

Practice Question Set For A-Level  
**Subject : Physics**  
**Paper-1 Topic : 2 (Mechanics)**

**Name of the Student:** \_\_\_\_\_

**Max. Marks : 25 Marks**

**Time : 25 Minutes**

**Q1.**

A student investigates how the efficiency of an electric motor being used to raise a load varies with the weight of the load.

The time taken for the motor to lift a load from the floor to the maximum height was measured using a stopwatch. The load was varied by adding weights, each marked '1.00 N'.

The spreadsheet shows the student's results (columns A to E) and calculation (column F).

|    | A        | B           | C                        | D        | E                    | F          |
|----|----------|-------------|--------------------------|----------|----------------------|------------|
|    | load / N | current / A | potential difference / V | time / s | change in height / m | efficiency |
| 1  |          |             |                          |          |                      |            |
| 2  | 2.00     | 1.8         | 4.6                      | 1.52     | 0.825                | 0.13       |
| 3  | 3.00     | 1.9         | 4.4                      | 2.05     | 0.825                | 0.14       |
| 4  | 4.00     | 2.1         | 4.3                      | 2.19     | 0.825                | 0.17       |
| 5  | 5.00     | 2.3         | 5.1                      | 2.26     | 0.825                | 0.16       |
| 6  | 6.00     | 2.5         | 4.5                      | 2.48     | 0.825                | 0.18       |
| 7  | 7.00     | 3.1         | 5.2                      | 2.17     | 0.825                | 0.17       |
| 8  | 8.00     | 3.7         | 4.8                      | 2.68     | 0.825                | 0.14       |
| 9  | 9.00     | 3.9         | 4.8                      | 3.36     | 0.825                | 0.12       |
| 10 | 10.00    | 4.2         | 4.7                      | 3.72     | 0.825                | 0.11       |

Explain how the value in cell F4 has been determined using the results obtained.

(3)

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**(Total for question = 3 marks)**

**Q2.**

A student is investigating a 'Cartesian diver'.

The diver is made from a plastic pipette. When placed in a plastic bottle full of water the diver rises to the top and touches the lid.



(a) Show that the downward force of the lid on the diver is about 0.02 N.

volume of diver =  $8.0 \times 10^{-6} \text{ m}^3$   
 mass of diver = 0.0059 kg  
 density of water =  $1.0 \times 10^3 \text{ kg m}^{-3}$

(3)

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(b) When the pressure is increased by squeezing the bottle, water is forced into the diver increasing its weight. The diver sinks, then remains at rest in the position shown.



The volume of air in the empty pipette in part (a) was  $8.0 \times 10^{-6} \text{ m}^3$ .  
 Show that the volume now occupied by the air is about  $6 \times 10^{-6} \text{ m}^3$ .

(3)

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- (c) The pressure of the air in the empty pipette in part (a) was  $1.01 \times 10^5$  Pa.  
Calculate the pressure of the air in part (b).

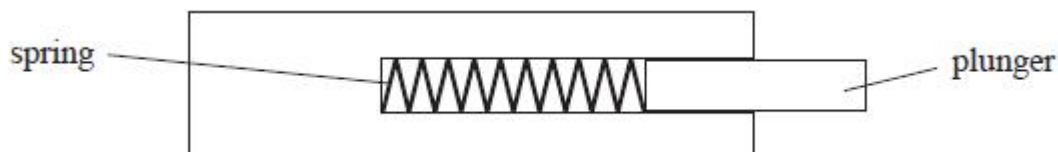
(2)

Pressure = .....

**(Total for question = 8 marks)**

### Q3.

A school dynamics trolley has a plunger attached to a spring. When the plunger is pushed in, the spring is compressed. When the plunger is released, it is pushed back out by the spring.



- (a) A student investigated the spring to determine whether it obeys Hooke's law in compression.

The trolley was placed vertically in front of a scale and weights were added in turn to the top of the plunger, as shown. The position of the end of the plunger was recorded each time.

