



Biomedical Admissions Test (BMAT)

Section 2: Mathematics Questions by Topic

M3: Ratio and Proportion

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M3: Ratio and Proportion - Questions by Topic

Mark scheme and explanations at the end

- 1 A professional golfer buys a golf putter for £24.00. Eight months later he sells it to his daughter for £16.00.

What is his percentage loss?

- A 5%
- B 25%
- C 33%
- D 50%
- E 75%

- 2 A bank increased the rate of simple interest from 3.5% to 4% per annum. Sarah deposited £5200 in the bank for 6 months at the new interest rate.

Find out how much more interest Sarah would receive than if she has deposited the money before the interest rate changed.

- A £104
- B £91
- C £208
- D £26
- E £13

- 3 Beatrice lent Eugene £4800 for 7 months. At the end of this period, Eugene had to pay Beatrice £119 as interest.

What was the rate of simple interest per annum?

- A 0.354%
- B 0.00354%
- C 4.25%
- D 0.0425%
- E 0.17%





- 4 Joanne invests £5000 at 2% rate of return compounded annually.

Find the total interest earned after 2 years.

- A £5202
- B £100
- C £5100
- D £202
- E £200

- 5 A developer is planning to build residential properties on a plot of land. His map is drawn to a scale of 1:160000. The area of the plot of land on the map is 10 cm^2 .

Calculate the real area of the plot of land, in square kilometres.

- A 256000
- B 2560
- C 2.56
- D 256
- E 25.6

- 6 Fiona just bought a motorbike for £8500. The bike depreciates by 40% each year.

How much will the bike be worth in 3 years time?

- A -£1700
- B £544
- C £1101.60
- D £1836
- E £3050.60

- 7 B varies with the cube of A . When $B = 12$, $A = 4$.

Find the value of A when $B = \frac{81}{16}$

- A 3
- B $\frac{27}{16}$
- C $\frac{64}{16}$
- D $\frac{3}{16}$





E 27

- 8 The time T in seconds it takes to boil water in a water tank is inversely proportional to the square root of the power P in watts (w) supplied to the water tank. When the power is 4 kilowatts, it takes 6 seconds to boil the water. Find the time taken to boil the water when the power is 2500 watts.

A $\frac{6}{25}$

B $30\sqrt{5}$

C $\frac{12}{5}\sqrt{10}$

D $\frac{23}{7}$

E $\frac{13}{7}$

- 9 Sam earned a gross total of £2460 last month from hiring out 3 different sized hoverboards to the public. Each board was hired out once only. From this, he (then) had to pay maintenance: he paid 10% of the cost of hire from the 1 person hoverboard, 20% of the cost of hire from the 2 person hoverboard, 30% of the cost of hire from the 3 person hoverboard. The 3 person hoverboard costs twice as much to hire as the 1 person hoverboard.

Given that the total cost of maintenance was £540, calculate the cost of hire for each hoverboard.

	1 person hoverboard	2 person hoverboard	3 person hoverboard
A	1020	480	2040
B	360	500	720
C	480	1020	960
D	400	1000	800
E	480	510	960

- 10 A sum of money was divided between Raj, Emme and John in the ratio 2:3:5. Emme's share was £13.50. What was the total sum of money?

A £45

B £67.50

C £27





- D £40.50
- E £90

- 11 Alexander mixes 800 g of cement with 2.8 kg of sand.

Express the ratio of cement to sand in its simplest form.

- A 20:7
- B 2000:7
- C 1:3.5
- D 7:2
- E 2:7

- 12 David bought some stamps for his collection. He bought them for £52 and sold them years later for £65.

Find the percentage increase in value.

- A 25 %
- B 13 %
- C 125 %
- D 20 %
- E 26 %

- 13 Tobias mixes together 300 g of material A and 75 g of material B.

Material A has a density of 20 g/cm^3

Material Y has a density of 15 g/cm^3

What is the density of the compound material?

- A 19 g/cm^3
- B 18 g/cm^3
- C 18.5 g/cm^3
- D 19.5 g/cm^3
- E 17 g/cm^3





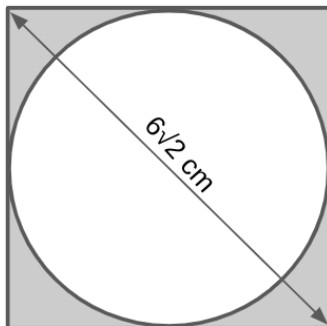
- 14 Isabella collected money for four different charities. The total amount collected was divided amongst the four charities, A, B, C and D, in the ratio

$$1 : \frac{1}{3} : \frac{3}{5} : \frac{1}{4}$$

Charity C received £36.

