

Percentages

Foundation and Higher tiers

Total marks: 188

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Percentage of a shape	R9	Foundation	1	No	1
2	Percentages as decimals and fractions	R9	Foundation	2	No	2
3	Percentage of an amount without a calculator	N12	Foundation	2	No	2
4	Ordering fractions, decimals and percentages	R9 N1	Foundation	3	No	2
5	One number as a percentage of another	R9	Foundation	3	No	2
6	Comparing a percentage and a fraction discount	N12 R9	Foundation	4	No	3
7	Equal percentages of amounts	R9	Foundation	4	No	2
8	Successive percentage changes	R9	Foundation	5	No	2
9	Percentage of a percentage	R9 N12	Foundation	5	No	3
10	Reverse percentage without a calculator	R9	Foundation	5	No	3
11	Percentage change in an area	R9	Foundation	6	No	3
12	Percentage of an amount with a calculator	N12 R9	Foundation	2	Yes	2
13	Percentage increase	R9	Foundation	3	Yes	2
14	Progress towards a fundraising target	R9	Foundation	3	Yes	4
15	Percentage decrease	R9	Foundation	4	Yes	3
16	Pass marks as percentages	R9	Foundation	4	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Comparing percentage increases	R9	Foundation	4	Yes	3
18	Simple interest	R9	Foundation	4	Yes	4
19	Percentage left, with units	R9 N13	Foundation	4	Yes	3
20	Percentage of a population	R9	Foundation	4	Yes	3
21	Percentage of a tank and a cost	R9 N13	Foundation	4	Yes	4
22	Percentage profit	R9	Foundation	4	Yes	3
23	Percentage from a bar chart	R9 S2	Foundation	4	Yes	3
24	Percentage of a time	R9 N13	Foundation	4	Yes	3
25	Comparing two pay rises	R9	Foundation	4	Yes	3
26	Reverse percentage	R9	Foundation	5	Yes	3
27	Compound interest	R16	Common	5	Yes	3
28	Comparing costs with a discount	R9	Foundation	5	Yes	4
29	Reverse percentage: VAT	R9	Foundation	5	Yes	3
30	Depreciation at two rates	R16	Common	5	Yes	3
31	Best buy with extra free	R9 R10	Foundation	5	Yes	4
32	Simple interest: finding the rate	R9	Foundation	5	Yes	3
33	Percentage change used to predict	R16 R9	Common	5	Yes	4
34	Growth: how many years	R16	Common	6	Yes	3
35	Compound against simple interest	R16 R9	Common	6	Yes	4
36	Comparing compound interest	R16	Common	6	Yes	4
37	Reverse percentage through two changes	R9	Foundation	6	Yes	4
38	Growth from a table	R16	Common	6	Yes	4
39	Reverse percentage of a percentage	R9	Foundation	6	Yes	4
40	Compound interest with a withdrawal	R16	Common	6	Yes	4
41	Decay: total lost	R16	Common	6	Yes	3
42	Reverse compound decrease	R16	Common	7	Yes	3
43	Successive changes and the change back	R16 R9	Common	7	Yes	4
44	Reverse percentage with tax bands	R9	Foundation	7	Yes	5
45	Reverse compound interest from the interest earned	R16	Common	7	Yes	3
46	Finding an unknown growth rate	R16	Common	7	Yes	4
47	Percentage changes in simultaneous equations	R9 A19	Common	7	Yes	4
48	An equivalent yearly rate of depreciation	R16 N7	Higher	7	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
49	Percentage change with a fixed volume	R9 R13	Higher	8	Yes	4
50	Iteration: paying off a loan	R16	Higher	8	Yes	5
51	Exponential growth model from two values	R16 A12	Higher	8	Yes	5
52	Percentage change in area and volume	R9 G19	Higher	8	Yes	3
53	Successive percentage changes leading to a quadratic	R9 A18	Higher	9	Yes	4
54	Iteration with a limit	R16	Higher	9	Yes	6
55	Growth then decay at the same rate	R16 N7	Higher	9	Yes	4
56	Compound interest with a fee: an inequality	R16 A22	Higher	9	Yes	4
	Total					188

