

# IB Mathematics — Year 6–7

Ratios, Proportions & Graphs · 20 Past-Exam Style Questions · Print & Practice

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_/20

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## Question 1 | Ratio Basics | Medium

*Concept: A ratio  $a:b$  can be simplified by dividing both parts by their GCD. Key: units must match.*

*Example: Simplify  $36:48 \rightarrow \text{GCD}=12 \rightarrow 3:4$*

Simplify the ratio 72 : 120.

### Step 1: What is the GCD of 72 and 120?

- A) 12
- B) 24
- C) 6
- D) 18

Working / Notes:

### Step 2: After dividing both by GCD, which simplified ratio do you get?

- A) 6:10
- B) 3:5
- C) 4:7
- D) 5:8

Working / Notes:

### Step 3: If a class has boys:girls = 3:5 and there are 24 boys, how many girls?

- A) 36
- B) 40
- C) 45
- D) 32

Working / Notes:

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## Question 2 | Direct Proportion | Medium

*Concept:  $y = kx$  where  $k = y/x$ . Graph: straight line through origin.*

*Example:  $y=15$  when  $x=3 \rightarrow k=5$ .  $y=5x$ . When  $x=7$ :  $y=35$*

$x$  and  $y$  are in direct proportion. When  $x = 4$ ,  $y = 14$ . Find  $y$  when  $x = 10$ .

### Step 1: What is the constant $k = y/x$ ?

- A) 3.5
- B) 4
- C) 2.5
- D) 5

Working / Notes:

**Step 2: Find y when x = 10.**

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

Working / Notes:

**Step 3: Which graph shape represents direct proportion?**

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

Working / Notes:

### Question 3 | Inverse Proportion | Hard

*Concept:  $y = k/x$ , so  $xy = \text{constant}$ . Graph: hyperbola.*

*Example:  $y \propto 1/x$ .  $x=6, y=8 \rightarrow k=48$ . When  $x=12$ :  $y=4$*

6 workers take 20 days to finish a project. How many days for 8 workers?

**Step 1: What is the constant  $k = \text{workers} \times \text{days}$ ?**

- A) 100
- B) 120
- C) 96
- D) 160

Working / Notes:

**Step 2: Using  $\text{days} = k/\text{workers}$ , find days for 8 workers.**

- A) 12
- B) 15
- C) 16

D) 18

Working / Notes:

**Step 3: Which graph shape represents  $y = k/x$ ?**

- A) Straight line through origin
- B) Parabola
- C) Hyperbola
- D) Circle

Working / Notes:

**Question 4 | Ratio Division | Medium**

*Concept: Divide a quantity in ratio  $a:b:c \rightarrow$  total parts =  $a+b+c \rightarrow$  one part =  $total \div (a+b+c)$ .*

*Example: Divide £240 in 3:5  $\rightarrow$  8 parts, each £30  $\rightarrow$  shares £90 and £150*

Three friends share \$360 in the ratio 2:3:4. How much does the largest share holder receive?

**Step 1: Total number of parts?**

- A) 7
- B) 8
- C) 9
- D) 10

Working / Notes:

**Step 2: Value of one part?**

- A) \$30
- B) \$36
- C) \$40
- D) \$45

Working / Notes:

**Step 3: Largest share (4 parts)?**

- A) \$120
- B) \$144
- C) \$160
- D) \$108

Working / Notes:

**Question 5 | Gradient &  $y = mx + c$  | Hard**

Concept:  $m = (y_2 - y_1) / (x_2 - x_1)$ . In  $y = mx + c$ ,  $m = \text{gradient}$ ,  $c = \text{y-intercept}$ .

Example: Through  $(1, 3)$  and  $(4, 12)$ :  $m = 9/3 = 3$

A line passes through  $(2, 5)$  and  $(6, 13)$ . Find the equation of the line.

**Step 1: What is the gradient?**

- A) 1.5
- B) 2
- C) 2.5
- D) 3

Working / Notes:

**Step 2: Using  $y = 2x + c$  and point  $(2, 5)$ , find  $c$ .**

- A)  $c = 0$
- B)  $c = 1$
- C)  $c = 2$
- D)  $c = 3$

Working / Notes:

**Step 3: Complete equation of the line?**

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

Working / Notes:

**Question 6 | Percentage & Ratio | Medium**

Concept:  $a / (a + b + c) \times 100\%$  converts ratio part to percentage.

Example: Boys:girls = 2:3 in class of 30  $\rightarrow$  Boys = 12  $\rightarrow$  40%

Concrete mix uses cement:sand:gravel = 1:3:5. What % is sand?

