

- A) Slowed down
- B) Stopped
- C) Sped up
- D) Distance decreased

Working space:

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**Question 11****Scale & Map Problems**◆◆ **Medium**

■ **Concept:** Scale 1:n means 1 unit on map = n units in reality. Real = Map × n. Map = Real ÷ n.

■ **Example:** Scale 1:50000. Map 3cm. Real=3×50000=150000cm=1.5km

**Part 1 of 3**

**11a. Scale 1:25000. Two towns 8cm on map. Real distance in km:**

- A) 1km
- B) 2km
- C) 3km
- D) 4km

Working space:

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**Part 2 of 3**

**11b. Scale 1:20. Real car 380cm. Model length:**

- A) 15cm
- B) 17cm
- C) 19cm
- D) 21cm

Working space:

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**Part 3 of 3**

**11c. 1cm represents 5m. Room 3.2cm. Actual length:**

- A) 12m
- B) 14m
- C) 16m
- D) 18m

Working space:

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**Question 12****Rate of Change**

◆◆ Medium

■ **Concept:** Rate of change = (change in  $y$ )/(change in  $x$ ). On a graph, this is the gradient. Units matter!

■ **Example:** Temperature rises 10 to 25 deg C in 3 hours. Rate = 5 deg/hour.

**Part 1 of 3**

**12a. Tank fills 0 to 120 litres in 8 minutes. Rate (L/min):**

- A) 10
- B) 12
- C) 15
- D) 20

Working space:

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**Part 2 of 3**

**12b. Cost vs quantity graph, gradient=4.50. Gradient represents:**

- A) Total cost
- B) Fixed cost
- C) Cost per item
- D) Number of items

Working space:

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**Part 3 of 3**

**12c.  $x=2, y=11$  and  $x=6, y=27$ . Average rate of change:**

- A) 3
- B) 4
- C) 5
- D) 6

Working space:

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**Question 13****Algebraic Ratio Problems**

◆◆◆ Hard

■ **Concept:** Use ratio-multiple method: write unknowns as  $ak$  and  $bk$ . Set up equations from conditions. Solve for  $k$ , then find unknowns.

■ **Example:** Ages  $A:B=3:5$ . Let  $A=3k$ ,  $B=5k$ . Use conditions to solve for  $k$ .

**Part 1 of 3****13a. Two numbers in ratio 5:3. Sum=64. Larger number:**

- A) 24
- B) 40
- C) 36
- D) 32

Working space:

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**Part 2 of 3****13b. Boys:Girls=3:4. 12 boys. Total students:**

- A) 16
- B) 24
- C) 28
- D) 32

Working space:

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**Part 3 of 3****13c. Solve: ratio of  $(1/2)$  to  $(3/4)$  as integers in simplest form:**

- A) 1:3
- B) 2:3
- C) 3:4
- D) 4:6

Working space:

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**Question 14****Conversion Graphs**

◆ Easy

■ **Concept:** Conversion graph: straight line, gradient = conversion factor. Read across/up to convert between units.

■ **Example:** Gradient 1.6 (km/mile). 5 miles =  $5 \times 1.6 = 8$  km.

**Part 1 of 3**

**14a. Currency graph: £1=€1.20. Euros for £35:**

- A) €38
- B) €40
- C) €42
- D) €45

Working space:

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**Part 2 of 3**

**14b. Miles-to-km gradient=1.6. Convert 12.5 miles to km:**

- A) 18km
- B) 19km
- C) 20km
- D) 21km

Working space:

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**Part 3 of 3**

**14c. Convert 56km to miles (1 mile=1.6km):**

- A) 30 miles
- B) 35 miles
- C) 40 miles
- D) 45 miles

Working space:

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**Question 15****Best Buy Problems**

◆◆ Medium

■ **Concept:** Best buy: compare unit price = Price  $\div$  Quantity. Lower unit price = better value. OR Value = Quantity  $\div$  Price (higher is better).