How much money did Isabella collect in total?

- A £144.00
B £131.00
C £147.00
D £114.40
E £134.00
- 15 A circular pizza fits exactly into a square pizza box, as shown in the diagram below.



The diagonal of the box measures $6\sqrt{2}$ cm long.

Express the area of the shaded regions as a fraction of the total box area.

- A $\frac{1-\pi}{36}$
B $1 - \pi$





C $\frac{12-\pi}{12}$

D $\frac{4-\pi}{4}$

E $\frac{1-\pi}{4}$

- 16 Alan and Heidi share some money in ratio 2 : 7. Heidi gets £28 more than Alan. How much does Alan receive?

A £11.20

B £39.20

C £50.40

D £5.60

E £8.00

- 17 The angles in a triangle are in the ratio 1 : 3 : 8.

What is the size of the largest angle?

A 115°

B 144°

C 120°

D 160°

E Not enough information

- 18 Suppose y is inversely proportional to x^2 , where $x < 0$. When $x = -4$, it is given that $y = 3$.

Calculate the value of x when $y = 8$.

A $x = 6$

B $x = \sqrt{6}$

C $x = \frac{-8\sqrt{6}}{3}$

D $x = -\sqrt{6}$

E $x = \frac{-8\sqrt{6}}{3}$

- 19 On Taylor's 12th birthday, he was 162 cm in height, having grown 8% since the year before.





How tall was Taylor on his 11th birthday?

- A 154 cm
- B 150 cm
- C 149 cm
- D 158 cm
- E 147 cm

- 20 The price of a laptop is reduced by 10%. In a sale, the new price is reduced by a further 10%.

By what percentage has the original price of the laptop been reduced in this sale?

- A 20%
- B 18%
- C 19%
- D 15%
- E 17.5%





Solutions

1 **C is the answer**

$$\text{Percentage change (\%)} = \frac{\text{'change'}}{\text{original}} \times 100$$

Calculate the **change**, i.e. the **loss** the golfer has made:

$$\text{change} = £24.00 - £16.00 = £8.00$$

Calculate the **percentage loss**:

$$\frac{\text{'loss'}}{\text{original}} \times 100 = \frac{8}{24} \times 100 = 33\%$$

D is incorrect because it divides the “change” by the new price rather than the original.

2 **E is the answer**

The question is asking for the additional interest Sarah will receive, so we have to calculate the **change in interest**.

Although the interest rate is given per annum, the time period the question is looking for is 6 months. The value to be substituted in for time would then be $\frac{6 \text{ months}}{12 \text{ months}} = \frac{1}{2}$ instead.

Interest at initial rate of 3.5% per annum

$$\begin{aligned} &= \frac{5200(3.5)(\frac{1}{2})}{100} \\ &= £91 \end{aligned}$$

Interest at new rate of 4% per annum

$$\begin{aligned} &= \frac{5200(4)(\frac{1}{2})}{100} \\ &= £104 \end{aligned}$$

Additional interest sarah will receive:

$$\begin{aligned} &= 104 - 91 \\ &= £13 \end{aligned}$$

A is incorrect because it is the total sum that would be in her bank account after 6 months at the 4% rate.

B is incorrect because it is the total sum that would be in her bank account after 6 months at the 3.5% rate.





C is incorrect because it is the total sum that would be in her bank account after 1 year at the 4% rate.

