



TOTAL SCORE

40/2 = 20 %

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
FAKULTI KEJURUTERAAN MEKANIKAL**

**UJIAN**

**KOD MATA PELAJARAN : BMCU 1022**  
**MATA PELAJARAN : KAEDAH UJIKAJI**  
**PENYELARAS : IMRAN SYAKIR MOHAMAD**  
**MASA : 1 JAM**  
**SEMESTER/SESI : 2 / 2009-2010**

**KURSUS : BMCA / BMCT**  
**KUMPULAN : 1 & 2**

**NAMA PELAJAR : \_\_\_\_\_**  
**NO MATRIK : \_\_\_\_\_**  
**NAMA PENSYARAH : \_\_\_\_\_**

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**ARAHAN KEPADA CALON :**

**(1) Jawab semua soalan.**

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**KERTAS SOALAN INI TERDIRI DARIPADA TUJUH (7) MUKA SURAT BERCETAK  
TERMASUK MUKA HADAPAN**

### Question 1 (6 marks)

- a) What is the basic dimension unit for:
- Density
  - Acceleration
- b) Show that the equation  $\text{Power} = \text{Force} \times \text{Velocity}$  is homogeneous in both S.I. unit and basic dimensions.
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Solution (a)

- $\text{ML}^{-3}$  **(1 mark)**
- $\text{LT}^{-2}$  **(1 mark)**

Solution (b)

$$P = Fv$$

SI unit for P is watt. Watt = Joule/second. Joule = Nm. Watt = Nm/s

SI unit for force = newton, velocity = m/s

Therefore:  $Fv = \text{Nm/s}$  **(2 marks)**

So, the equation is homogeneous.

Writing in MLT dimension,

$$[P] = \text{ML}^2\text{T}^{-3}$$

$$[v] = \text{LT}^{-1}$$

$$[F] = \text{MLT}^{-2}$$

Substituting into the equation:

$$\text{ML}^2\text{T}^{-3} = \text{MLT}^{-2} \times \text{LT}^{-1} = \text{ML}^2\text{T}^{-3} \quad \textbf{(2 marks)}$$

Hence the equation is homogeneous.

## Question 2 (6 marks)

Explain what is mode ( $M_o$ ), mean ( $\bar{X}$ ) and median ( $M_d$ )? For a set of five whole numbers, the mean is 4, the mode is 1, and the median is 5. What are the five numbers? Show your explanation.

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Solution

Mode is the most frequently occurring score value. **(1 mark)**

Mean is the sum of the score divided by the number of score. **(1 mark)**

Median is the score value which cut the distribution in half. **(1 mark)**

As the mode is 1, there must be at least two 1's. But because the median is 5, the third number must be 5, and so we have the set of numbers  $\{1, 1, 5, x, y\}$ .

If the mean is 4, the sum of the numbers must be  $4 \times 5 = 20$ ; that is,  $1 + 1 + 5 + x + y = 20 \Rightarrow x + y = 13$ .

Without loss of generality (WLOG), let  $x \leq y$ , and if  $x = y$ , we get  $x + x = 13$ ,  $2x = 13$ ,  $x = 6.5$ . Clearly  $x \geq 5$ , and so  $5 \leq x \leq 6.5$

However, if  $x = 5$ , we would have two modal values: 1 and 5. Hence we deduce that  $x = 6$ ,  $y = 7$ .

Explanation = **(2 marks)**

The set of five numbers must be  $\{1, 1, 5, 6, 7\}$ . **(1 mark)**

**Question 3 (6 marks)**

The following readings are taken of a certain physical mass.

Reading	1	2	3	4	5	6	7	8	9	10
X (kg)	40.3	33.8	40.9	51.3	46.5	44.0	45.6	44.0	39.8	33.8

Compute the: variance and standard deviation. Show all the calculation.

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Solution

Variance

X	$\bar{X} - X$	$\left(\bar{X} - X\right)^2$
33.8	8.2	67.24
33.8	8.2	67.24
39.8	2.2	4.84
40.3	1.7	2.89
40.9	1.1	1.21
44.0	-2.0	4.00
44.0	-2.0	4.00
45.6	-3.6	12.96
46.5	-4.5	20.25
51.3	-9.3	86.49
$\bar{X} = 42.0$		$\Sigma = 271.12$

Table or calculation = **(2 marks)**

$$s^2 = \frac{271.12}{9} = 30.12 \text{ kg}^2 \quad \textbf{(2 marks)}$$

Standard deviation.

