Maths Problem Solving Starters

Levels 2 – 4

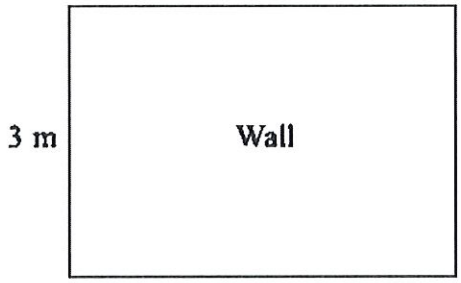
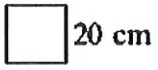
Name: Worked solutions.

Class: _____

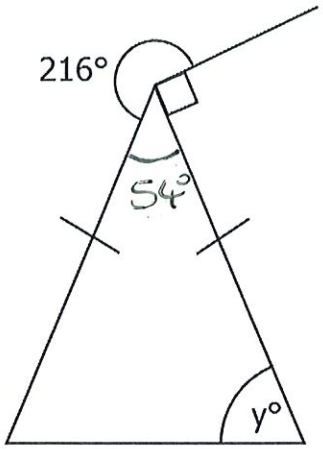
Teacher: _____

Remember:

- You will need: pen, pencil, rubber and a ruler.
- Check your work carefully.
- Show all of your working out, with clear steps.

1.	Rani has 160 DVDs. • 35% of her DVDs are thrillers. • $\frac{2}{5}$ of her DVDs are comedies. • The rest of her DVDs are science fiction. How many science fiction DVDs does Rani have? 35% of 160 30% = 48 5% = 8 + 56 thrillers (1) $\frac{2}{5}$ of 160 = 2 × 32 = 64 comedies (1) 160 − (56 + 64) = 40 (1) (1) 40	/ 4
2.	Here is a diagram of a wall. Diagram NOT accurately drawn   Tile Alison wants to cover all of the wall with tiles. The tiles are squares with sides of length 20 cm. The tiles are sold in packs. There are 10 tiles in each pack. Each pack of tiles costs £35. Alison only has £1000. Can she buy enough packs of tiles to cover the wall? 3m ÷ 20cm = 15 tiles (1) 4m ÷ 20cm = 20 tiles (1) 15 × 20 = 300 tiles needed. (1) 300 ÷ 10 = 30 packs. (1) 30 × £35 = £1050 needed. (1) Alison does not have enough. (1)	/ 6

3. Work out the value of y.
Give reasons for your answer.



54° because angles around a point sum to 360°. (1)

$y = \frac{180 - 54}{2} = 63°$ (1)

because angles in a triangle sum to 180° and isosceles triangles have two equal angles. (1)

/ 4

4. Samantha wants to buy a new pair of trainers. There are 3 shops that sell the trainers she wants.

Sports '4' All	**Edexcel Sports**	**Keef's Sports**
Trainers £5 **plus** 12 payments of £4.50	Trainers $\frac{1}{5}$ off usual price of £70	Trainers £50 **plus** VAT at 20%

From which shop should Samantha buy her trainers to get the best deal? You must show all of your working.

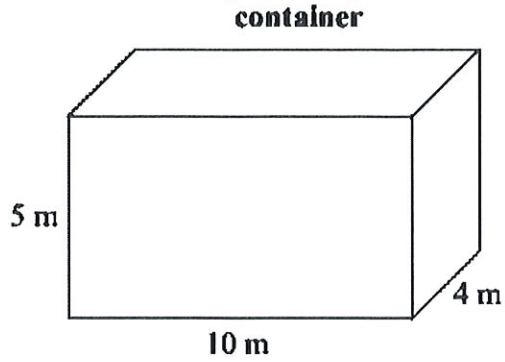
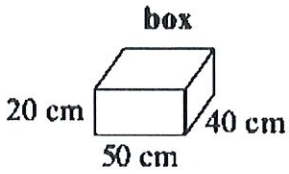
12 × £4.50
+ £5
= £54 + £5
= £59 (1)

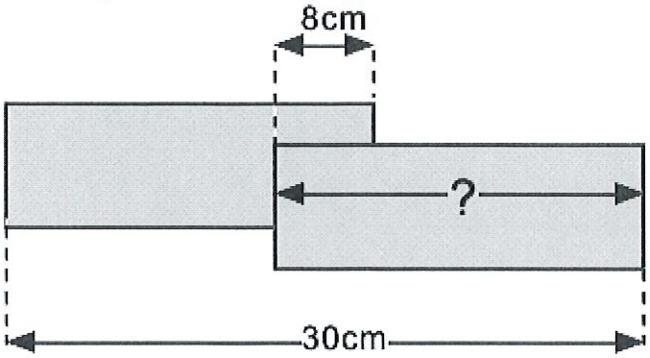
$\frac{1}{5}$ of £70
= £14
£70 − £14 = £56 (1)