■ **Example:** Pack A: 500g/\$2.40=\$0.0048/g. Pack B: 750g/\$3.30=\$0.0044/g. B is better.

**Part 1 of 3**

**15a. A: 400g for \$2.80. B: 600g for \$3.90. Better value:**

- A) A
- B) B (lower unit price)
- C) Equal
- D) Not enough info

Working space:

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**Part 2 of 3**

**15b. 3 books cost \$21.60. Cost of 7 books:**

- A) \$48.80
- B) \$50.40
- C) \$52.20
- D) \$54.00

Working space:

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**Part 3 of 3**

**15c. A: 1.5L for \$2.70. B: 2L for \$3.40. Cheaper per litre:**

- A) Juice A (\$1.80/L)
- B) Juice B (\$1.70/L)
- C) Same
- D) Cannot compare

Working space:

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**Question 16****Percentage Change & Ratio**

◆◆ Medium

■ **Concept:** % change =  $(\text{New}-\text{Old})/\text{Old} \times 100$ . New:Old =  $(100+p):100$  after p% increase. Watch out: sequential % changes are NOT additive!

■ **Example:** Price \$80 to \$100. % change =  $20/80 \times 100 = 25\%$ .

**Part 1 of 3****16a. Value increases from 60 to 75. Percentage increase:**

- A) 20%
- B) 22%
- C) 25%
- D) 30%

Working space:

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**Part 2 of 3****16b. Price reduced 15%. New price=\$68. Original price:**

- A) \$78.20
- B) \$80.00
- C) \$82.00
- D) \$85.00

Working space:

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**Part 3 of 3****16c. 20% increase then 20% decrease. Net change:**

- A) 0%
- B) -4%
- C) +4%
- D) -2%

Working space:

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**Question 17****Linear vs Non-linear Graphs**

◆◆ Medium

■ **Concept:** Linear:  $y=mx+c$  (straight line). Non-linear:  $y=x^2$  (parabola),  $y=x^3$  (cubic),  $y=1/x$  (hyperbola),  $y=a^x$  (exponential). Key: exponential has constant ratio between consecutive  $y$ -values.

■ **Example:**  $y=2x+1$ : linear.  $y=x^2-4$ : parabola.  $y=2^x$ : exponential.

## Part 1 of 3

**17a. Which equation gives a straight-line graph?**

- A)  $y=x^2+3$
- B)  $y=3x-7$
- C)  $y=4/x$
- D)  $y=2^x$

Working space:

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## Part 2 of 3

**17b.  $y=-x^2+4$ . Where does it cross the  $x$ -axis?**

- A) (2,0) only
- B) (-2,0) only
- C) (2,0) and (-2,0)
- D) (4,0) and (-4,0)

Working space:

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## Part 3 of 3

**17c.  $y$  doubles every time  $x$  increases by 1. Type of graph:**

- A) Linear
- B) Quadratic
- C) Exponential
- D) Reciprocal

Working space:

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**Question 18****Ratios with Fractions**

◆◆◆ Hard

■ **Concept:** For fraction ratios: multiply by LCM to clear fractions. Cross-multiply:  $a/b = c/d \Rightarrow ad=bc$ . Mixed ratios: convert to same denominator.

■ **Example:** Solve  $x/3=(x+4)/7$ . Cross-multiply:  $7x=3x+12$ .  $4x=12$ .  $x=3$ .

## Part 1 of 3

**18a. Solve:  $x/5 = (x+6)/9$** 

- A)  $x=5.5$
- B)  $x=7.5$
- C)  $x=9$
- D)  $x=12$

Working space:

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## Part 2 of 3

**18b.  $2/3$  of a number is 18. Find  $3/4$  of that number:**

- A) 18
- B) 20
- C) 20.25
- D) 22.5

Working space:

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## Part 3 of 3

**18c. Express ratio  $(1/2):(3/4)$  as integers in simplest form:**

- A) 1:3
- B) 2:3
- C) 3:4
- D) 4:6

Working space:

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**Question 19****Graph Transformations**

◆◆◆ Hard

■ **Concept:**  $y=f(x)+a$ : shift UP a.  $y=f(x-a)$ : shift RIGHT a.  $y=-f(x)$ : reflect in x-axis.  $y=af(x)$ : vertical stretch by factor a. Note direction carefully!

