

Lagan College Mathematics Department



GCSE FURTHER MATHS

Vectors
PP Questions

Answer **all twelve** questions

- 1 (Throughout this question **i** and **j** denote unit vectors parallel to a set of standard x - y axes.)

A package of mass 4 kg rests in equilibrium on a smooth horizontal plane under the action of three horizontal forces

$$(2\mathbf{i} - 3\mathbf{j}) \text{ N} \quad (7\mathbf{i} - 5\mathbf{j}) \text{ N} \quad \text{and} \quad (a\mathbf{i} + b\mathbf{j}) \text{ N}$$

where a and b are constants.

- (i) Find the values of a and b . [3]

The three forces are now removed and replaced by a single force $(8\mathbf{i} - 6\mathbf{j})$ N and the package begins to move along the plane.

- (ii) Calculate the acceleration of the package in vector form. [1]

- 2 Ursula recorded the fuel consumption of each of 38 cars taking part in a fixed length test drive. Each recording was rounded to the nearest litre. The results are summarised in **Table 1**.

Table 1

Fuel consumption (litres)	8–9	10–11	12–14	15–17	18–19
Number of cars	6	8	12	9	3

Using **Fig. 1** in your Supplementary Answer Booklet, draw a histogram to represent this information. **Label each axis clearly.** [5]

- 5 A particle is initially at rest at the origin. It is acted upon by a force \mathbf{F} and it moves with constant acceleration in a straight line in a horizontal plane. After 4 seconds the position vector of the particle is $(-16\mathbf{i} + 24\mathbf{j})$ metres.

(i) Show that the acceleration of the particle is $(-2\mathbf{i} + 3\mathbf{j})\text{ m/s}^2$. [2]

(ii) Find in vector form the velocity of the particle after 4 seconds. [2]

The particle is of mass 3 kg. The force \mathbf{F} is the resultant of two forces \mathbf{P} and \mathbf{Q} where $\mathbf{P} = (10\mathbf{i} - 5\mathbf{j})\text{ N}$.

(iii) Find the force \mathbf{Q} in vector form. [3]

- 6 (a) Students were asked how long it had taken them to travel to school. The times were recorded to the nearest minute and are summarised in **Table 2**.

Table 2

Time taken t (min)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 40$	$40 < t \leq 60$
Number of students	23	86	122	107	51

Calculate an estimate of the median time. [4]

- (b) Luca recorded the number of people in each car passing through the school gates. **Table 3** below summarises his findings.

Table 3

Number of people	1	2	3	4	5	6	7
Number of cars	18	46	71	85	x	10	2

If the mean number of people per car is 3.5 find x . [4]

- 1 Micah recorded the volumes of liquid produced in an experiment carried out by his class. The mean volume was calculated to be 77 ml and the standard deviation 8.1 ml.

To compare these volumes with results recorded under different conditions, each volume had to be multiplied by 0.69

- (i) Calculate the mean and standard deviation of the adjusted volumes. [2]

The **original** volumes were each rescaled by adding 0.2 and then multiplying by 0.98

- (ii) Calculate the mean and standard deviation of these rescaled volumes. [3]

- 2 (Throughout this question **i** and **j** denote unit vectors parallel to a set of standard x - y axes.)

A body of mass 8 kg, initially at the origin O, accelerates uniformly from a velocity of $(4\mathbf{i} - 2\mathbf{j})$ m/s to a velocity of $(3\mathbf{i} + 9\mathbf{j})$ m/s in 6 seconds.

- (i) Find its displacement from O after 6 seconds. [2]

A force **P** is then applied to the body causing it to come to rest in a further 12 seconds.

- (ii) Find the acceleration of the body. [1]

- (iii) **Hence** find the force **P** in component form. [1]

- (iv) Find the magnitude of **P**. [1]

Section A

Mechanics

You should spend approximately **one hour** on this section.

Take $g = 10 \text{ m/s}^2$ when required.

- 1** (Throughout this question **i** and **j** denote unit vectors parallel to a set of standard x - y axes.)

Vectors **a** and **b** are defined by

$$\mathbf{a} = 2\mathbf{i} + 3\mathbf{j} \quad \text{and} \quad \mathbf{b} = 4\mathbf{i} - 2\mathbf{j}$$

Find

- (i)** the vector $3\mathbf{a} - \mathbf{b}$ in terms of **i** and **j**,

Answer _____ [2]

- (ii)** the magnitude of the vector $3\mathbf{a} - \mathbf{b}$,

Answer _____ [1]

Examiner Only	
Marks	Remark

(iii) the acute angle the vector $3\mathbf{a} - \mathbf{b}$ makes with the positive x -axis.

Answer _____^o [1]

Examiner Only	
Marks	Remark

Section A**Mechanics**

Candidates should spend approximately one hour on this section.

Take $g = 10 \text{ m/s}^2$

Throughout this question **i** and **j** denote unit vectors parallel to a set of standard x - y axes.

- 1** A particle is initially at rest at the origin. It is acted upon by a force and it moves with constant acceleration in a straight line on a horizontal plane. After 2 seconds the position vector of the particle is $(15\mathbf{i} - 21\mathbf{j})$ metres.

Calculate the acceleration of the particle.

[2]