3 **C is the answer**

Let R be the rate of simple interest per annum.

$$\text{Using interest} = \frac{x_0 RT}{100},$$

$$119 = \frac{4800(R)(\frac{7}{12})}{100}$$

Rearrange to make R the subject:

$$R = 119 \div \frac{4800(\frac{7}{12})}{100} = 28 \quad \frac{4800(\frac{7}{12})}{100} \Rightarrow \frac{119}{28} = \frac{17}{4} = 4\frac{1}{4} = 4.25 \quad R = 119$$

The calculations can be simplified as shown

below:

Alternative method:

Interest for 7 months is £119. Therefore, interest

for 1 year is: £119

$$\times \frac{12}{7} = £204$$

$$\begin{array}{r} \times \quad 1 \quad 7 \\ \quad 1 \quad 2 \\ \hline \quad 3 \quad 4 \\ \quad 1 \quad 7 \\ \hline \quad 2 \quad 0 \quad 4 \end{array}$$

$$\begin{array}{r} 1 \quad 7 \\ 7 \overline{) 1 \quad 1 \quad 9} \\ \underline{7} \\ 4 \quad 9 \\ \underline{4 \quad 9} \\ 0 \end{array}$$

As interest rate is a percentage of the initial value/deposit, the interest rate is

$$\frac{£204}{£4800} \times 100\% = 0.0425 \times 100\% = 4.25\%$$

$$\text{Simplify } \frac{204}{4800} = \frac{102}{2400} = \frac{51}{1200} = \frac{17}{400}$$

$$\begin{array}{r} 0. \quad 0 \quad 4 \quad 2 \quad 5 \\ 4 \quad 0 \quad 0 \overline{) 1 \quad 7 \quad 0 \quad 0} \\ \underline{1 \quad 6 \quad 0 \quad 0} \\ 1 \quad 0 \quad 0 \quad 0 \\ \underline{8 \quad 0 \quad 0} \\ 2 \quad 0 \quad 0 \quad 0 \\ \underline{2 \quad 0 \quad 0 \quad 0} \\ 0 \end{array}$$



D is incorrect because it is the correct value in decimal form, not percentage form. $4.25\% = 0.0425$

Total interest earned after 2 years

= £202

[illegible]

B is incorrect because it is the total simple interest after 1 year.

$$\frac{PRT}{100} = \frac{5000(2)(1)}{100} = 100$$

E is incorrect because it is the total simple interest after 2 years.

$$\frac{PRT}{100} = \frac{5000(2)(2)}{100} = 200$$

The given scale is 1:160000. This means that 1 unit on is 160000 units in real-life size.

	1.	6
×	1.	6
	9	6
1	6	
2.	5	6

the map

The question is looking at an **area** which requires the **ratio to be squared**.



$$1 \text{ cm} : 1.6 \text{ km} \Rightarrow 1 \text{ cm}^2 : 2.56 \text{ km}^2$$

The question is looking for the real area of a plot of land given that the area of the plot of land drawn on the map is 10 cm^2 .

$$1 \text{ cm}^2 : 2.56 \text{ km}^2 \Rightarrow 10 \text{ cm}^2 : 25.6 \text{ km}^2$$

A is incorrect because the units were converted incorrectly: $1 \text{ km} = 1000 \text{ cm}$ was used instead of $1 \text{ km} = 100000 \text{ cm}$:

$$\begin{aligned} 1 \text{ cm} : 160000 \text{ cm} &\Rightarrow 1 \text{ cm} : 160 \text{ km} \text{ (wrong conversion)} \\ 1 \text{ cm} : 160 \text{ km} &\Rightarrow 1 \text{ cm}^2 : 25600 \text{ km}^2 \Rightarrow 10 \text{ cm}^2 : 256000 \text{ km}^2 \end{aligned}$$

C is incorrect.

$$1 : 160000 \Rightarrow 1 \text{ cm} : 1.6 \text{ km} \Rightarrow 1 \text{ cm}^2 : 2.56 \text{ km}^2$$

The answer option of 2.56 will be obtained if working is stopped here and the ratio is not scaled up to 10 cm^2 .

D is incorrect because the operations were performed in the wrong order. The units were multiplied by 10 before incorrectly squaring only the kilometre value:

$$\begin{aligned} 1 \text{ cm} : 160000 \text{ cm} &\Rightarrow 1 \text{ cm} : 1.6 \text{ km} \\ 1 \text{ cm} : 1.6 \text{ km} &\Rightarrow 10 \text{ cm} : 16 \text{ km} \end{aligned}$$

Final incorrect conversion as the same operation has not been applied to both sides:
 $\Rightarrow 10 \text{ cm}^2 : 256 \text{ km}^2$

6 D is the answer

$$N = N_0(1+r/100)^n$$

where N = Amount in n days/years

N_0 = Initial amount

n = Number of days/years

$r/100$ = % change per day/year

This is the formula for compound growth and decay. You must know this formula to answer this type of question. It is important to note that if the percentage change is a decrease, it'll be $N = N_0(1-r/100)^n$

$$\begin{aligned} N &= £8500 (1-40/100)^3 \\ N &= £8500 (1-0.4)^3 \\ &= £8500 (0.6)^3 \end{aligned}$$





To calculate $(0.6)^3$ break it into stages. First calculate 0.6×0.6 and then multiply the answer by 0.6 again.