■ **Example:**  $y=(x-3)^2+1$ : parabola shifted right 3 and up 1.

**Part 1 of 3**

**19a.  $y=x^2$  shifted 4 right and 3 down. New equation:**

- A)  $y=(x+4)^2-3$
- B)  $y=(x-4)^2-3$
- C)  $y=(x-4)^2+3$
- D)  $y=(x+4)^2+3$

Working space:

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**Part 2 of 3**

**19b.  $y=f(x)$  passes through (2,5).  $y=f(x+3)$  passes through:**

- A) (5,5)
- B) (-1,5)
- C) (2,8)
- D) (2,2)

Working space:

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**Part 3 of 3**

**19c.  $y=f(x)$  through (3,6). Through which point does  $y=2f(x)$  pass?**

- A) (6,6)
- B) (3,12)
- C) (3,3)
- D) (6,12)

Working space:

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**Question 20****Mixed Challenge**

◆◆◆ Hard

■ **Concept:** Combine multiple concepts: ratio equations, gradient as rate, proportionality in context. Always: define variables, check units, verify answer.

■ **Example:** Real IB: identify problem type, set up correct formula, solve, verify.

**Part 1 of 3**

**20a. Recipe: flour:sugar=5:2. 350g flour. Sugar needed:**

- A) 100g
- B) 120g
- C) 140g
- D) 160g

Working space:

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**Part 2 of 3**

**20b. Line through (0,5) and (4,13). Which point is also on the line?**

- A) (2,8)
- B) (6,17)
- C) (3,11)
- D) (5,15)

Working space:

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**Part 3 of 3**

**20c. P and Q inversely proportional. P=8,Q=15. Find P when Q=24:**

- A) 4
- B) 5
- C) 6
- D) 7.5

Working space:

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**Answer Key**

Q	Part 1	Part 2	Part 3	Topic
1	A) 2:3	B) 5:8	B) 12:20	Ratio Simplification
2	A) \$60 and \$140	C) 120	B) 10cm	Dividing in a Ratio
3	C) 35	C) 320km	C) 55	Direct Proportion
4	B) 4	B) 90mph	B) 4	Inverse Proportion
5	B) 2	A) -5	B) Gradient -4	Gradient of a Line
6	B) $y=4x-2$	B) $y=3x+2$	C) -3	$y = mx + c$
7	B) $-4/3$	A) $y=5x+7$	C) 3	Parallel & Perpendicular Lines
8	C) 10	B) (3,1)	B) (8,-1)	Distance & Midpoint
9	B) Straight line through origin	B) (4,6)	C) 20	Graphs of Proportional Relationships
10	C) (3,0)	C) 0	C) Sped up	Reading & Interpreting Graphs
11	B) 2km	C) 19cm	C) 16m	Scale & Map Problems
12	C) 15	C) Cost per item	B) 4	Rate of Change
13	B) 40	C) 28	B) 2:3	Algebraic Ratio Problems
14	C) €42	C) 20km	B) 35 miles	Conversion Graphs
15	B) B (lower unit price)	B) \$50.40	B) Juice B (\$1.70/L)	Best Buy Problems
16	C) 25%	B) \$80.00	B) -4%	Percentage Change & Ratio
17	B) $y=3x-7$	C) (2,0) and (-2,0)	C) Exponential	Linear vs Non-linear Graphs
18	B) $x=7.5$	C) 20.25	B) 2:3	Ratios with Fractions
19	B) $y=(x-4)^2-3$	B) (-1,5)	B) (3,12)	Graph Transformations
20	C) 140g	C) (3,11)	B) 5	Mixed Challenge

*Explanation key is available in the interactive HTML version ([ib\\_math\\_ratio\\_graph.html](#))*