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**Centre Number**

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**Student Number**

# Year 12 Physics

## 2011 Assessment Task 3
## Data Processing and Presentation

**General Instructions**

- Reading time: 5 minutes
- Working time: 60 minutes
- Write using blue or black pen
- You may use a pencil to draw or complete diagrams
- Attempt ALL questions
- Calculators may be used

**Total marks – 35**

**Section A - 10 marks**

Multiple choice
Questions 1-10

**Section B - 25 marks**
Extended answers
Questions 11 - 14

## Section A – Multiple Choice

**10 marks**

Allow about 20 minutes for this section.
Shade the circle corresponding to the most correct response for each question on the answer sheet provided.

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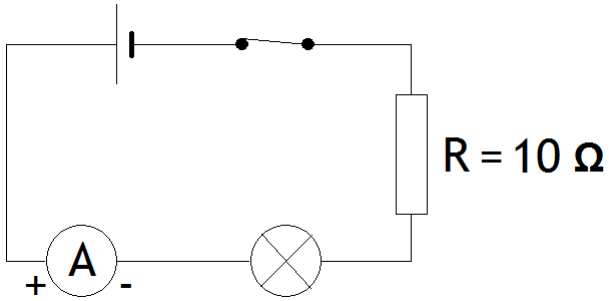
Questions 1 and 2 refer to the information below, which is about an experiment designed to confirm the resistance of a 10 Ω resistor using Ohm's Law.

Ohm's Law states that

$$V = IR$$

where $V$ is the voltage across the resistor, $I$ is the current through the resistor and $R$ is the resistance of the resistor.

The data in the table was collected using a circuit such as the one shown in the diagram. The source voltage was set using the dial on the power source then the voltage was measured across the 10 Ω resistor.




| Voltage (V) | Current (A) | Resistance (Ω) |
|---|---|---|
| 2.00 | 0.19 | 10.53 |
| 4.10 | 0.38 | 10.79 |
| 6.10 | 0.63 | 9.68 |
| 7.90 | 0.78 | 10.13 |
| 10.10 | 0.97 | 10.41 |

**Question 1**

Which of the following lists contains the independent, dependant and controlled variables in that order?

(A) Voltage, current and resistance

(B) Voltage, resistance and current

(C) Current, resistance and voltage

(D) Current, voltage and resistance

**Question 2**

The ammeter that was used had a zero offset error so that when no current was flowing, the reading on the ammeter was -0.2 A. This fault would affect

(A) neither the reliability or accuracy of the data.

(B) only the reliability of the data.

(C) only the accuracy of the data.

(D) both the reliability and accuracy of the data.

**Question 3**

The speed of a wave in a metal string is dependant on the tension in the string and the mass of the string per unit length. The equation is given by

$$v = \sqrt{\frac{Z}{M}}$$

where $Z$ is the tension in the string and $M$ is the mass per unit length of the string.

Which of the following hypotheses is correct for an experiment designed to measure the relationship between the velocity and tension in the string?

(A) The tension in the string is directly proportional to the velocity.

(B) The tension in the string is inversely proportional to the velocity.

(C) The tension in the string is directly proportional to the velocity squared.

(D) The tension in the string is inversely proportional to the velocity squared.

**Question 4**

When a voltage $V$ of 12.2 V is applied to a DC motor, the current $I$ in the motor is measured to be 0.20 A. Which one of the following is the correct output power $VI$ of the motor given to an appropriate number of significant digits?

(A) 2 W

(B) 2.4 W

(C) 2.40 W

(D) 2.44 W

Questions 5 and 6 refer the information below that shows the data collected by four different students measuring the acceleration due to gravity using a pendulum.

**Karen's Data**

| Length Pendulum (m) | Period Pendulum (s) | Acceleration Due to Gravity ($ms^{-2}$) |
|---|---|---|
| 1.0 | 2.10 | 8.94 |
| 1.2 | 2.20 | 9.78 |
| 1.4 | 2.36 | 9.91 |
| 1.6 | 2.60 | 9.33 |
| 1.8 | 2.80 | 9.05 |
| 2.0 | 3.00 | 8.76 |
| | AVERAGE | 9.30 |