Exam Tip - To multiply decimals, ignore the decimal points and multiply the numbers as if they are whole numbers. You then add the decimal point back into the answer by starting at the right and moving the point the number of places equal to the sum of the decimal places in the numbers multiplied.

$$(0.6)^3 = 0.36 \times 0.6 = 0.216$$

$$N = £8500 \times 0.216$$

$$N = \text{£}1836$$

A is incorrect. This answer has been reached by calculating the simple decay, not compound decay. Compound decay must be calculated since the question says the bike depreciates in value by 40% each year.

B is incorrect. This answer has been reached by calculating 40% of £8500 in year 1 to reach £3400, followed by 40% of £3400 to reach £1360 in year 2 followed by 40% of £1360 in year 3 to reach £544. This is incorrect because it is simply working out how much the value of the 40% depreciation is, NOT the value of the bike itself following the depreciation.

7

A is the answer

The key to solving this question is to be able to identify that “ B varies with the cube of A ” is another way of saying “ B is directly proportional to the cube of A ”. This then becomes a **proportion** question.

Convert the sentence given in the question into a statement of proportionality:

$$B \propto A^3$$

Replace \propto with ‘ $=k$ ’ to form an equation. ‘ k ’ represents an **unknown constant**. Since this question refers to **direct proportion**, the generic equation is $y = kx$. If this question was about **inverse proportion** the generic equation would be $y = \frac{k}{x}$

$$B = kA^3$$

Use the given values of B and A (12 and 4) to find k :

$$12 = k4^3 \quad \Rightarrow 12 = 64k \quad \Rightarrow k = \frac{12}{64} \quad \Rightarrow k = \frac{3}{16}$$





Put the value of k back into the equation: $B = \frac{3}{16}A^3$

Use the equation to find the value of A when $B = \frac{81}{16}$

$$\frac{81}{16} = \frac{3}{16}A^3 \quad \Rightarrow 27 = A^3 \quad \Rightarrow A = 3$$

Exam Tip - The phrase "varies with" is a phrase you need to know refers to direct proportionality and the equation it corresponds to.

8

C is the answer

This is an **inverse proportion** question.

Convert the information given in the question into a proportionality: $T \propto \frac{1}{\sqrt{P}}$

Replace \propto with ' $= k$ ' to form an equation. ' k ' represents an unknown constant.
Because this question refers to **inverse direct proportion** the generic equation is:

$$y = \frac{k}{x}$$

If this question was about **direct proportion** the generic equation would be $y = kx$.

$$T = \frac{k}{\sqrt{P}}$$

Use the given values of T and P (6 seconds and 4 kilowatts) to find k . You must identify that the power P is measured in **watts** in the equation, yet the value is provided to you in kilowatts. Before substituting the values for T and P into the equation, convert 4 kilowatts into watts.

$$4\text{kw} = 4000\text{w}$$

$$6 = \frac{k}{\sqrt{4000}} \Rightarrow 6 = \frac{k}{\sqrt{400} \times \sqrt{10}} \Rightarrow 6 = \frac{k}{20\sqrt{10}} \Rightarrow k = 120\sqrt{10}$$

You are not expected to know the square root of 4000. However you should be able to manipulate surds to simplify the surd down to $20\sqrt{10}$. Simplifying $\sqrt{4000}$ to $20\sqrt{10}$ will make the rest of the calculation easier for you.

Put the value of k back into the equation: $T = \frac{120\sqrt{10}}{\sqrt{P}}$





Use the equation to find the value of T when $P = 2500 \text{ watts}$

$$T = \frac{120\sqrt{10}}{\sqrt{2500}} \Rightarrow T = \frac{120\sqrt{10}}{\sqrt{25 \times 100}} \Rightarrow T = \frac{120\sqrt{10}}{5 \times 10} \Rightarrow T = \frac{120\sqrt{10}}{50}$$

Simplifying this gives: $T = \frac{12}{5}\sqrt{10}$

A is incorrect because the power of 4 kilowatts has not been converted into watts.