**Step 1: Fraction of mixture that is sand?**

- A)  $1/9$
- B)  $3/9$

- C)  $\frac{5}{9}$
- D)  $\frac{3}{5}$

Working / Notes:

**Step 2: Convert to percentage.**

- A) 30%
- B) 33.3%
- C) 37.5%
- D) 33%

Working / Notes:

**Step 3: If total mixture = 270 kg, how many kg is cement?**

- A) 27 kg
- B) 30 kg
- C) 54 kg
- D) 45 kg

Working / Notes:

### Question 7 | Distance-Time Graphs | Hard

*Concept: Gradient = speed. Horizontal line = stationary. Negative slope = returning.*

*Example: 120 km in 2 hours  $\rightarrow$  speed = 60 km/h*

A cyclist travels 30 km in 1.5 h, rests 0.5 h, returns 30 km in 2 h. What is the return speed?

**Step 1: A horizontal segment on a d-t graph represents?**

- A) Constant speed
- B) Acceleration
- C) Stationary (rest)
- D) Deceleration

Working / Notes:

**Step 2: Return journey speed?**

- A) 10 km/h
- B) 12 km/h
- C) 15 km/h
- D) 20 km/h

Working / Notes:

**Step 3: Average speed for entire 4-hour journey (60 km total)?**

- A) 12 km/h
- B) 15 km/h
- C) 7.5 km/h
- D) 20 km/h

Working / Notes:

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**Question 8 | Exchange Rates & Ratio | Medium**

*Concept: Exchange rates are proportion problems. Use unitary method: find value of 1, then scale.*

*Example: £1 = € 1.15. Convert £350: € 350 × 1.15 = € 402.50*

Rate: £1=\$1.32. Emma converts £450, spends \$250, converts rest back. How much does she get?

**Step 1: Dollars after conversion of £450?**

- A) \$594
- B) \$580
- C) \$600
- D) \$612

Working / Notes:

**Step 2: Dollars remaining after spending \$250?**

- A) \$334
- B) \$344
- C) \$350
- D) \$340

Working / Notes:

**Step 3: Converting \$344 back to £ (at £1=\$1.32)?**

- A) £260.61
- B) £254.23
- C) £245.00
- D) £280.00

Working / Notes:

**Question 9 | Quadratic Graphs | Hard**

Concept:  $y = ax^2 + bx + c$ . If  $a > 0$ : opens up (min). Roots where  $y=0$ . Vertex  $x = (r_1+r_2)/2$ .

Example:  $y = x^2 - 5x + 6$ : roots  $x=2,3$ . Vertex  $x=2.5$

For  $y = x^2 - 4x - 5$ , find the roots and the x-coordinate of the vertex.

**Step 1: Which factored form is correct?**

- A)  $(x-5)(x+1)$
- B)  $(x+5)(x-1)$
- C)  $(x-5)(x-1)$
- D)  $(x+5)(x+1)$

Working / Notes:

**Step 2: Roots (x-intercepts)?**

- A)  $x=5$  and  $x=-1$
- B)  $x=-5$  and  $x=1$
- C)  $x=5$  and  $x=1$
- D)  $x=-5$  and  $x=-1$

Working / Notes:

**Step 3: x-coordinate of the vertex?**

- A)  $x=2.5$
- B)  $x=2$
- C)  $x=-2$
- D)  $x=3$

Working / Notes:

**Question 10 | Scale & Map Ratios | Medium**

Concept: Scale  $1:n$  means 1 unit on map =  $n$  units in real life. Convert carefully ( $cm \rightarrow m \rightarrow km$ ).

Example: Scale  $1:25000$ . Map= $4\text{ cm} \rightarrow real = 100000\text{ cm} = 1\text{ km}$

Map scale  $1:80000$ . Two towns are  $6.5\text{ cm}$  apart on the map. Real distance in km?

**Step 1: Real distance in cm?**

- A)  $480,000\text{ cm}$
- B)  $520,000\text{ cm}$

- C) 560,000 cm
- D) 600,000 cm

Working / Notes:

**Step 2: Convert to metres.**

- A) 5,200 m
- B) 5,000 m
- C) 52,000 m
- D) 520 m

Working / Notes:

**Step 3: Convert to kilometres.**

- A) 52 km
- B) 5.2 km
- C) 0.52 km
- D) 520 km

Working / Notes:

**Question 11 | Speed-Time Graphs | Hard**

*Concept: Gradient = acceleration. Area under graph = distance. Rectangle + triangles for each phase.*

*Example: Trapezoid sides 4 and 8, height 20 m/s → Area =  $1/2(4+8) \times 20 = 120$  m*

Car: 0 to 30 m/s in 5 s, constant 30 m/s for 10 s, brakes to 0 in 6 s. Total distance?

