

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

**Foundation Year
2008/09**

COMPUTING

**IS50001A (FY02)
Foundation Mathematics for Computing**

EXAMINATION

Duration: 3 hours

You should answer all the questions on this paper. There are ten questions in total. All questions are worth 10 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.

No calculators should be used.

**THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM**

1. This question is about numbers, fractions, ratios and the binary and hexadecimal number systems

(a) Convert the following into decimals. [3]

i. $0.333\dots$

ii. 0.125

(b) Write the following as fractions in their simplest form. [2]

i. $\frac{238}{1000} = \frac{119}{500}$

ii. $0.0125 = \frac{125}{10000} = \frac{1}{80}$

(c) Write how much Asif, Beth and Charlie get if they share £5000 in the following ratios [2]

i. £500 for Asif £2000 for Beth and £2500 for Charlie

ii. £10 for Asif £100 for Beth and £890 for Charlie

iii. £50 for Asif £500 for Beth and £4450 for Charlie

(d) Calculate the following and show your working in binary [3]

i. 10101_2

ii. 1101_2

iii. $10010_2 * 100100_2 = 110110_2$

2. This question is about sets and logic

Complete truth tables for the following and hence decide whether each of the logical formula is a contingency, tautology or a contradiction.

(a)

$$(P \wedge \neg Q) \vee Q$$

[4]

P	Q	$\neg Q$	$P \wedge \neg Q$	$(P \wedge \neg Q) \vee Q$
T	T	F	F	T
T	F	T	T	T
F	T	F	F	T
F	F	T	F	F

This is a contingency

(b)

$$(\neg P \Rightarrow \neg Q) \Rightarrow (\neg P \Rightarrow R)$$

[6]

P	Q	R	$\neg P$	$\neg Q$	$\neg P \Rightarrow \neg Q$	$\neg P \Rightarrow R$	$(\neg P \Rightarrow \neg Q) \Rightarrow (\neg P \Rightarrow R)$
T	T	T	F	F	T	T	T
T	T	F	F	F	T	T	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	T	F	F	T	T
F	T	F	T	F	F	F	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	F	F

This is a contingency

3. This question is about sets and Venn diagrams

The sets A , B and C are defined as follows.

$$A = \{1, 3, 5, 7, 9\}$$

$$B = \{0, 1, 2, 4, 6, 8\}$$

$$C = \{2, 4, 5, 6, 7\}$$

$$\epsilon = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$$

(a) Calculate the following [5]

i. $A \cup B = \epsilon$

ii. $A \cup (B \cap C) = \{1, 2, 3, 4, 5, 6, 7, 9\}$

iii. $(A \cup B) \cap C = C$

iv. $\overline{A} \cup B = B$

v. $\overline{A \cap C} = \{0, 1, 2, 3, 4, 6, 8, 9\}$

(b) Shade the following regions on a venn diagram [5]

i. $P \cap Q$

ii. $\overline{P \cap Q}$

iii. $\overline{(P \cup Q) \cap R}$

4. This question is about series

Consider the following series

(a) $x_k = 3 + 4k$

(b) $x_k = 3 - 5k$

(c) $x_k = k + \frac{1}{k}$

(d) $x_k = \frac{2}{3^k}$

(a) $x_1 = 7$ and $x_2 = 11$ [2]

(b) (a) is arithmetic, (b) is arithmetic, (c) is neither and (d) is geometric [4]

(c) -87 [2]

(d) 1 [2]

5. This questions is about linear, simultaneous and quadratic equations

- (a) Solve the following equations [4]

$$x = 0$$

$$x = -\frac{1}{10}$$

- (b) Solve the following quadratic equations by factorisation [3]

$$(x + 1)(x - 2) = 0, x = 1, -2$$

$$(2x - 1)(x + 2) = 0, x = \frac{1}{2}, -2$$

- (c) Solve the following simultaneous equations [3]

$$x = -5, y = 3$$

6. This question is about functions

Consider the following functions

$$f(x) = x^3$$

$$g(x) = \frac{1}{x+1}$$

$$h(x) = 3x - 1$$

(a) Evaluate the following [3]

i. 1

ii. 512

iii. 1

(b) $8x^3$ and $(x + 1)^3$ [2]

(c) $\frac{1}{x} - 1$ [2]

(d) $\frac{1}{9}x^{-3}$ [3]

7. This question is about plotting graphs

(a) See below $x = -1, y = 3$ [4]

(b) See below $x = 1, x = -1$ [3]

(c) Sketch the following graphs. Please see below [3]

$$y = x^3$$

$$y = -x^3$$

$$y = (-x)^3$$

8. This question is about trigonometry

(a) See below [2]

(b) Make x the angle between the sides of length 3 and 4. Then calculate [3]

$$\cos x = \frac{3}{5}$$

$$\sin x = \frac{4}{5}$$

$$\tan x = \frac{4}{3}$$

(c) In which quadrant (1,2,3 or 4) does the angle x lie for the following situations [2]

$\sin x > 0$ and $\cos x > 0$ quadrant 1

$\sin x < 0$ and $\cos x > 0$ quadrant 2

(d) Solve $\sin x = \sin 2x$ for $0 \leq x < 360$ solutions $x = 0, 90, 180, 270$ [3]

9. This question is about matrices

- (a) Evaluate the following [2]

$$\begin{pmatrix} 3 & 2 & 1 \\ 0 & 0 & 1 \\ 1 & 3 & 6 \end{pmatrix} + \begin{pmatrix} 0 & 1 & 2 \\ 0 & 0 & 1 \\ 1 & 2 & 3 \end{pmatrix} = \begin{pmatrix} 3 & 3 & 3 \\ 0 & 0 & 2 \\ 2 & 5 & 9 \end{pmatrix}$$

- (b) Evaluate the following [2]

$$\begin{pmatrix} 2 & 1 \\ 3 & 6 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} = \begin{pmatrix} 4 & 7 \\ 15 & 24 \end{pmatrix}$$

- (c) Write down the identity 4 by 4 matrix. [2]

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

- (d) Find the inverse of the following Matrix. [2]

It is its own self-inverse

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

- (e) Prove that the following matrix has no inverse. [2]

$$\begin{pmatrix} a & b \\ a^2 & ab \end{pmatrix}$$

determinant = $a^2b = a^2b = 0$ so there is no inverse matrix

10. This Question is about Probability

(a) This is about tossing 2 coins [3]

- i. What is the probability of obtaining exactly two heads? $\frac{1}{4}$
- ii. What is the probability of obtaining exactly one head? $\frac{1}{2}$
- iii. What is the probability of obtaining exactly no heads? $\frac{1}{4}$

(b) If I tossed a coin 5 times what is the probability that it would be heads every time? $(\frac{1}{2})^5 = \frac{1}{32}$ [2]

(c) A biased die with 6 sides has the following probabilities [5]

$$P(1) = 0.1$$

$$P(2) = 0.15$$

$$P(3) = 0.1$$

$$P(4) = 0.2$$

$$P(5) = 0.2$$

$$P(6) = \textit{unknown}$$

- i. What is P(6)? 0.25
- ii. What is the probability of getting an odd number? 0.4
- iii. What is the probability of throwing the dice twice and getting a total score of 3 = $0.015 + 0.015 = 0.03$?
- iv. What is the most likely score when you toss a dice twice? 7