20% of £50
= £10 (1)
£50 + £10 = £60 (1)

Samantha should buy her trainers from Edexcel Sports. (1)

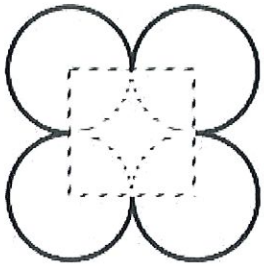
/ 5

5.	Marc drives a truck. The truck pulls a container. The container is a cuboid 10 m by 4 m by 5 m.   Marc fills the container with boxes. Each box is a cuboid 50 cm by 40 cm by 20 cm. Show that Marc can put no more than 5000 boxes into the container. 5m ÷ 20cm = 25 boxes (1) 10m ÷ 50cm = 20 boxes (1) 4m ÷ 40cm = 10 boxes (1) 25 × 20 × 10 = 5000 boxes. (1)	/ 4
6.	A hotel charges £50 for a room for a single person per night and then £10 extra for each additional person per night. A large family takes two rooms for a night and is charged £150 in total for the two rooms. How many people are there in the family? £150 − (2 × £50) = £50 (1) £50 ÷ £10 = 5 extra people. (1) 2 + 5 = 7 people. (1) 7	/ 3

7.	Two identical rectangular tiles are arranged to overlap each other by 8cm. The length of the whole arrangement is 30cm.  *not drawn to scale* Work out the length of a tile. $\frac{30-8}{2} + 8 = 19$ (1) (1) (1) 19 cm	/ 3
8.	At a concert, the ratio of adults to children is 2 : 3. There are 786 children in the audience. An adult ticket costs twice as much as a child ticket. The total box office takings for the concert are £11921. Work out the cost of an adult ticket. $786 \div 3 \times 2 = 524$ adults (1) $524 \times 2c + 786 \times c = 11921$ (1) $1834c = 11921$ (1) $c = 6.5$ (1) $2c = 13$ (1) £ 13	/ 5
9.	Ann and Bob shared £240 in the ratio 3 : 5. Ann gave a half of her share to Colin. Bob gave a tenth of his share to Colin. What fraction of the £240 did Colin receive? £240 ÷ 8 × 3 = £90 £240 ÷ 8 × 5 = £150 (1) £90 ÷ 2 = £45 $\frac{1}{10}$ of £150 = £15 (1) £45 + £15 = £60 (1) $\frac{60}{240} = \frac{1}{4}$ (1) $\frac{1}{4}$	/ 4

10.

The circumference of this circle is 24cm. Four of these circles are put together to make this shape. The centres of the circles are at the vertices of a square. What is the perimeter of the shape?



$\frac{3}{4}$ of 24 = 18 (1)

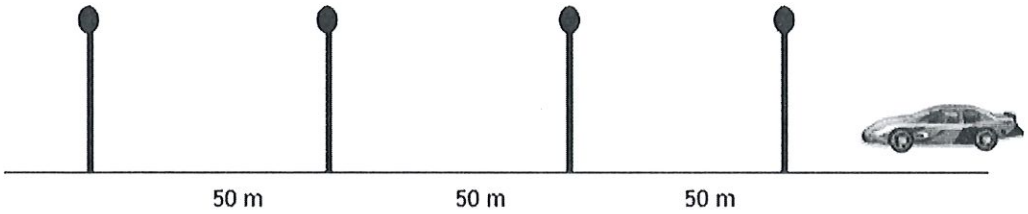
18 × 4 = 72 (1)

72 cm

/ 2

11.

Roger lives in the village of Hawkshaw. He wants to find out if cars break the speed limit through the village.



Roger times each car as it goes between four lampposts. The distance between each lamppost is 50 m. The speed limit through the village is 30 mph. The first car Roger times takes 12 seconds to go between the four lampposts. Is this car breaking the speed limit? You must show all of your working.