**Lachlan's Data**

| Length Pendulum (m) | Period Pendulum (s) | Acceleration Due to Gravity ($ms^{-2}$) |
|---|---|---|
| 1.0 | 1.90 | 10.92 |
| 1.2 | 2.25 | 9.35 |
| 1.4 | 2.34 | 10.08 |
| 1.6 | 2.50 | 10.10 |
| 1.8 | 2.90 | 8.44 |
| 2.0 | 3.10 | 8.21 |
| | AVERAGE | 9.52 |

**David's Data**

| Length Pendulum (m) | Period Pendulum (s) | Acceleration Due to Gravity ($ms^{-2}$) |
|---|---|---|
| 1.0 | 2.00 | 9.86 |
| 1.2 | 2.20 | 9.78 |
| 1.4 | 2.37 | 9.83 |
| 1.6 | 2.54 | 9.78 |
| 1.8 | 2.69 | 9.81 |
| 2.0 | 2.85 | 9.71 |
| | AVERAGE | 9.79 |

**Talia's Data**

| Length Pendulum (m) | Period Pendulum (s) | Acceleration Due to Gravity ($ms^{-2}$) |
|---|---|---|
| 1.0 | 1.91 | 9.07 |
| 1.2 | 2.22 | 8.81 |
| 1.4 | 2.31 | 8.90 |
| 1.6 | 2.58 | 9.07 |
| 1.8 | 2.65 | 8.96 |
| 2.00 | 2.97 | 8.96 |
| | AVERAGE | 8.96 |

**Question 5**

Which student collected the most reliable data?

(A) Karen

(B) Lachlan

(C) David

(D) Talia

**Question 6**

Which student collected the most accurate data?

(A) Karen

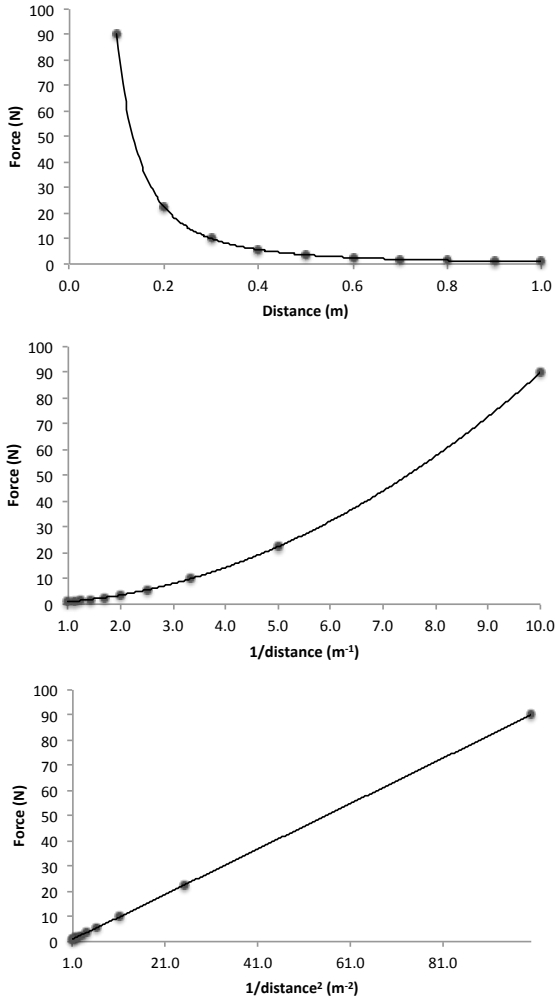
(B) Lachlan

(C) David

(D) Talia

**Question 7**

An experiment was done to measure the force between two spheres, each carrying a charge of 10 μC. The force $F$ was measured at different distances $d$ and the data was processed to give the three graphs shown below.




A correct conclusion based on these data alone would be

(A) $F \propto d$

(B) $F \propto d^2$

(C) $F \propto \frac{1}{d}$

(D) $F \propto \frac{1}{d^2}$

**Question 8**

The time $T$ of oscillation of a mass $m$ suspended from a vertical spring is given by the expression

$$T = 2\pi \sqrt{\frac{m}{k}}$$

where $k$ is a constant.

Which on of the following plots for a graph would allow the value of the constant $k$ to be determined using the gradient of the line?

(A) $T^2$ against $m$

(B) $\sqrt{T}$ against $\sqrt{m}$

(C) $T$ against $m$

(D) $\sqrt{T}$ against m

**Question 9**

An experiment was done to measure the acceleration due to gravity by dropping different objects with varying masses from different heights and then timing how long they took to fall to the ground using a stopwatch. At each height, three (3) trials were conducted and an average time calculated. The relationship between height and time is given by

$$h = \frac{gt^2}{2}$$

where $h$ is the height, $g$ is the acceleration due to gravity and $t$ is the time taken to fall to the ground.

