

# QQQ – Decision 2 – Chapter 7 – Recurrence Relations (Version 1)

**Total Marks: 25**

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

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**1.**

**(a)** Find the general solution of the recurrence relation

$$u_{n+1} = 3u_n + 2^n \quad n \geq 1$$

**(4)**

**(b)** Find the particular solution of this recurrence relation for which  $u_1 = u_2$

**(2)**

**(Total 6 marks)**

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**2.** Martina decides to open a bank account to help her to save for a holiday. Each month she puts £ $k$  into the account and allows herself to spend one quarter of what was in the account at the end of the previous month.

Let  $u_n$  (where  $n \geq 1$ ) represent the amount in the account at the end of month  $n$ .

Martina has £ $k$  in the account at the end of the first month.

**(a)** By setting up a first order recurrence relation for  $u_{n+1}$  in terms of  $u_n$ , determine an expression for  $u_n$  in terms of  $n$  and  $k$ .

**(6)**

At the end of the 8th month, Martina needs to have at least £1750 in the account to pay for her holiday.

**(b)** Determine, to the nearest penny, the minimum amount of money that Martina should put into the account each month.

**(2)**

**(Total 8 marks)**

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**3.** An increasing sequence  $\{u_n\}$  for  $n \in \mathbb{N}$  is such that the difference between the  $n$ th term of  $\{u_n\}$  and the mean of the previous two terms of  $\{u_n\}$  is always 6

**(a)** Show that, for  $n \geq 3$

$$2u_n - u_{n-1} - u_{n-2} = 12$$

**(2)**

Given that  $u_1 = 2$  and  $u_2 = 8$

**(b)** find the solution of this second order recurrence relation to obtain an expression for  $u_n$  in terms of  $n$ . **(7)**

**(c)** Show that as  $n \rightarrow \infty$ ,  $u_n \rightarrow kn$  where  $k$  is a constant to be determined. You must give reasons for your answer. **(2)**

**(Total 11 marks)**