30 mph ≈ 48 km/h (1)

4 lamposts = 150m

$S = \frac{D}{T} = \frac{150}{12}$ = 12.5 m/s (1) (1)

12.5 × 3600 ÷ 1000 = 45 km/h (1)

The car is not breaking the speed limit. (1)

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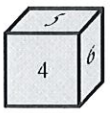
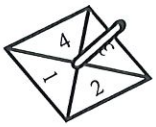
12. A village fair has stalls to raise money for charity. On one stall there is a game where you roll a 6-sided dice and spin a 4-sided spinner.

- The dice is labelled 1, 2, 3, 4, 5, 6
- The spinner is labelled 1, 2, 3, 4





The score on the dice and the score on the spinner are added to get the total score. The table shows some of the possible total scores.

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10

(a) Complete the table of possible total scores.

People pay 50p to play the game. The prizes are:

- £1 for a total score of 7 or 8
- £2 for a total score of 9 or 10

During one day of the fair, exactly 360 people played the game.

(b) Did the stall make a profit or a loss on this day? You must fully explain your answer.

P(win £1) = $\frac{7}{24}$ (1) P(win £2) = $\frac{3}{24}$ (1)

360 × 50p = £180 taken. (1)

$\frac{7}{24}$ of 360 = 105 people win £1 ∴ £105 (1)

$\frac{3}{24}$ of 360 = 45 people win £2 ∴ £90 (1)

£180 − (£105 + £90) = −£15

Total loss of £15. (1) (1)

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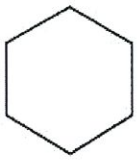
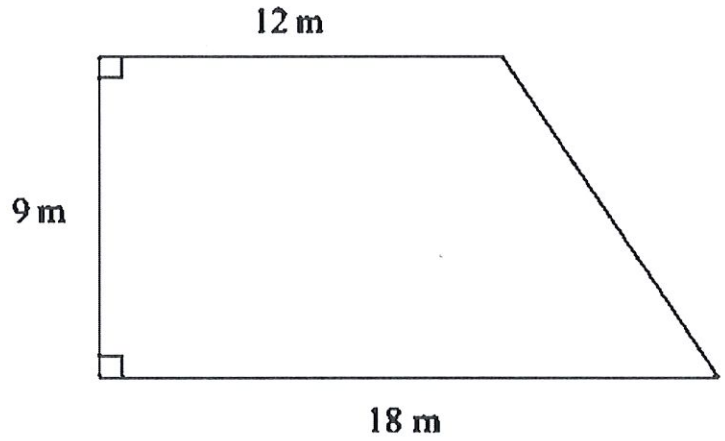
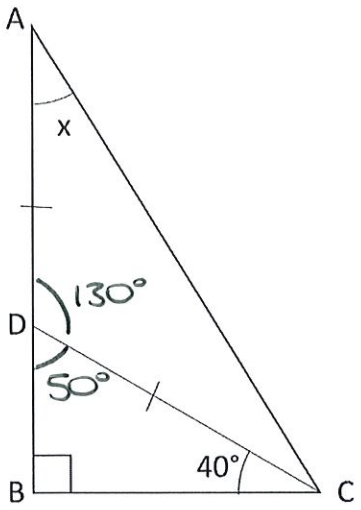
13.	 This hexagon has a perimeter of 24cm. Three of the hexagons are used to make this shape. What is the perimeter of the shape?  $24 \div 6 = 4cm$ (1) $4 \times 12 = 48cm$ (1) 48 cm	/ 2
14.	Dan can put up 30 tiles in one hour. He always works at the same speed. He tiles a wall that needs 140 tiles. He starts work at 7.30 a.m. He has a 20 minute break in the morning and 45 minutes for lunch. Work out the time that Dan should finish tiling the wall. $\frac{140}{30} = 4\frac{2}{3}$ hours $= 4$ hours 40 minutes (1) (1) 7:30am + 4 hrs + 40 mins + 20mins + 45 mins (1) = 1:15pm (1) 1:15pm	/ 4
15.	Peter works out the cost of the gas he used last year. At the start of the year, the gas meter reading was 12967 units. At the end of the year, the gas meter reading was 14059 units. Each unit of gas he used cost 44p. Work out the mean cost per month of the gas he used last year. 14059 − 12967 = 1092 units (1) 4004 ÷ 12 = 48048 (1) 4004p = £40.04 (1) 1092 × 44 = 48048 (1) Attempt to multiply £ 40.04	/ 5

