Q1

i

Considering The International Bank first

4% earned for the first year, so the total after 1 year is

$$£2000 \times 1.04 = £2080$$

Finding first year amount for either bank [1]

And then 1% interest each year after that, and there is only 1 year remaining

$$£2080 \times 1.01 = £2100.80$$

[1]

So the total earned in The International Bank after 2 years will be £2100.80

Considering The Friendly Bank next

5% earned for the first year, so the total after 1 year is

$$£2000 \times 1.05 = £2100$$

And then 0.5% interest each year after that, and there is only 1 year remaining

$$£2100 \times 1.005 = £2110.50$$

[1]

So the total earned in The Friendly Bank after 2 years will be £2110.50

Comparing the two final amounts

$$£2110.50 > £2100.80$$

The Friendly Bank will give Viv the most money after 2 years [1]

Q2

2a

This is a repeated percentage increase, like compound interest, of 1 560 000 by 5.2% for 2 years (2015 to 2017)

$$1\,560\,000 \times 1.052^2 = 1\,726\,458.24$$

1 for method, 1 for answer [2]

Round to 3 significant figures

1 730 000 [1]

2b

Use the same method as in part a, repeated percentage increase of 5.2% (compound interest)
But here we can fill in the "answer" with an unknown power, which will be the number of years, n, since beginning of 2015

$$1\,560\,000 \times 1.052^n = 2\,000\,000$$

Substitute in different values of n on your calculator until the result is over 2 000 000

When n=3 (beginning of 2018) $1\,560\,000 \times 1.052^3 = 1\,816\,234.068$

When n=4 (beginning of 2019) $1\,560\,000 \times 1.052^4 = 1\,910\,678.24$

When n=5 (beginning of 2020) $1\,560\,000 \times 1.052^5 = 2\,010\,033.509$

Trying several values of n [1]

So the population will have reached over 2 000 000 by the beginning of 2020 [1]

i) Use the same method as in part a, repeated percentage increase of 5.2% (compound interest)
But here we can fill in the "answer" with an unknown power, which will be the number of years, n, since beginning of 2015

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Trying several values of n [1]

So the population will have reached over 2 000 000 by the beginning of 2020 [1]

ii) **If the assumed rate is too low, this means the population will grow faster than expected, and so the population will pass 2000000 sooner than predicted in part (i)** [1]

Q3

3a

At the end of the first year there will be a total of

$$£200 \times 1.033 = £206.60$$

[1]

At the end of the second year there will be a total of

$$£206.60 \times 1.015 = £209.699$$

[1]

Round to nearest penny

£209.70 [1]

Find the price increase of the train ticket, which has risen by 12.5% **to** £225
This means that £225 is 112.5% of the original amount

$$£225 = 112.5\%$$

Divide both sides by 112.5

$$£2 = 1\%$$

Multiply both sides by 100

$$£200 = 100\%$$

So the original price was £200, and it is now £225

Train ticket price increase = 225 - 200 = £25

[1]

Now find the increase for Katie's weekly pay, which has risen by 5% **to** £535.50
This means that £535.50 is 105% of the original pay

$$£535.50 = 105\%$$

Divide both sides by 105

$$£5.10 = 1\%$$

Multiply both sides by 100

$$£510 = 100\%$$

So Katie's original pay was £510 per week, and it is now £535.50

Pay increase = 535.50 - 510 = £25.50

[1]

The pay increase is slightly greater than the increase in train ticket price [1]

Q4

This is a "backwards" compound interest problem
The multiplier for an increase of 3% is 1.03, and it is applied twice, so we can write

$$M \times 1.03^2 = £2652.25$$

[1]

Where M is the amount of money initially invested
Divide both sides by 1.03^2 (which is 1.0609)

$$M = 2652.25 \div 1.03^2$$

[1]

£2500 [1]

4b

Call the initial amount of money A

The Saver Account gives 4% compound interest, for 5 years, so the amount of money at the end of 5 years will be

$$A \times 1.04^5$$

Find the value of 1.04^5 on your calculator

$$A \times 1.216652902...$$

So this is an increase of approximately 21.7%

[1]

The Investment Account awards 21% interest at the end of 5 years

$$21.7\% > 21\%$$

So the Saver Account is the best [1]
Requires full working/explanation for answer mark

Q5

5a

A repeated percentage increase (compound interest) of 2% for 8 years (2009 to 2017)

$$50\,000 \times 1.02^8 = 58\,582.96905$$

[1]

Round to nearest £100

£58 600 [1]

5b

This is a "backwards" compound interest problem, an increase of *x*% is equivalent to a multiplier of *m*, applied for 6 years, so we can write

$$250\,000 \times m^6 = 325\,000$$

[1]