To improve the reliability of the data collected in this experiment, the method could be modified by

(A) using only one object with the same mass for each height.

(B) using the wall clock in the laboratory instead of a stopwatch.

(C) recording only one (1) time measurement for each height.

(D) recording five (5) time measurements for each height.

**Question 10**

For a transformer, there is a relationship between current *I* and the number of turns *N* in the primary and secondary coil.

The table below shows data collected from an experiment where current and number of turns in the primary and secondary coils were measured.

| $N_p$ | $N_s$ | $I_p$ (A) | $I_s$ (A) |
|---|---|---|---|
| 100 | 100 | 1.0 | 1.0 |
| 100 | 80 | 1.0 | 1.3 |
| 100 | 60 | 1.0 | 1.7 |
| 100 | 40 | 1.0 | 2.5 |
| 100 | 20 | 1.0 | 5.0 |

A correct conclusion that could be drawn from the results of this experiment would be that

(A) the number of turns in the secondary coil is proportional to the current in the secondary coil.

(B) the number of turns in the secondary coil is inversely proportional to the current in the secondary coil.

(C) the number of turns in the secondary coil is proportional to the voltage in the secondary coil.

(D) the number of turns in the secondary coil is inversely proportional to the voltage in the secondary coil.

## Section B

**30 marks**

Allow about 40 minutes for this section
Answer the questions in the spaces provided.

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**Centre Number**

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**Student Number**

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**Marks**

**Question 11** (4 marks)

A student was designing an experiment to determine the relationship between the pressure, volume and temperature of a gas. In doing some background research, they found the following results from an experiment that was conducted by physicist on a constant concentration of a gas.

| Pressure (atm) | Volume (L) | Temperature (K) |
|---|---|---|
| 5 | 1 | 61 |
| 10 | 1 | 121 |
| 15 | 1 | 182 |
| 20 | 1 | 242 |
| 25 | 1 | 303 |
| 25 | 2 | 605 |
| 25 | 4 | 1211 |
| 25 | 8 | 2421 |
| 25 | 16 | 4840 |
| 30 | 13 | 4840 |
| 35 | 11 | 4840 |
| 40 | 10 | 4840 |
| 45 | 9 | 4840 |

(a) Deduce a suitable hypothesis for the relationship between volume and temperature. **2**

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(b) Which variable(s) would need to be controlled in an experiment designed to measure the relationship in part (a)? **2**

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**Marks**

**Question 12** (5 marks)

A student used a simple pendulum and the equation below to measure the acceleration due to gravity.

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Where $T$ is the period of the pendulum, $l$ is the length and $g$ is the acceleration due to gravity.

Their method is outlined below:

1. The equipment was set-up as shown in the diagram on the right.
2. The pendulum was adjusted to a starting length of 1.0 m.
3. The 100 g mass was pulled back to make an angle of 30° to the vertical and the time taken to complete two (2) oscillations was measured and recorded using a stopwatch.
4. The pendulum length was adjusted to 1.2, 1.4, 1.6, 1.8 and 2.0 m and Step 3 was repeated for each length.

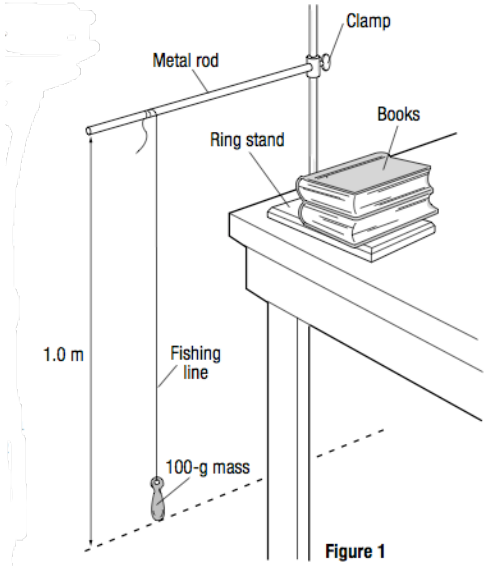

Figure 1

(a) Identify the independent and dependant variables in this experiment. **1**

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(b) Outline one change you would make to the method to improve the RELIABILITY of the data collected. **2**