The $\sqrt{4}$ has been used to work out the value of k instead of $\sqrt{4000}$ as required.

B is incorrect because the equation has been set up for direct proportion i.e $y = kx$ when this question is about inverse proportion.

9

C is the answer

Let x , y , and z represent the cost of hire for the 1 person, 2 person and 3 person hoverboards, respectively. Three different equations can now be written:

- One equation for the cost of hire
- One equation for the maintenance cost
- One equation for the statement that the 3 person hoverboard costs twice as much as the 1 person hoverboard

$$x + y + z = 2460 \quad (1)$$

$$0.1x + 0.2y + 0.3z = 540 \quad (2)$$

$$z = 2x \quad (3)$$

Equation (2) shows the % of the cost of hire of each hoverboard that has been paid towards maintenance, to reach the total maintenance cost of £540.

Now we need to solve the above equations to find values for x and y . You can make this question slightly easier for yourself by realising that equation (3) is a very easy one to work with, making z the easiest to eliminate.

Substitute $z = 2x$ into equations (1) and (2) to eliminate z .

$$\begin{aligned} x + y + 2x &= 2460 \\ \Rightarrow 3x + y &= 2460 \quad (4) \end{aligned}$$

$$0.1x + 0.2y + 0.3(2x) = 540 \Rightarrow 0.7x + 0.2y = 540 \quad (5)$$

Now we need to solve equations (4) and (5) **simultaneously**. There are multiple ways to do this. We have outlined two possible methods below:





Method 1

Rearrange (4): $y = 2460 - 3x$

Substitute (4) into (5):

$$\begin{aligned} 0.7x + 0.2(2460 - 3x) &= 540 \\ \Rightarrow 0.7x + 492 - 0.6x &= 540 \\ \Rightarrow 0.1x = 58 &\Rightarrow x = 580 \end{aligned}$$

Substitute $x = 580$ into the equation

$y = 2460 - 3x$ to find y :

$$\begin{aligned} y &= 2460 - 3(580) \\ y &= 2460 - 1740 \\ y &= 720 \end{aligned}$$

Finally, find the value of z by substituting the value for x into $z = 2x$:

$$\begin{aligned} z &= 2(580) \Rightarrow z = 1160 \\ \Rightarrow x &= 580, y = 720, z = 1160(\mathbf{C}) \end{aligned}$$

Method 2

Multiply both sides of equation (5) by 5 so you can subtract equation (4) from it:

$$\begin{aligned} 0.7x + 0.2y &= 540 \\ \Rightarrow 3.5x + y &= 2700 \quad (6) \end{aligned}$$

Calculate (6)-(4):

$$\begin{aligned} 3.5x + y &= 2700 \\ - \quad 3x + y &= 2460 \\ \hline \Rightarrow 0.5x &= 240 \Rightarrow x = 480 \\ z &= 2(480) = 960 \end{aligned}$$

Rearrange equation (1):

$$\begin{aligned} x + y + z &= 2460 \Rightarrow \\ y &= 2460 - x - z = 2460 - 960 \\ &= 1500 \\ \Rightarrow x &= 480, y = 1500, z = 960(\mathbf{C}) \end{aligned}$$

Exam Tip - There are many ways to arrive at the correct answer. Even if you cannot recall a formula, stay **calm**, **reread** the question, **think** about what the question is telling and how you could work step by step to get to the answer.

10 A is the answer

Let x be the total sum of money.

Then dividing Emme's share by the total share, there exists the following relationship:

$$\frac{3}{2+3+5}(x) = 13.50$$

$$\frac{3}{10}(x) = 13.50$$

$$x = 13.50 \times \frac{10}{3} = 45$$

An **alternative method** is simply recognising that Emme's share is 3 'parts'. Divide £13.50 by 3 to get the value of 1 'part' as £4.50. As there is a total of 10 'parts', the total sum of money is £4.50 × 10 = £45.





B is incorrect because it uses the wrong ratio, taking Emme's share to be $\frac{2}{10}$ instead.

C is incorrect because it uses the wrong ratio, taking Emme's share to be $\frac{5}{10}$ instead.