Question 1 R9 · Foundation · Grade 1 · 1 mark

Q	Answer	Mark	Comments
1	8 squares shaded	B1	any 8

Question 2 R9 · Foundation · Grade 2 · 2 marks

Q	Answer	Mark	Comments
2(a)	60%	B1	
2(b)	$\frac{7}{20}$	B1	

Question 3 N12 · Foundation · Grade 2 · 2 marks

Q	Answer	Mark	Comments
3	10% = 36 and 5% = 18	M1	oe, any correct build up
	54	A1	

Question 4 R9 N1 · Foundation · Grade 3 · 2 marks

Q	Answer	Mark	Comments
4	$\frac{2}{5}$, 41%, 0.42, $\frac{9}{20}$	B2	B1 for all four correctly written in a common form, or one value out of place

Question 5 R9 · Foundation · Grade 3 · 2 marks

Q	Answer	Mark	Comments
5	$\frac{28}{80} \times 100$	M1	oe, $\frac{7}{20}$ or $\frac{35}{100}$
	35	A1	

Question 6 N12 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
6	68×0.75 or $68 - 17$ or £51	M1	oe
	$75 - 25$ or $\frac{2}{3} \times 75$ or £50	M1	oe
	Shop B with £51 and £50	A1	

Question 7 R9 · Foundation · Grade 4 · 2 marks

Q	Answer	Mark	Comments
7	24	M1	30% of 80 worked out
	40	A1	

Question 8 R9 · Foundation · Grade 5 · 2 marks

Q	Answer	Mark	Comments
8	1.2×0.8 or an example, such as $100 \rightarrow 120 \rightarrow 96$	M1	oe
	No with 0.96 or 96 or 4% less	A1	

Question 9 R9 N12 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
9	0.45×0.3 or 13.5%	M1	oe
	0.55×0.4 or 22%	M1	oe
	35.5	A1	oe

Question 10 R9 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
10	$72 \div 9$ or 8 (5%), or $72 \div 45$ or 1.6 (1%), or 16 (10%)	M1	oe, a correct step from $45\% = 72$
	11×8 or 55×1.6 or $160 - 72$	M1	oe, a full method; 160 is the full butt
	88	A1	

Question 11 R9 · Foundation · Grade 6 · 3 marks

Q	Answer	Mark	Comments
11	1.2×0.85 or an example, such as $10 \times 10 = 100$ and 12×8.5	M1	oe
	1.02 or 102	M1	oe
	2% increase	A1	must say increase

Question 12 N12 R9 · Foundation · Grade 2 · 2 marks

Q	Answer	Mark	Comments
12	0.23×6284 or $6284 \div 100 \times 23$	M1	oe
	£1445.32	A1	

Question 13 R9 · Foundation · Grade 3 · 2 marks

Q	Answer	Mark	Comments
13	36.50×1.08 or $36.50 \times 0.08 (= 2.92)$	M1	oe
	£39.42	A1	

Question 14 R9 · Foundation · Grade 3 · 4 marks

Q	Answer	Mark	Comments
14(a)	$\frac{2918.40}{3850} \times 100$ or 0.758...	M1	oe
	75.8	A1	accept 75.8 or [75.80, 75.81]
14(b)	0.15×3850 or £577.50	M1	oe, or their (a) + 15
	No with £3495.90, or with 90.8%	A1	or No with £354.10 still needed

Question 15 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
15	$18\,400 - 13\,800$ or 4600	M1	
	$\frac{4600}{18\,400} \times 100$	M1	oe, or $\frac{13\,800}{18\,400} = 0.75$
	25	A1	

Question 16 R9 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
16(a)	$\frac{49}{65} \times 100$ or 0.78×65 or 50.7	M1	oe
	No with 75.4% or with 50.7	A1	accept 75% or 75.385%
16(b)	0.78×65 or 50.7	M1	oe
	51	A1	not 50.7

Question 17 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
17	one correct percentage increase, such as $\frac{1.40}{14.80} \times 100$ or 9.5%	M1	oe, or a multiplier such as $\frac{16.20}{14.80} = 1.09...$
	all three percentage increases or multipliers	M1	oe
	Route 36 with 9.5% and 10.5% and 7.6%	A1	accept values rounded or truncated to at least 2 significant figures

Question 18 R9 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
18(a)	2750×0.0185 or 50.875	M1	oe, one year's interest
	£203.50	A1	
18(b)	$250 \div 50.875$ or 4.91 or a build up of 50.875 a year	M1	oe
	5	A1	