16.	Potatoes cost £15 for a 25 kg sack at a farm shop. The same type of potatoes are on offer, costing £1.30 for a 2 kg bag, at a supermarket. Where are the potatoes better value, at the farm shop or at the supermarket? You must show your working. Farm shop: £15 ÷ 25kg = 0.6 £/kg (1) (1) or Supermarket: £1.30 ÷ 2kg = 0.65 £/kg (1) Cheaper at the farm shop. (1)	/ 4
17.	 Diagram NOT accurately drawn Here is a diagram of Jim's garden. Jim wants to cover his garden with grass seed to make a lawn. Grass seed is sold in bags. There is enough grass seed in each bag to cover 20 m² of garden. Each bag of grass seed costs £9.99. Work out the least cost of putting grass seed on Jim's garden. Area: $\frac{1}{2}(12+18)9 = 135\,m^2$ (1) 135 ÷ 20 ≈ 7 bags needed. (1) (1) £9.99 × 7 = £69.93 (1) £ 69.93	/ 4

18.	Triangle ABC is a right-angled triangle. ADB is a straight line. DA = DC Angle BCD = 40° Work out the size of the angle marked x. You must give reasons for each stage of your working.  BDC = 50° because (1) angles in a triangle sum to 180°. ADC = 130° because (1) angles on a straight line sum to 180°. $x = \frac{180 - 130}{2} = 25°$ (1) because angles in a triangle sum to 180° and isosceles triangles have two equal angles. (1) x = 25 °	/ 4
19.	'Purple fire' paint is made by mixing red and blue paint in the ratio 3 : 1. 'Purple sea' paint is made by mixing red and blue paint in the ratio 1 : 3. 1 litre of purple fire paint is mixed with 500 millilitres of purple sea by mistake. How much red paint needs to be added to the mixture to make it purple fire again? 1 Litre fire red : blue 3 : 1 750 : 250 (1) 500 ml sea red : blue 1 : 3 125 : 375 (1) Total: red : blue 875 : 625 (1) 3 × 625 = 1875 ml of red needed. (1) 1875 − 875 = 1000ml (1) (1L or) 1000ml	/ 5

20.	Marcus thinks of a number between 25 and 35. He divides the number by 2 and then subtracts 0.5. He takes this answer, divides it by 2 and then subtracts 0.5. He repeats this process a number of times and gets zero. What number did he start with? $\frac{\frac{x}{2} - 0.5}{2} - 0.5 \ldots = 0$ OR (1) $(0 + 0.5) \times 2 = 1$ $(1 + 0.5) \times 2 = 3$ $(3 + 0.5) \times 2 = 7$ $(7 + 0.5) \times 2 = 15$ $(15 + 0.5) \times 2 = 31$ (1) 2+ iterations (1) 31	/ 3
21.	Mr Watkins needs to buy some oil for his central heating. Mr Watkins can put up to 1200 litres of oil in his oil tank. There is already 650 litres of oil in the tank. Mr Watkins is going to fill the tank with oil. The price of oil is 70p per litre. Mr Watkins gets 5% off the price of the oil. How much does Mr Watkins pay for the oil he needs to buy? 1200 − 650 = 550 L needed. (1) 550 × 0.7 = £385. (1) 5% of £385 = £19.25 (1) £385 − £19.25 = £365.75 (1) (1) £ 365.75	/ 5

22. Amy has organised a Christmas party for some children.
Each child will get a party bag. Each party bag contains:

- 1 balloon,
- 1 bar of chocolate,
- and 1 toy.

Amy buys some packets of balloons. Each packet contains 10 balloons. She buys some boxes of chocolate bars. Each box contains 18 chocolate bars. She also buys some packets of toys. Each packet contains 12 toys. A packet of balloons costs £2.10. A box of bars of chocolate costs £4.50. A packet of toys costs £13.20. Work out the total cost of the contents of one party bag.

(1)

Balloon: £2.10 ÷ 10 = 21p each
Chocolate: £4.50 ÷ 18 = 25p each
Toy: £13.20 ÷ 12 = £1.10 each } (1)

£1.10
0.25
0.21
1.56

(1)

£ 1.56

Amy makes up all of the party bags. There are no balloons, chocolate bars or toys left over. Work out the least total number of party bags that Amy makes up.

10 20 30 ...
18 36 54 ...
12 24 36 ...