**Step 1: Distance during acceleration (triangle: base=5, height=30)?**

- A) 60 m
- B) 75 m
- C) 90 m
- D) 150 m

Working / Notes:

**Step 2: Distance at constant speed (30 m/s × 10 s)?**

- A) 250 m
- B) 300 m
- C) 320 m
- D) 400 m

Working / Notes:

**Step 3: Total distance (all three phases)?**

- A) 435 m
- B) 450 m
- C) 465 m
- D) 480 m

Working / Notes:

**Question 12 | Proportion Equations | Hard**

*Concept:  $y$  proportional to  $x^2$ :  $y=kx^2$ . Find  $k$ , then solve for unknowns.*

*Example:  $y$  proportional  $x^2$ .  $y=45$  when  $x=3 \rightarrow k=5$ . When  $x=5$ :  $y=125$*

$y$  is proportional to  $x^2$ . When  $x=4$ ,  $y=48$ . Find  $x$  when  $y=75$ .

**Step 1: Find  $k$  in  $y = kx^2$ .**

- A)  $k=2$
- B)  $k=3$
- C)  $k=4$
- D)  $k=5$

Working / Notes:

**Step 2: Set up equation for  $y=75$ .**

- A)  $x^2=20$
- B)  $x^2=25$
- C)  $x^2=30$
- D)  $x^2=15$

Working / Notes:

**Step 3: Value of  $x$ ?**

- A)  $x=4$
- B)  $x=5$
- C)  $x=6$
- D)  $x=3$

Working / Notes:

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**Question 13 | Ratio in Geometry | Medium**

*Concept: Similar shapes: length scale factor  $k \rightarrow$  area scales  $k^2 \rightarrow$  volume scales  $k^3$ .*

*Example: Scale factor 3, area small=10  $\rightarrow$  area large =  $10 \times 9 = 90 \text{ cm}^2$*

Two similar cylinders have heights in ratio 2:5. Smaller volume =  $40 \text{ cm}^3$ . Find larger volume.

**Step 1: Scale factor of the heights?**

- A) 2
- B) 2.5
- C)  $\frac{5}{2}$
- D) 5

Working / Notes:

**Step 2: Volumes scale by? (scale factor cubed)**

- A)  $2.5^2$
- B)  $2.5^3$
- C) 2.5
- D)  $2.5^4$

Working / Notes:

**Step 3: Volume of the larger cylinder?**

- A)  $100 \text{ cm}^3$
- B)  $312.5 \text{ cm}^3$
- C)  $250 \text{ cm}^3$
- D)  $625 \text{ cm}^3$

Working / Notes:

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**Question 14 | Reading Graphs — Intercepts | Medium**

*Concept: x-intercept: set  $y=0$ . y-intercept: set  $x=0$ . For  $y=mx+c$ ,  $c$  is the y-intercept.*

*Example:  $3x+2y=12$ : y-intercept ( $x=0$ )  $\rightarrow y=6$ . x-intercept ( $y=0$ )  $\rightarrow x=4$*

Line:  $5x - 2y = 10$ . Find both intercepts and gradient.

**Step 1: y-intercept ( $x=0$ )?**

- A)  $y=5$
- B)  $y=-5$
- C)  $y=2$
- D)  $y=-2$

Working / Notes:

**Step 2: x-intercept (y=0)?**

- A)  $x=2$
- B)  $x=10$
- C)  $x=-2$
- D)  $x=5$

Working / Notes:

**Step 3: Gradient in  $y=mx+c$  form?**

- A)  $m=5$
- B)  $m=2.5$
- C)  $m=5/2$
- D) Both B and C

Working / Notes:

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**Question 15 | Ratio — Mixtures | Medium**

*Concept: Combine mixtures by calculating total amounts of each component, then simplify the new ratio.*

*Example: Mix 200 mL (3:1) + 300 mL (1:2) → juice:  $150+100=250$ , water:  $50+200=250$  → 1:1*

Alloy A: copper:zinc = 3:2. Alloy B: copper:zinc = 4:1. Equal masses mixed. New ratio Cu:Zn?

**Step 1: In 100g of Alloy A, copper = ?**

- A) 50 g
- B) 60 g
- C) 40 g
- D) 75 g

Working / Notes:

**Step 2: In 100g of Alloy B, copper = ?**

- A) 75 g
- B) 80 g
- C) 60 g
- D) 90 g

Working / Notes:

**Step 3: Total Cu=140g, Zn=60g → simplified ratio?**

- A) 7:3
- B) 14:6
- C) 3:7
- D) 2:1

Working / Notes:

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**Question 16 | Proportional Reasoning | Hard**

*Concept: Scale factor = new/old. Apply to all quantities. Cross-multiply for proportion equations.*

*Example: 5 apples = £1.80 → 1 apple = £0.36 → 8 apples = £2.88*

Recipe for 6 people: 450g flour, 3 eggs. How much flour and eggs for 10 people?