Question 19 R9 N13 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
19	1500 (ml) or 0.34 (litres)	B1	a correct conversion
	$\frac{1160}{1500} \times 100$	M1	oe, or $100 - \frac{340}{1500} \times 100$
	77.3	A1	accept 77.3 or [77.33, 77.34]

Question 20 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
20	100 – 17.4 or 82.6% or $0.174 \times 48\,316$ or 8406.98	M1	oe
	$0.826 \times 48\,316$ or $48\,316 - 8407$	M1	oe
	39 909	A1	accept 39 909.016

Question 21 R9 N13 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
21	0.65×55 or $55 - 0.35 \times 55$ or 35.75	M1	oe, litres needed
	35.75×148.9 or 5323.175	M1	oe
	£53.23	A1	or 5323p, or 53.2318
	No, with their cost	B1ft	ft their cost if M1 M1 scored

Question 22 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
22	36×4.25 or £153	M1	
	$\frac{153 - 118}{118} \times 100$ or $\frac{153}{118} \times 100$	M1	oe, or 1.2966
	29.7	A1	accept 29.7 or [29.66, 29.67]

Question 23 R9 S2 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
23	204	B1	the total read from the chart
	$\frac{52}{204} \times 100$	M1	oe, ft their total
	25.5	A1	accept 25.5 or [25.49, 25.50]

Question 24 R9 N13 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
24	342 (minutes) or 5.7 (hours)	M1	
	0.38×342 or 129.96 or 0.38×5.7 or 2.166	M1	oe
	2 hours 10 minutes	A1	not 2 hours 17 minutes

Question 25 R9 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
25	11.86×1.048 or $11.86 + 0.569...$	M1	oe
	12.20×1.021 or $12.20 + 0.256...$	M1	oe
	Ben with £12.43 and £12.46	A1	or 12.429 and 12.456

Question 26 R9 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
26	$100 - 15$ or 85% or 0.85	M1	
	$57.80 \div 0.85$	M1	oe, or $57.80 \div 85 \times 100$
	£68	A1	accept £68.00

Question 27 R16 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
27	4200×1.025 or 4305	M1	oe, or 1.025^n with $n \geq 2$
	4200×1.025^3	M1	oe, a full method
	£4522.94	A1	accept £4522.95 from rounding each year

Question 28 R9 · Foundation · Grade 5 · 4 marks

Q	Answer	Mark	Comments
28	649×0.85 or £551.65	M1	oe
	8.50×24 or £204	M1	
	32.40×24 or £777.60	M1	
	Option A by £21.95	A1	with £755.65 and £777.60

Question 29 R9 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
29	$83.94 \div 1.2$ or £69.95	M1	oe
	$83.94 - 69.95$ or 69.95×0.2	M1	oe
	£13.99	A1	not £16.79

Question 30 R16 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
30	$14\,750 \times 0.82$ or 12 095	M1	oe
	$14\,750 \times 0.82 \times 0.89^2$	M1	oe, a full method
	£9580.45	A1	accept £9580

Question 31 R9 R10 · Foundation · Grade 5 · 4 marks

Q	Answer	Mark	Comments
31	600×1.3 or 780 (g)	M1	oe
	a comparable value for A, such as $315 \div 7.5 = 42$ (p per 100 g) or $750 \div 3.15 = 238.1$ (g per £1)	M1	
	the same value for B, such as $329 \div 7.8 = 42.2$ or $780 \div 3.29 = 237.1$	M1	ft their grams for B
	Pack A with correct values	A1	

Question 32 R9 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
32	$394.20 \div 4$ or £98.55	M1	oe
	$\frac{98.55}{3650} \times 100$	M1	oe, or $\frac{394.20}{3650} (= 0.108) \div 4$
	2.7	A1	

Question 33 R16 R9 · Common · Grade 5 · 4 marks

Q	Answer	Mark	Comments
33(a)	$\frac{2213 - 1840}{1840} \times 100$ or $\frac{373}{1840} \times 100$	M1	oe, or $\frac{2213}{1840} = 1.2027...$
	20.3	A1	accept 20.3 or [20.27, 20.28]
33(b)	2213×1.203 or $2213 \times \frac{2213}{1840}$	M1	oe, ft their (a)
	2662	A1	accept [2661, 2663]

