Question 8   (50 marks)
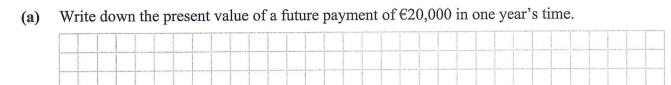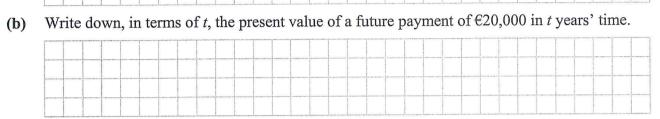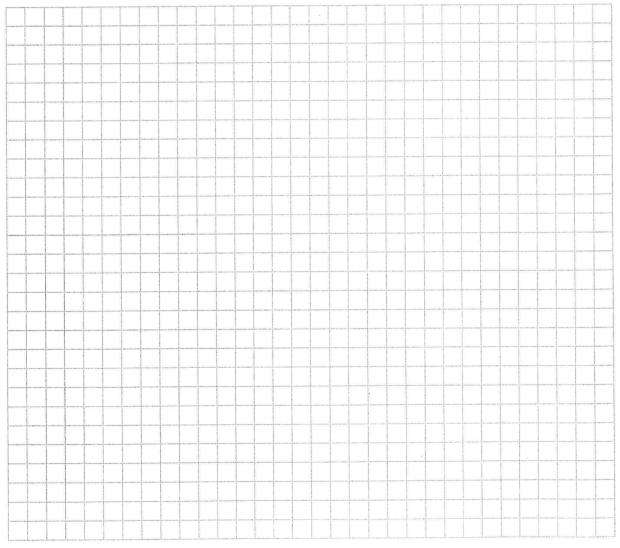
Pádraig is 25 years old and is planning for his pension. He intends to retire in forty years' time, when he is 65. First, he calculates how much he wants to have in his pension fund when he retires. Then, he calculates how much he needs to invest in order to achieve this. He assumes that, in the long run, money can be invested at an inflation-adjusted annual rate of 3%. Your answers throughout this question should therefore be based on a 3% annual growth rate.
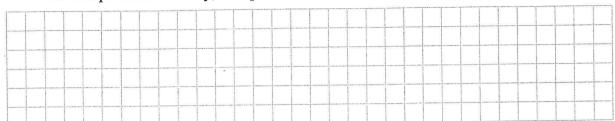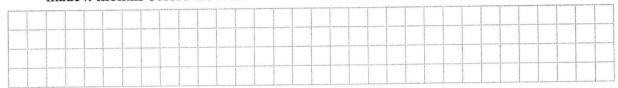
(a) Write down the present value of a future payment of €20,000 in one year's time.

(b) Write down, in terms of t, the present value of a future payment of €20,000 in t years' time.

(c) Pádraig wants to have a fund that could, from the date of his retirement, give him a payment of €20,000 at the start of each year for 25 years. Show how to use the sum of a geometric series to calculate the value, on the date of retirement, of the fund required.
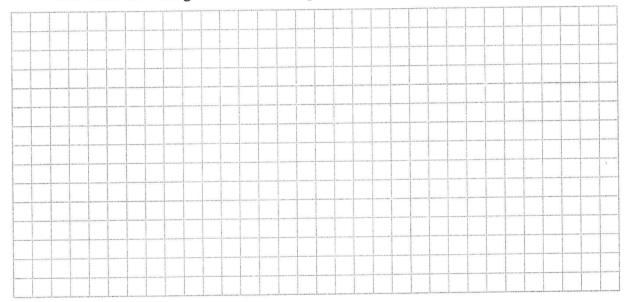
(d) Pádraig plans to invest a fixed amount of money every month in order to generate the fund calculated in part **(c)**. His retirement is $40 \times 12 = 480$ months away.

    (i) Find, correct to four significant figures, the rate of interest per month that would, if paid and compounded monthly, be equivalent to an effective annual rate of 3%.

    (ii) Write down, in terms of n and P, the value on the retirement date of a payment of €P made n months before the retirement date.

    (iii) If Pádraig makes 480 equal monthly payments of €P from now until his retirement, what value of P will give the fund he requires?

(e) If Pádraig waits for ten years before starting his pension investments, how much will he then have to pay each month in order to generate the same pension fund?

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