**Step 1: Scale factor from 6 to 10 people?**

- A) 1.5
- B) 5/3
- C) 2
- D) 4/3

Working / Notes:

**Step 2: Flour needed for 10 people?**

- A) 700 g
- B) 720 g
- C) 750 g
- D) 800 g

Working / Notes:

**Step 3: Eggs needed for 10 people?**

- A) 4 eggs
- B) 5 eggs
- C) 6 eggs
- D) Round up to 5

Working / Notes:

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**Question 17 | Parallel & Perpendicular Lines | Hard**

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

*Example: L:  $y=3x+2$ . Perpendicular gradient =  $-1/3$ . Through (0,4):  $y=-x/3+4$*

Line L:  $y=4x-3$ . Line M passes through (8,1) and is perpendicular to L. Find equation of M.

**Step 1: Gradient perpendicular to  $y=4x-3$ ?**

- A) 4
- B) -4
- C)  $1/4$
- D)  $-1/4$

Working / Notes:

**Step 2: Using gradient  $-1/4$  and point (8,1), find c.**

- A)  $c=2$
- B)  $c=3$
- C)  $c=4$
- D)  $c=5$

Working / Notes:

**Step 3: Equation of line M?**

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

Working / Notes:

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**Question 18 | Best Value & Ratio | Medium**

*Concept: Calculate price per unit (price  $\div$  quantity). Lowest unit price = best value.*

*Example: 500g for £1.20 vs 750g for £1.65  $\rightarrow$  £0.0024/g vs £0.0022/g  $\rightarrow$  B is better*

Juice: Small 330mL £0.89, Medium 500mL £1.29, Large 1.5L £3.49. Best value?

**Step 1: Price per 100 mL for Small?**

- A) £0.27
- B) £0.28
- C) £0.26
- D) £0.25

Working / Notes:

**Step 2: Price per 100 mL for Large (1500 mL)?**

- A) £0.23
- B) £0.24
- C) £0.25
- D) £0.22

Working / Notes:

**Step 3: Which gives BEST value?**

- A) Small £0.27/100mL
- B) Medium £0.258/100mL
- C) Large £0.233/100mL
- D) All equal

Working / Notes:

**Question 19 | Interpreting Real Graphs | Hard**

*Concept: Conversion graphs: gradient = conversion rate. Read values from axes carefully.*

*Example:  $C = (5/9)(F - 32)$ . At  $F = 32$ ,  $C = 0$ . Gradient =  $5/9$*

Conversion graph: miles to km, through origin. Point (5 miles, 8 km). How many km is 12.5 miles?

**Step 1: Gradient (km per mile)?**

- A) 1.5
- B) 1.6
- C) 1.8
- D) 2.0

Working / Notes:

**Step 2: Convert 12.5 miles to km.**

- A) 18 km
- B) 20 km
- C) 22 km
- D) 25 km

Working / Notes:

**Step 3: How many miles is 24 km?**

- A) 12 miles
- B) 15 miles
- C) 16 miles
- D) 18 miles

Working / Notes:

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**Question 20 | Compound Proportion | Hard**

*Concept: A varies jointly with B and C:  $A = k \times B \times C$ . Find k from known values, then apply.*

*Example: 3 workers  $\times$  4 days = £360  $\rightarrow$   $k=30$ . 5 workers  $\times$  6 days = £900*

Printing cost varies with number of flyers AND colours. 500 flyers, 2 colours = £40. Find cost for 800 flyers, 3 colours.

**Step 1: Find k from  $40 = k \times 500 \times 2$ .**

- A)  $k=0.04$
- B)  $k=0.04$  per flyer-colour
- C)  $k=4$
- D)  $k=0.04$  ( $=40/1000$ )

Working / Notes:

**Step 2: Cost for 800 flyers, 3 colours?**

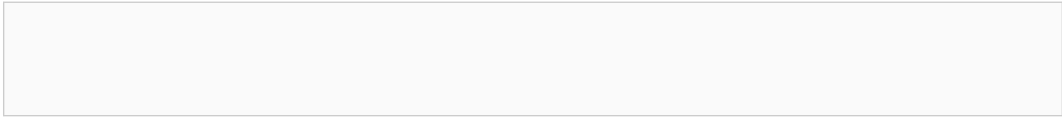
- A) £84
- B) £96
- C) £100
- D) £120

Working / Notes:

**Step 3: If flyers double (colours same), cost?**

- A) Same
- B) Doubles
- C) Triples
- D) Quadruples

Working / Notes:



## Answer Key

Q	Step 1	Step 2	Step 3
1	B	B	B
2	A	B	C
3	B	B	C
4	C	C	C
5	B	B	B
6	B	B	B
7	C	C	B
8	A	B	A
9	A	A	B
10	B	A	B
11	B	B	C
12	B	B	B
13	B	B	D
14	B	A	D
15	B	B	A
16	B	C	D
17	D	B	A
18	A	A	C
19	B	B	B
20	D	B	B