Question 34 R16 · Common · Grade 6 · 3 marks

Q	Answer	Mark	Comments
34	2400×1.06 or 2544	M1	oe, a growth step
	$2400 \times 1.06^3 = 2858.4...$ and $2400 \times 1.06^4 = 3029.9...$	M1	values either side of 3000
	4	A1	

Question 35 R16 R9 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
35	6000×1.03^5 or £6955.64	M1	oe
	$6000 \times 0.032 \times 5$ or £960	M1	oe
	£955.64 and £960	A1	or £6955.64 and £6960
	Account B by £4.36	A1	

Question 36 R16 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
36	8000×1.024^6	M1	oe
	$8000 \times 1.04 \times 1.019^5$	M1	oe
	£9223.37 and £9141.01	A1	
	Account X by £82.36	A1	accept [£82.35, £82.37]

Question 37 R9 · Foundation · Grade 6 · 4 marks

Q	Answer	Mark	Comments
37(a)	$63.18 \div 0.9$ or £70.20	M1	oe
	$70.20 \div 1.35$	M1	oe, or $63.18 \div 1.215$
	£52	A1	accept £52.00
37(b)	21.5	B1ft	ft their (a)

Question 38 R16 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
38(a)	two of $\frac{5160}{5000}$, $\frac{5325.12}{5160}$, $\frac{5495.52}{5325.12}$	M1	oe, or the increases 160 and 165.12 as percentages
	all three equal 1.032 (or 3.2%) and a statement	A1	
38(b)	5000×1.032^8	M1	oe, or 5495.52×1.032^5
	£6432.91	A1	accept [£6432.90, £6432.92]

Question 39 R9 · Foundation · Grade 6 · 4 marks

Q	Answer	Mark	Comments
39	$4104 \div 0.15$ or 27 360	M1	oe, the number of fiction books
	$27\,360 \div 0.38$ or $4104 \div 0.057$ or 72 000	M1	oe, the number of books
	$72\,000 \times 0.62$	M1	oe, or $72\,000 - 27\,360$
	44 640	A1	

Question 40 R16 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
40	5000×1.031^2 or 5314.805	M1	oe
	$5314.805 - 1200$ or 4114.805	M1	dep on the first M1
	4114.805×1.031^2	M1	oe
	£4373.88	A1	

Question 41 R16 · Common · Grade 6 · 3 marks

Q	Answer	Mark	Comments
41	280×0.955^6 or 212.41	M1	oe
	$280 - 212.41$	M1	dep
	67.6	A1	accept [67.58, 67.59]

Question 42 R16 · Common · Grade 7 · 3 marks

Q	Answer	Mark	Comments
42	0.88	M1	oe
	$13\,939.20 \div 0.88^2$	M1	oe, or $\div 0.7744$
	£18 000	A1	

Question 43 R16 R9 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
43(a)	$1.12 \times 0.8 \times 1.08$ or 0.96768	M1	oe, or an example such as $100 \rightarrow 112 \rightarrow 89.6 \rightarrow 96.768$
	3.232% decrease	A1	accept 3.2% decrease; must say decrease
43(b)	$1 \div 0.96768$ or $\frac{100}{96.768}$	M1	oe
	3.3	A1	accept 3.3 or [3.33, 3.34]

Question 44 R9 · Foundation · Grade 7 · 5 marks

Q	Answer	Mark	Comments
44	45 000 – 12 000 or 33 000	M1	
	$0.2 \times 33\,000$ or 6600	M1	oe, tax in the 20% band
	9873.60 – 6600 or £3273.60	M1	
	$3273.60 \div 0.4$ or 8184	M1	oe
	£53 184	A1	

Question 45 R16 · Common · Grade 7 · 3 marks

Q	Answer	Mark	Comments
45	1.028^4 or 1.11679	M1	oe
	$613.16 \div (1.028^4 - 1)$ or $613.16 \div 0.11679$	M1	oe
	£5250	A1	accept [£5249.50, £5250.50]

Question 46 R16 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
46	$236\,000 \times 1.035$ or 244 260	M1	
	$260\,395 \div 244\,260$ or 1.06606	M1	oe
	$\sqrt{1.06606}$ or 1.03250	M1	oe
	3.25	A1	accept [3.24, 3.26]