11 **E is the answer**

Write down the ratio of cement to sand with their respective units:

Cement : Sand
800 g : 2.8 kg

Convert the ratio into one with **common units**. You can choose to make the common unit g or kg:

800 g : 2800 g

Simplify the ratio:

800 g : 2800 g

$\Rightarrow 8 : 28$

$\Rightarrow 2 : 7$

A is incorrect because the units were converted wrongly. 2.8 kg was converted to 280 g instead. Remember that 1 kg = 1000 g!

B is incorrect because the units were not converted into common units. This results in the incorrect initial ratio to begin with.

C is incorrect because the ratio is not in its simplest form. The simplest form of a ratio must not involve fractions or decimals.

D is incorrect because it is the ratio of sand to cement instead.

12 **A is the answer**

As the question is asking for the percentage increase in value, we first need to find the **change** in value.

Identify the '**original value**' and its units:

'Original value' = £52

Identify the '**final value**' and its units. Change to have the same units as 'original value' if necessary.

'Final value' = £65





The question is looking for the 'percentage increase':

$$\% \text{ increase} = \frac{\text{change in value}}{\text{'original value'}} \times 100\% = \frac{\text{'original value'} - \text{'final value'}}{\text{'original value'}} \times 100\%$$

$$\Rightarrow \% \text{ increase} = \frac{£(65-52)}{£52} \times 100\%$$

$$\Rightarrow \% \text{ increase} = \frac{13}{52} \times 100\%$$

$$\Rightarrow \% \text{ increase} = \frac{1}{4} \times 100\% = 25\%$$

B is incorrect because it simply takes the change in value as the percentage change.

C is incorrect because it uses $\frac{\text{new value}}{\text{original value}} \times 100\%$.

D is incorrect because it uses $\frac{\text{change}}{\text{new value}} \times 100\%$.

E is incorrect.

Exam Tip - You need to be able to easily recall the equation for percentage change!

$$\% \text{ change} = \frac{\text{'original value'} - \text{'final value'}}{\text{'original value'}} \times 100\%$$

13 **A is the answer**

Let X denote the compound material.

Calculate the total mass of the compound material X:

$$\text{Mass of material X} = 300 + 75 = 375 \text{ g}$$

Calculate the density of material X by multiplying each given density by the **proportion** of that material which is within the compound material:

$$\text{Density of material X} = (\text{Proportion of Material A in X} \times 20) + (\text{Proportion of Material B in X} \times 15)$$

$$\Rightarrow \text{Density of material X} = \left(\frac{300}{375} \times 20\right) + \left(\frac{75}{375}\right)$$

$$\Rightarrow \text{Density of material X} = \left(\frac{6000}{375}\right) + \left(\frac{1125}{375}\right)$$





$$\Rightarrow \text{Density of material X} = \frac{7125}{375}$$

$$\Rightarrow \text{Density of material X} = 19 \text{ g/cm}^3$$

Therefore, the compound material X has density **19 g/cm³**.

B is incorrect

C is incorrect

D is incorrect

E is incorrect

14 **B is the answer**

Charity C received £36. Divide this value by the ratio value for charity C:

$$36 \div \frac{3}{5} = 36 \times \frac{5}{3} = 60$$

Therefore, as $\frac{3}{5}$ units represents £36, we have found that 1 unit represents £60.

Calculate the sum of values in the ratio:

$$1 + \frac{1}{3} + \frac{3}{5} + \frac{1}{4} = \frac{60}{60} + \frac{20}{60} + \frac{36}{60} + \frac{15}{60} = \frac{131}{60}$$

Thus, there are $\frac{131}{60}$ units in the ratio in total. Multiply this value by the value for one unit to calculate the total amount raised for charity:

$$\text{Total raised} = \frac{131}{60} \times 60 = 131$$

Therefore, Isabella raised **£131** for charity.