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(c) Outline one change you would make to the method to improve the VALIDITY of the experiment. **2**

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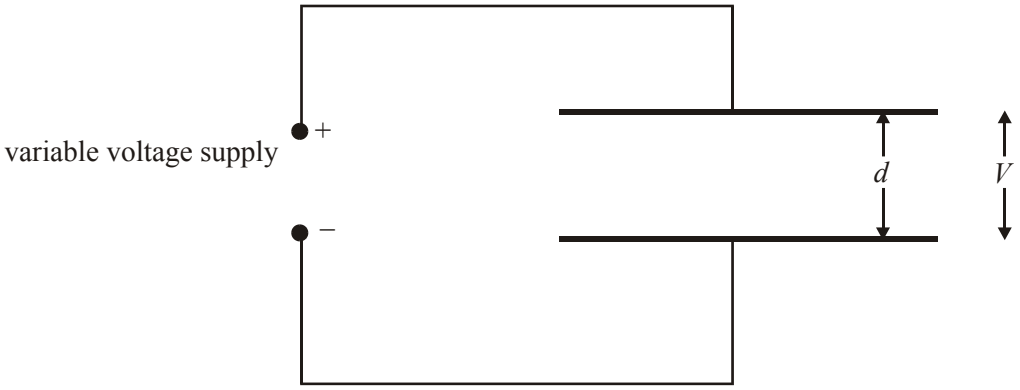
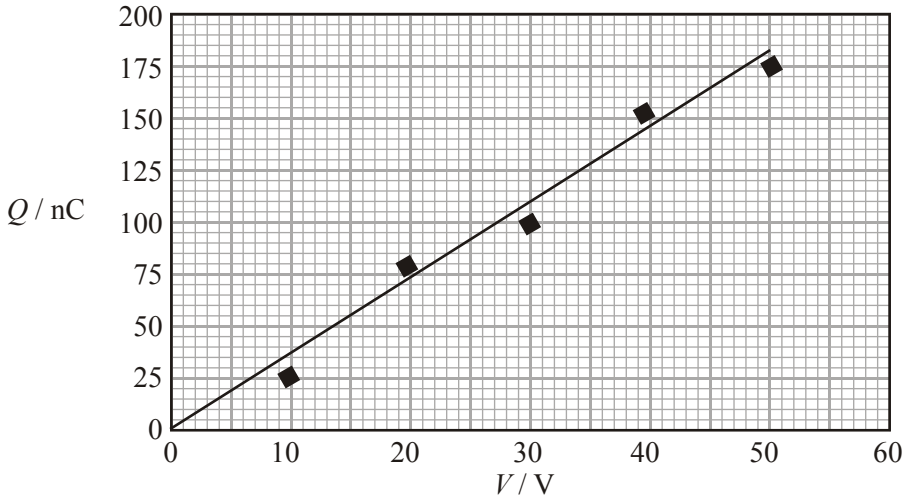
**Marks**

**Question 13** (5 marks)

The diagram below shows two parallel conducting plates connected to a variable voltage supply. The plates are of equal areas and are a distance *d* apart.




The charge *Q* on one of the plates is measured for different values of the potential difference *V* applied between the plates. The results of the experiment are shown in the graph below.




(a) Determine the gradient of the line of best fit given that 1 nC = $10^{-9}$ C. **2**

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(b) The gradient of the graph is a property of the two plates and is known as *capacitance*. Deduce the units of capacitance. **1**

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**Marks**

**Question 13 continued**

(c) The relationship between $Q$ and $V$ for this arrangement is given by the expression **2**

$$Q = \frac{\varepsilon_0 VA}{d}$$

where $A$ is the area of one of the plates.

In this particular experiment $A = 0.20\ \text{m}^2$ and $d = 0.50$ mm.

Use your answer to (b) to determine a value for $\varepsilon_0$.