(2)

LCM of 10, 18, 12
= 180

(1)

180

/ 6

23.	Stephen imports cars from the USA. He sells them in the UK. He has just bought a car in the USA costing $24 000. It cost him £900 to import the car to the UK. The exchange rate is £1 = $1.20. Stephen needs to make a profit of 20% on his total costs. Work out the least amount that Stephen must sell the car for in the UK. Give your answer in pounds. $24000 ÷ $1.20 = £20000 (1) £20000 + £900 = £20900 20% of £20900 = £4180 (1) £20900 + £4180 = £25080 (1) £ 25 080	/ 3
24.	Barbara uses her car to work as a volunteer driver at her local hospital. She is paid 30p for every mile she drives. On average she drives 2000 miles each month. Here is some information about the running costs of Barbara's car: Fuel consumption: 50 miles per gallon Other running costs: 10 pence per mile Petrol costs £5 per gallon. After paying for fuel and other running costs, Barbara saves the money left over. Barbara is planning to use this money for a holiday that will cost £3000. Will Barbara have enough money after saving for a year? Paid : 2000 × 0.3 = £600 per month. (1) 2000 ÷ 50 = 40 gallons needed per month £5 × 40 = £200 spent on fuel. (1) 0.1 × 2000 = £200 on running costs. (1) £600 − (£200 + £200) = £200 made per month. (1) 12 months × £200 = £2400. (1) Barbara will not have enough. (1)	/ 6

25. The table gives information about the costs of posting parcels.

Maximum weight of parcel	Cost	
2 kg	£4.40	
4 kg	£7.60	*
6 kg	£9.50	*
8 kg	£11.70	
10 kg	£12.60	*
20 kg	£14.50	*

Alex has to post some parcels. He has to post:

- 1 parcel with a weight of 5.8 kg
- 1 parcel with a weight of 9.5 kg
- 1 parcel with a weight of 3.25 kg
- 1 parcel with a weight of 16.5 kg

(1) use of table.

Alex has £45 to spend on posting the four parcels. Can he post all the parcels?

(1)
9.50
12.60
7.60
14.50 +
44.20 (1)
2 2

Alex needs £44.20 so he does have enough money. (1)

/ 4

26. Angel Ltd manufacture components for washing machines. The probability that a component will be made within a tolerance of one tenth of a millimetre is 0.995. Angel Ltd. manufacture 10 000 components each day. Work out an estimate for the number of components that will not be within the tolerance of one tenth of a millimetre each day.

1 − 0.995 = 0.005 (1)

0.005 × 10000 = 50

(1) (1)

50

/ 3

27. Harry has a bowl of flakes for breakfast each morning. In each bowl he has on average 35 g of flakes. A box contains 500 g of flakes.

(a) Will one box last more than two weeks? You must show all of your working.

(1)

$500 \div 35 = 14 \text{ r } 10$

(1) 14 days = 2 weeks.

The box will last 2 weeks.

(1)

Harry is on a diet. He is allowed to eat food containing no more than 2000 calories per day. In one bowl of flakes, there are 130 calories.

(b) What percentage is one bowl of flakes of his daily allowance?

$\frac{130}{2000} \times 100 = \frac{6.5}{100} \times 100$

(1)

(1) 6.5 %

Each box of flakes is in the shape of a cuboid. The dimensions of a box are 23 cm by 7 cm by 30 cm.

(c) Work out the volume of each box.

$23 \times 7 \times 30$ (1)

$= 161 \times 30$

$= 4830 \text{ cm}^3$

(1) (1) 4830 cm^3

/ 8

28. Georgina needs 94 carpet tiles to carpet her bedroom floor. Carpet tiles are sold in boxes of 8 at £16.95 per box. A single carpet tile can be bought for £2.99. Georgina bought the carpet tiles for her bedroom spending the least amount of money. Show how Georgina did this.

$94 \div 8 = 11 \text{ r } 6$ (1)

$(11 \times £16.95) + (6 \times £2.99)$ (1)

$= £186.45 + £17.94$

$= £204.39$ (1)

OR

$12 \times £16.95 = £203.40$ (1)

(1) 12 boxes of tiles is cheapest.

/ 5

29. Ashley wants to buy some tins of tile paint. He finds out the costs of paint at two shops. Ashley needs 6 tins of tile paint. Ashley wants to get all the tins of paint from the same shop. He wants to pay the cheapest possible total price. Which of the two shops should Ashley buy the tile paint from?