Divide both sides by 250 000

$$m^6 = 1.3$$

Take the 6th root of both sides, you may have to press SHIFT + $\sqrt{\ }$ on your calculator

$$m = \sqrt[6]{1.3} = 1.044697508...$$

[1]

Equivalent to an increase of 4.4697508... %

Round to 2 significant figures

***x* = 4.5%** [1]

Q6

6

Find the total amount in the account after the 2 years at 1.5% interest

$$6000 \times 1.015^2 = 6181.35$$

Amount after 2 years [1]

This amount then has an interest of x% applied to it, resulting in a total of 6311.16 in the account
We can use a multiplier m to represent an increase of x%

$$6181.35 \times m = 6311.16$$

Divide both sides by 6181.35

$$m = 1.021$$

Method to find the multiplier [1]

A multiplier of 1.021 is equivalent to an increase of 2.1%

2.1 % [1]

Q7

7

We can use a multiplier m to represent a percentage increase of x%
This percentage increase is applied 6 times, as the interest is earned over 6 years

$$8000 \times m^6 = 8877.62$$

Divide both sides by 8000

$$m^6 = 1.1097025$$

[1]

Find the 6th root of both sides, you will need to use the $\sqrt[\square]{\square}$ button, or similar, on your calculator

$$m = \sqrt[6]{1.1097025} = 1.0175$$

[1]

A multiplier of 1.0175 is equivalent to an increase of 1.75%

x = 1.75 [1]

Q8

8

Work out the amount to pay back for each offer separately and then compare.

Offer 1

Compound interest means a 5% increase ***each*** year, for 2 years.

"$P\left(1+\frac{r}{100}\right)^n$"

$$6000\left(1+\frac{3}{100}\right)^2 = 6000 \times 1.03^2$$
$$= 6365.4$$

[1]

Offer 2

As the interest rates are different we need to calculate each year separately.

"$P\left(1+\frac{r}{100}\right)^n$"

After year 1: $6000\left(1+\frac{1}{100}\right) = 6000 \times 1.01 = 6060$

After year 2: $6060\left(1+\frac{5}{100}\right) = 6060 \times 1.05 = 6363$

[1]

Now compare the two offers and answer the question.

Offer 1 requires Mia to pay back £6365.40 whilst offer 2 requires Mia to pay back £6363, so no Mia is not correct [1]

Q9

9

Compound interest means a 1.5% increase ***each*** year.

$$"P\left(1+\frac{r}{100}\right)^n"$$

However, in this case we do not know n, but we do know the value Mirek wants the investment to be worth after n years.
Mirek wants £1000 interest so the amount of the investment will need to be at least

£6000 + £1000 = £7000

Therefore we need to solve the inequality

$$6000\left(1+\frac{1.5}{100}\right)^n = 6000\times 1.015^n \geq 7000$$

Use of 1.015 or equivalent [1]
"6000 × 1.1015^n" [1]

To solve this, use your calculator to work out the value of the investment after each year, one by one.
This is an iteration method.
Start by typing in 6000 to your calculator and press =/EXE so it is on the answer line and stored under the ANS key.
Then type in "ANS × 1.015" and press EXE. Keep doing this until the value is over £7000 - but you need to count how many times you press EXE as this will be the value of *n*.
We recommend writing down the value after each year to help keep track. You do not need to write all digits down and you do not need to round, it's just a way of keeping track. You could use a tally instead.
If you lose count, or are in any doubt, it is best to start again from the beginning.

If you lose count, or are in any doubt, it is best to start again from the beginning.

After 1 year: 6090
After 2: 6181.35
3: 6274.07...
4: 6368.18...
5: 6463.70...
6: 6560.65...
7: 6659.06...
8: 6758.95...
9: 6860.33...
10: 6963.24...
11: 7067.69...

It will take 11 years (nearest whole) for Mirek's £6000 investment to earn more than £1000 interest [1]

Q10

10a

Account A
3% per year compound interest, for 3 years, on £10 000

£10 000 × 1.03^3 = **£10 927.27**

[2]

Account B
4% for the first year on £10 000

£10 000 × 1.04 = £10 400.00

3% for the second year, on £10 400

£10 400 × 1.03 = £10 712.00

2% for the third year, on £10 712

£10 712 × 1.02 = **£10 926.24**

[2]

Find the difference between the two final amounts

£10 927.27 - £10 926.24 = £1.03 = 103p

Account A by 103p [1]

10b

Account A states that there are no withdrawals until the end of 3 years, whereas Account B says that withdrawals are allowed at any time. So if Derrick needs access to his money then he may choose Account B instead. [1]