

### Question 1

- (a) The first 16 integers  $\geq 0$  can be represented by 4 bit binary strings.
- (i) List these integers in hexadecimal, together with their binary equivalents.
  - (ii) Find the hexadecimal equivalent of the binary numeral 100101.01 and find the binary equivalent of the hexadecimal numeral 59.A [4]
- (b) Working in the binary system compute the following sum, showing all your working:
- $$(110111)_2 + (1010111)_2 + (1110111)_2.$$
- [2]
- (c) (i) Define what is meant by an irrational number. Say whether or not the repeating decimal 0.17321732..... is a rational or irrational number, justifying your answer.
- (ii) Showing all your working, express the repeating decimal 0.270270..... as a fraction in its simplest terms. [4]

### Question 2

- (a) Let  $A = \{2n : n \in \mathbb{Z}^+\}$  and  $B = \{3, 6, 9, 12, \dots\}$  be two sets of numbers.
- (i) Describe the set  $A$  by the listing method.
  - (ii) Describe the set  $B$  by the rules of inclusion method.
  - (iii) Find the two sets  $A \cap B$  and  $A - B$ , by the listing method. [5]
- (b) Let  $P$ ,  $Q$  and  $R$  be subsets of a universal set  $\mathcal{U}$ .
- (i) Construct a membership table for the set  $X = P' \cup (Q \cap R)$ .
  - (ii) Draw a labelled Venn diagram showing  $P$ ,  $Q$ , and  $R$  intersecting in the most general way.
  - (iii) Shade the region  $X$  on your diagram.
  - (iv) Is the set  $Q \cap R \subseteq X$ ? Justify your answer. [5]