Question 47 R9 A19 · Common · Grade 7 · 4 marks

Q	Answer	Mark	Comments
47	$0.08w = 0.12s$	M1	oe, or $1.08w + 0.88s = 11.25$
	$w + s = 11.25$	M1	
	a correct method to eliminate one letter, such as $0.08w = 0.12(11.25 - w)$	M1	oe, or $0.2w = 1.35$
	£6.75	A1	

Question 48 R16 N7 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
48(a)	$64\,000 \times 0.925^2$ or 54 760, or $0.925^2 = 0.855625$	M1	oe, B after 2 years
	£54 760 and £54 400, or a fall of 14.4375% and 15%, with a correct conclusion	A1	
48(b)	$\sqrt{0.85}$ or 0.9220	M1	oe, the yearly multiplier
	7.8	A1	accept 7.8 or [7.80, 7.81]

Question 49 R9 R13 · Higher · Grade 8 · 4 marks

Q	Answer	Mark	Comments
49	1.08^2 or 1.1664	M1	oe, the change in the area of the circle
	$1 \div 1.1664$ or 0.8573	M1	oe, or an example such as $r=10$, $h=10$ giving new height 8.57
	$1 - 0.8573$ or 14.27	M1	oe
	14.3	A1	accept 14.3 or [14.26, 14.27]

Question 50 R16 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
50(a)	$2000 \times 1.015 - 250$ or £1780	M1	
	£1556.70	A1	
50(b)	continues the process for at least two more months, such as £1330.05 and £1100.00	M1	ft their (a)
	9 payments	A1	
	£146.94	A1	accept [£146.89, £146.99]

Question 51 R16 A12 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
51(a)	$ab^2 = 6615$ and $ab^5 = 7658$	M1	both
	$b^3 = \frac{7658}{6615}$ or 1.1577	M1	oe
	$b = 1.05$	A1	accept [1.049, 1.051]
	$a = 6000$	A1	accept [5995, 6005]
51(b)	the number of bees increases by 5% each week	B1ft	oe, ft their b

Question 52 R9 G19 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
52	$\sqrt{1.3}$ or 1.1402	M1	oe, the length scale factor
	$(\sqrt{1.3})^3$ or 1.4822	M1	oe
	48.2	A1	accept 48.2 or [48.22, 48.23]

Question 53 R9 A18 · Higher · Grade 9 · 4 marks

Q	Answer	Mark	Comments
53	$(1 + \frac{x}{100})(1 - \frac{2x}{100}) = 0.896$	M1	oe
	$2x^2 + 100x - 1040 = 0$	M1	oe, a correct three term quadratic = 0
	$\frac{-100 + \sqrt{(100^2 - 4 \times 2 \times (-1040))}}{2 \times 2}$	M1	oe, correct use of the formula or completing the square
	8.8	A1	accept [8.83, 8.84]; the negative solution rejected

Question 54 R16 · Higher · Grade 9 · 6 marks

Q	Answer	Mark	Comments
54(a)	$400 \times 0.62 + 400$ or 648	M1	oe
	801.76	A1	accept 801.8
54(b)	$L = 0.62L + 400$	M1	oe, or $400 \div 0.38$
	1053	A1	accept [1052, 1053]
54(c)	values for at least the 4th, 5th and 6th doses, such as 897.1, 956.2, 992.8	M1	oe
	the 7th dose with 1015.6	A1	

Question 55 R16 N7 · Higher · Grade 9 · 4 marks

Q	Answer	Mark	Comments
55	$12\,000 \times (1 + \frac{r}{100})^4 \times (1 - \frac{r}{100})^4 = 11\,520$	M1	oe
	$(1 - \frac{r^2}{10\,000})^4 = 0.96$ or $(1 + \frac{r}{100})(1 - \frac{r}{100}) = 0.98985$	M1	oe
	$\frac{r^2}{10\,000} = 0.01015$ or $r^2 = 101.54$	M1	oe
	10.1	A1	accept 10.1 or [10.07, 10.08]

Question 56 R16 A22 · Higher · Grade 9 · 4 marks

Q	Answer	Mark	Comments
56	$(x - 150) \times 1.046^5$	M1	oe, Account Q
	$x \times 1.038^5$ compared with Account Q	M1	oe, an equation or inequality
	$x = \frac{150 \times 1.046^5}{1.046^5 - 1.038^5}$ or 3982.96	M1	oe, or trials either side
	£3983	A1	