# 1.10 Systems of Linear Equations

## Question Paper

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| Course | DP IB Maths |
| Section | 1. Number & Algebra |
| Topic | 1.10 Systems of Linear Equations |
| Difficulty | Very Hard |

**Time allowed:** 90

**Score:** /72

**Percentage:** /100

## Question 1a

Solve the following simultaneous equations.

(a)

$$5x - 2y = 9.5$$
$$-2x - 5y = 16.5$$

**[2 marks]**

## Question 1b

(b)

$$3(a - 2b) = 7 - b$$
$$2(2a - b) = 5b - 11$$

**[2 marks]**

## Question 1c

(c)

$$\frac{2(p-q)}{5} - \frac{3p}{2} = \frac{p - 4q}{10}$$
$$\frac{2p}{3} - \frac{4q}{5} = 1 - \frac{2}{3}q$$

**[3 marks]**

## Question 2

Use an algebraic method to solve the following system of linear equations.

$$2x-3y-5z=4$$

$$x-4y+6z=-6$$

$$3y-2x-3z=0$$

**[6 marks]**

## Question 3

Solve the following system of linear equations using an algebraic method.

$$2x-3y+4z=-1$$

$$x-4y-6z=8$$

$$5y-3x-5z=1$$

**[1 mark]**

## Question 4

Use an algebraic method to solve the following system of linear equations.

$$3y - 2x + 5z = 14$$

$$3x - 2y - 2z = 11$$

$$3z - 4x - 4y = 35$$

**[6 marks]**

## Question 5

Find the unique point of intersection of the planes with the following Cartesian equations:

$$x - 3y + 2z = -3$$

$$z + 2y - x = 4$$

$$3z + y - 4x = 1$$

**[6 marks]**

## Question 6

Consider the function $f$ defined by $f(x) = x^4 + ax^3 + bx^2 + cx + 24$. The graph $y = f(x)$ passes through the points $(1,36)$, $(2,24)$ and $(3,0)$.

Find the values of $a$, $b$ and $c$.

**[6 marks]**

## Question 7a

Consider the system of equations

$$2a + 6b + xc = y$$

$$6b - a - c = 7$$

$$a + 2b - 3c = 1$$

where $x$ and $y$ are real constants.

(a)
Find the value of $x$ such that the system does not have a unique solution.

**[5 marks]**

## Question 7b

(b)
Given that $c = 0$ find the values of $a$, $b$ and $y$ such that the system of equations has a solution

**[3 marks]**

## Question 8a

Consider the following system of equations

$$x + 2y - z = 0$$

$$2x - y + 4z = 0$$

$$x - 3y + (1 - a)z = 4 - a^2$$

(a)
Show that the system has a unique solution when $a \neq -4$.

**[3 marks]**

## Question 8b

(b)
For the case where $a \neq -4$, state the solution in terms of $a$.

**[5 marks]**

## Question 8c

(c)
For the case where $a = -4$, show that there are no solutions.

**[2 marks]**

## Question 9a

The following system of equations has an infinite number of solutions.

$$3x - 2y - 7z = 3$$

$$2x + y - 4z = 1$$

$$3y - x + 3z = k$$

(a)
Find the value of $k$.

**[4 marks]**

## Question 9b

(b)
Find the general solution.

**[4 marks]**

## Question 10a

Consider the following system of linear equations.

$$x - 3y + 3z = k$$

$$3x - 2y + z = 4$$

$$2x + y - 2z = 2$$

(a)
Show that the system of equations does not have a unique solution.

**[3 marks]**

## Question 10b

(b)
Find the value of $k$ for which the equations are consistent.

**[2 marks]**

## Question 10c

(c)
For the value of $k$ found in part (b), find the general solution of these equations.

**[3 marks]**

## Question 11

The rate, $R$, of increase of the volume of a cloud created in a science lab is related to the change in air temperature, $T$, and air pressure, $P$, by the equation

$$R = kT^x P^y, \text{ where } x, y, k \in \mathbb{R}.$$

A meteorologist takes measurements at three intervals and records the data as follows.

| Measurement | $R$ $(\text{cm}^3\text{s}^{-1})$ | $T$ $(°\text{C})$ | $P(\text{kPa})$ |
|---|---|---|---|
| 1 | 48.75 | 17.1 | 101.2 |
| 2 | 46.13 | 15.9 | 101.8 |
| 3 | 43.47 | 14.7 | 102.5 |

Find $x$, $y$ and $k$.

**[6 marks]**