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**Marks**

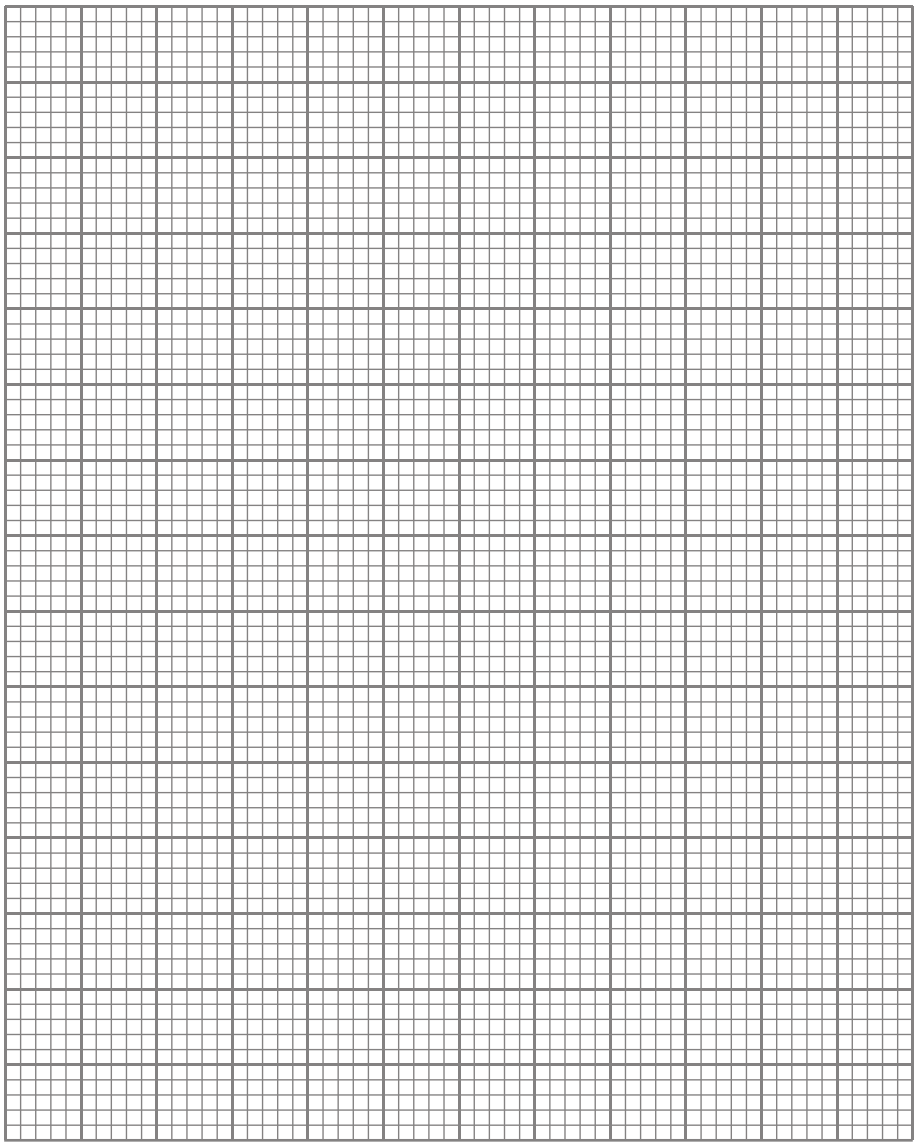
**Question 14** (11 marks)

This question is about change of electrical resistance with temperature. The table below gives values of the resistance $R$ of an electrical component for different values of its temperature $T$.

| **Temperature (°C)** | 1.2 | 2.0 | 3.5 | 5.2 | 6.8 | 8.1 | 9.6 |
|---|---|---|---|---|---|---|---|
| **Resistance (Ω)** | 3590 | 3480 | 3250 | 3060 | 2880 | 2770 | 2650 |

(a) On the grid below, plot a graph to show the variation with temperature $T$ of the resistance $R$. Show values on the temperature axis from $T = 0$ °C to $T = 10$ °C. **5**

Draw a curve that best fits the points you have plotted. Extend your curve to cover the temperature range from 0°C to 10°C.



**Marks**

**Question 14 continued**

(b) Use your graph to determine the resistance at 0°C and 10°C. **2**

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(c) On your graph, draw a straight-line between the resistance values at 0 °C and at 10 °C. This line shows the variation with temperature (between 0°C and 10°C) of the resistance, assuming a linear change. **1**

(d) Assuming a linear change of resistance with temperature, use your graph to determine the temperature at which the resistance is 3060 Ω. **1**

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(e) Use your answer in (d) to calculate the percentage difference in the temperature for a resistance of 3060 Ω that results from assuming a linear change rather than the non-linear change. **2**

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***End of paper***