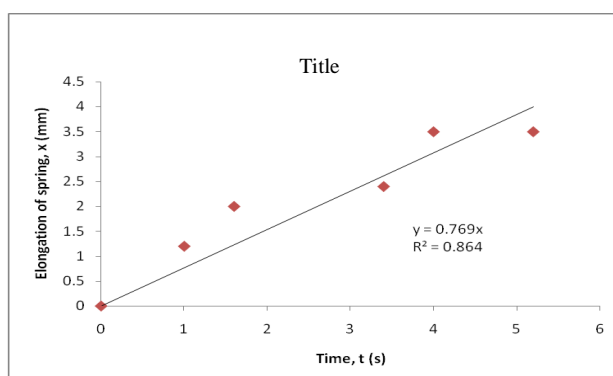
$$s = \sqrt{30.12} = 5.49 \text{ kg} \quad \textbf{(2 marks)}$$

#### Question 4 (8 marks)

The following readings are taken from the experiment of determination of gravitational acceleration.

Time, t (s)	1.0	1.6	3.4	4.0	5.2
Elongation of spring, x (mm)	1.2	2.0	2.4	3.5	3.5

- (a) Plot the graph. **(3 marks)**



- (b) Find the equation that describes the linear relationship for the data above. Use the following formula to derive the relationship.

$$a = \frac{\sum y \sum x^2 - \sum x \sum xy}{n \sum x^2 - (\sum x)^2}, \quad b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

x	y	xy	x <sup>2</sup>
1.0	1.2	1.2	1.0
1.6	2.0	3.2	2.56
3.4	2.4	8.16	11.56
4.0	3.5	14.0	16.0
5.2	3.5	18.2	27.04
$\Sigma = 15.2$	$\Sigma = 12.6$	$\Sigma = 44.76$	$\Sigma = 58.16$

Table or calculation = **(2 marks)**

$$a = \frac{\sum y \sum x^2 - \sum x \sum xy}{n \sum x^2 - (\sum x)^2} = \frac{(2.6)(8.16) - (5.2)(44.76)}{5(8.16) - (5.2)^2} = 0.878 \quad \textbf{(1 mark)}$$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} = \frac{5(44.76) - (5.2)(2.6)}{5(8.16) - (5.2)^2} = 0.540 \quad \textbf{(1 mark)}$$

The relationship is  $y = 0.878x + 0.540$  **(1 mark)**

**Question 5 (8 marks)**

What is an **average deviation** mean? Find the average and the average deviation of the following measurements of a mass.

Mass (g)	4.32	4.35	4.31	4.36	4.37	4.34
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Solution:

**average deviation** of a data set is the [average](#) of the absolute deviations and is a [summary statistic](#) of [statistical dispersion](#) or variability. **(2 marks)**

Mass (grams)	$ m - m_{ave} $
4.32	0.0217
4.35	0.0083
4.31	0.0317
4.36	0.0183
4.37	0.0283
4.34	0.0017
Sum = 26.05	Sum = 0.1100
Average = $26.05/6$ = 4.3417 <b>(1 mark)</b>	N-1 = 5 <b>(1 mark)</b> Average deviation = $0.1100/5 = 0.022$ <b>(1 mark)</b>

Table or calculation = **(3 mark)**

The mass is  $(4.342 \pm 0.022)$  g or  $(4.34 \pm 0.02)$  g [using average deviations]

### Question 6 (6 marks)

- a) List what are the sections head that should be include in a technical report?
- b) Give an example how we write a reference for:
- i. Book
  - ii. Journal article
  - iii. Thesis
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#### Solution (a)

- Abstract
- Introduction
- Apparatus & Experimental Procedure (or method)
- Data & result
- Discussion
- Conclusion

Each = **(0.5 mark), total = (3 marks)**

#### Solution (b)

- i. Author (year). Title. Place published: Publisher. **(1 mark)**
- ii. Author (year). Title of the article. *Title of the journal*. Volume (Number): page.  
**(1 mark)**
- iii. Author (year). Title of the thesis. Institution: Thesis award. **(1 mark)**