A is incorrect

C is incorrect

D is incorrect

E is incorrect





15 D is the answer

The aim of this question is to work out the grey shaded area and express it as a fraction of the total area of the square box. To find this, we must work out the:

- area of square box ($A = a^2$)
- area of circle ($A = \pi r^2$)
- grey shaded area (area of square box - area of circle)

But to work out any of these areas, we must first find the length of the square (denote this a) and we do this as follows:

$$\sqrt{2}a = d \text{ (where } d \text{ is the diagonal length)}$$

$$\Rightarrow \sqrt{2}a = 6\sqrt{2} \Rightarrow a = 6\text{cm.}$$

Then we can work out our areas:

Square: $A = a^2 = 6 * 6 = 36\text{cm}^2$

Circle: $A = \pi r^2 = \left(\frac{6}{2}\right)^2 \pi = 9\pi$

Grey shaded area: $A = 36 - 9\pi$

Now, all that's left to do is work out the area of the grey shaded regions as a fraction of the total box area, which is

$$A = \frac{36-9\pi}{36} = 1 - \frac{\pi}{4} = \frac{4-\pi}{4}$$

Therefore, we conclude that the area of the shaded regions as a fraction of the total box area will be $\frac{4-\pi}{4}$, hence the correct answer is **D**.

16 A is the answer

Here, we use trial and error, along with our knowledge of ratios to come to the correct answer.





Alan and Heidi share some money in ratio 2 : 7, which means that for every £2 that Alan has, Heidi will have £7.

This means that if Alan has $£x$ then Heidi will have $£\frac{7}{2}x$. So, we can set up the following table, and multiple each multiple choice option by $\frac{7}{2}$ and then see if there is a £28 different between $£x$ and $£\frac{7}{2}x$.

Alan's Amount ($£x$)(£)	Heidi's Amount ($£\frac{7}{2}x$) (£)	Difference (£)
11.20	39.20	28
39.20	137.20	98
50.40	176.40	126
5.60	19.60	14
8.00	28	20

Therefore, we conclude that the correct answer is **A**.

17 C is the answer

Here, we are given the ratio of three angles in a triangle. We know that the three angles in a triangle must add up to 180° .

Therefore, we can add the numbers given in the ratio, and divide this number by 180.

Therefore, $8 + 3 + 1 = 12$, and $\frac{180}{12} = 15$. Therefore each ratio of *one* is *worth* 15° .

We can then work out the size of each angle as follows:

$$\begin{array}{lll} 1 * 15 = 15^\circ & \text{and} & 3 * 15 = 45^\circ \\ 8 * 15 = 120^\circ & & \text{and} \end{array}$$

Therefore, the largest angle in the triangle is 120° and **C** is the correct answer.

Note that, we can check if our logic is correct, and add these three angles. We expect them to add to 180° , and they do since $120^\circ + 45^\circ + 15^\circ = 180^\circ$.





18 **D is the answer**

We know that y is proportional to $\frac{1}{x^2}$, and we can write this as $y = \frac{k}{x^2}$ where k is a proportional constant.

The next step will be to work out our k value using the information we are given, before going onto answer the question.

When $x = -4$ and $y = 3$, we have that

$$3 = \frac{k}{(-4)^2} = \frac{k}{16}$$
$$\Rightarrow k = 48.$$

Now that we have solved for k , we can work out what the value of x will be when $y = 8$.

$$y = \frac{48}{x^2} \Rightarrow 8x^2 = 48 \Rightarrow x^2 = \frac{48}{8} \Rightarrow x = + / - \sqrt{6}.$$

Since we were told $x < 0$ $x = -\sqrt{6}$.

Therefore, the correct answer is **D**.

19 **B is the answer**

Here, we are given the height of Taylor, and the percentage that their height has increased in a year, and we want to carry out a **reverse percentage calculation**, to work out their height one year ago. We can do this using the following formula:

$$\text{Original Value} = \text{New Value} / \text{Change}$$

$$\Rightarrow \text{Original Value} = \frac{162}{1.08} = 150$$

Therefore, we conclude that Taylor was 150cm tall on his 11th Birthday, and thus the correct answer is **B**.

20 **C is the answer**

In this question, we are told the price of a laptop is reduced by 10%, and then the **new price** is then **reduced again** by a **further 10%**.





Let the laptop cost £100, then after the first price reduction, the laptop will cost $£100 * 0.90 = £90$.

The price of the laptop then reduces further, by 10%, from the new price (£90). This means that the price of the laptop after the second reduction will be $£90 * 0.90 = £81$.

Overall, the laptop has changed from £100 to £81, and we can work out the percentage change by doing $(1 - \frac{81}{100}) * 100 = 19\%$.

Therefore, the laptop has reduced in price by **19%**, hence **C** is the correct answer.

A is incorrect because it simply add the two 10%'s together, which is incorrect, as we must take into account that the second 10% is a **further reduction** from the already reduced price.