Paints R Us	**Deco Mart**
Normal price £2.40 per tin Special offer Buy 2 tins and get 3rd tin free!	Normal price £2 per tin Special offer 15% off normal price

Pay for 4 tins. (1)

$4 \times £2.40 = £9.60$ (1)

15% of £2.00

10% = £0.20

5% = £0.10

£0.30 (1)

$£2 - £0.30 = £1.70$ (1)

$6 \times £1.70 = £10.20$ (1)

Ashley should buy the paint from Paints R Us. (1)

/ 6

30. Debra and Mark are planning to go on a cruise. They can travel with one of two companies, Caribbean Calypso or Royal European. The table shows the cost per person to travel with each company.

		Type of cabin			
		Inside	Outside	Balcony	Suite
Cost per person	Caribbean Calypso	£1136	£1319	£1529	£2329
	Royal European	£1043	£1263	£1484	£2147

Caribbean Calypso has a discount of 10% if you book online. Royal European has a discount of 5% if you book online. Debra and Mark are going to book a suite for their cruise. They are going to book online. Debra and Mark want to pay the lowest possible cost. Which company should they choose? You must show all your working.

C.C.

10% of £2329

= £232.90 (1)

£2329 - £232.90

= £2096.10 (1)

R.E.

5% of £2147

= £107.35 (1)

£2147 - £107.35

= £2039.65 (1)

They should use Royal European. (1)

/ 5

31. Harry is thinking about having a water meter. These are the two ways he can pay for the water he uses. Harry uses an average of 160 litres of water each day. Harry wants to pay as little as possible for the water he uses. Should Harry have a water meter?

Water meter

A charge of £28.20 per year

plus

91.22p for every cubic metre of water used

(1 cubic metre = 1000 litres)

No water meter

A charge of £107 per year

160 × 365 = 58400 L = 58.4 m^3 (1) (1)

£28.20 + (58.4 × 0.9122) = £81.47 (1) (1)

Yes, Harry should get a water metre. (1)

/ 5

32. Tim is travelling home from holiday by plane. He buys some food and drink on the plane. Tim buys two cheese rolls, a coffee and an orange juice. He pays part of the cost with a 10 euro note. He pays the rest of the cost in pounds (£). How much does Tim pay in pounds?

Price List

Cheese Roll	£3.50
Crisps	£1.20
Chocolate bar	£1.30
Coffee	£2.50
Tea	£2.00
Orange Juice	£2.20

Exchange rate £1 = 1.25 euros

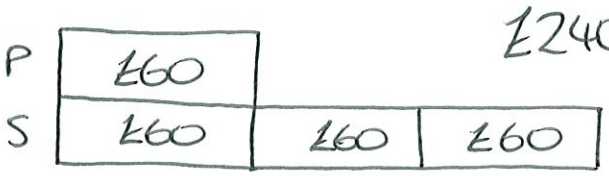
3.50
3.50
2.50
2.20
11.70 (1)

€10 = £8 (1)

£11.70 − £8 = £3.70 (1) (1)

£ 3.70

/ 4

33.	Petra and Stephan share out £240 so that Petra gets one third of what Stephan gets. How much do they each get?  3 × £60 = £180 (1) Petra: £ 60 Stephen: £ 180	/ 3
34.	Melissa has a bag of marbles. She shares them with her friends. She gives $\frac{1}{3}$ of the marbles to Jessica. She gives $\frac{2}{9}$ of the marbles to Samantha. She has 32 marbles left. How many marbles did she give to Samantha? $1 - \left(\frac{1}{3} + \frac{2}{9}\right)$ (1) $= 1 - \left(\frac{3}{9} + \frac{2}{9}\right)$ $= 1 - \frac{5}{9}$ $= \frac{4}{9}$ (1) $\frac{4}{9}$ of $x = 32$ $\frac{1}{9}$ of $x = 8$ (1) $\frac{2}{9}$ of $x = 16$ (1)	/ 4

35. The cost of a trip on a low-cost airline is given by this formula:

$$C = N(O + R + 2T)$$

- C is the overall cost;
- N is the number of people travelling;
- O is the price of the outgoing flight, per person;
- R is the price of the return flight (the flight back), per person;
- T is the price of airport taxes for one flight, per person.

Susan and her two friends went to Paris. The return flight was £10 less than the outgoing flight, and the airport taxes were £21 for each flight for each person. The overall cost was £294. What was the price of the outgoing flight for each person?

$C = 294 \quad N = 3 \quad O = ?$

$R = O - 10 \quad T = 21$ (1)

$294 = 3(O + O - 10 + 42)$ (1)

$98 = 2O + 32$

$66 = 2O$ (1)

$33 = O$ (1)

£ 33

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