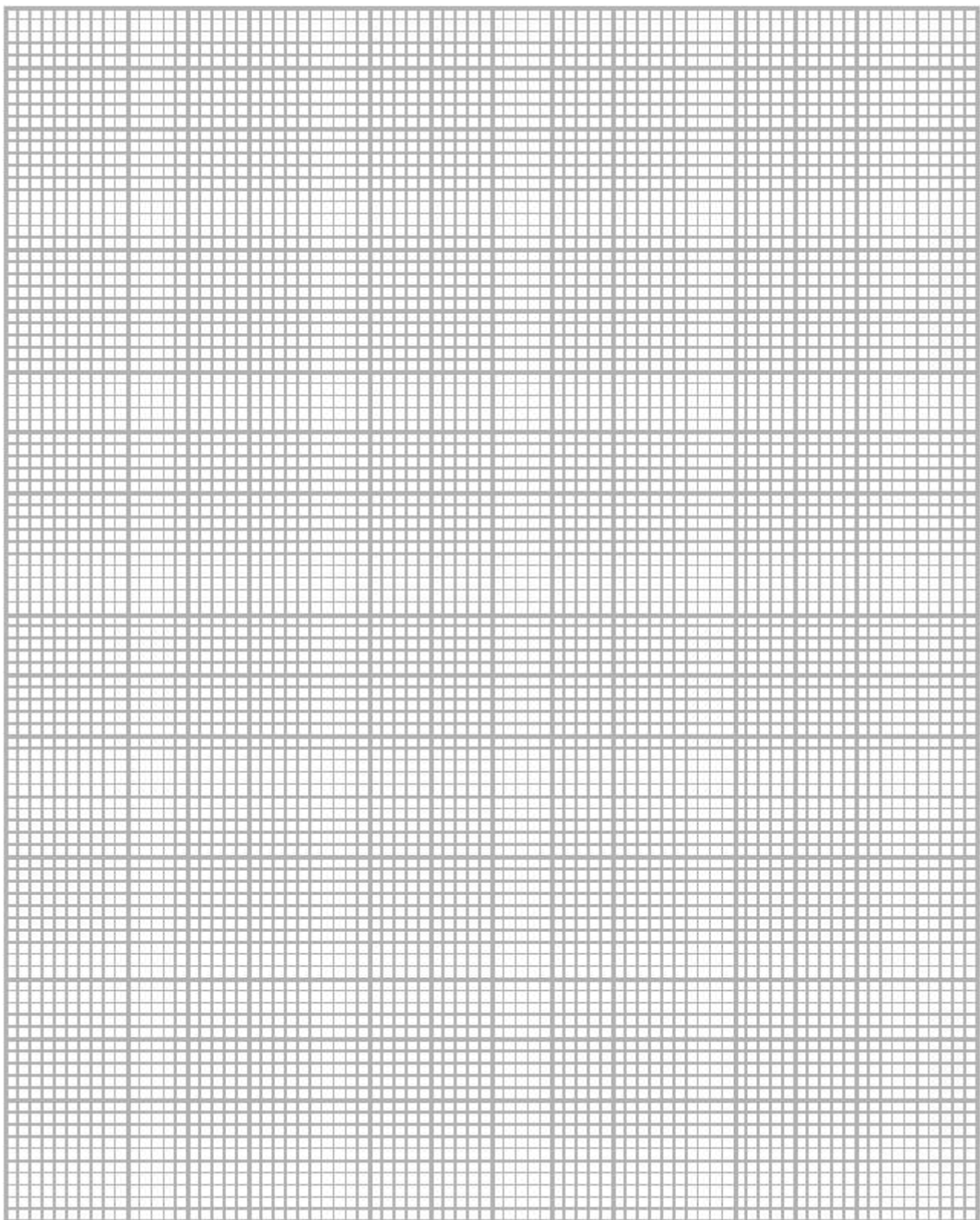


The recorded results are shown in the table.

| Weight / N | Position of plunger / cm |  |
|------------|--------------------------|--|
| 0.00       | 37.3                     |  |
| 2.00       | 37.0                     |  |
| 4.00       | 36.6                     |  |
| 6.00       | 36.2                     |  |
| 8.00       | 35.9                     |  |
| 10.00      | 35.5                     |  |

(i) Use the results to plot a graph of weight against compression. You may use the additional column for your processed data.

(5)



(ii) The student concluded that the spring obeys Hooke's law with a spring constant of about  $600 \text{ N m}^{-1}$ . Determine whether the student's conclusion is justified.

(4)

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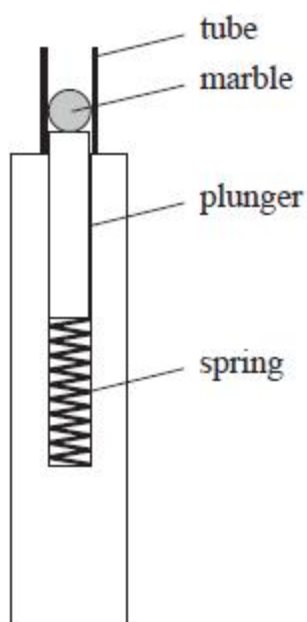
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 (b) Another trolley was adapted by placing a tube around the plunger so that it could be used to launch marbles. A marble was placed in the tube while the plunger was depressed. When the plunger was released it launched the marble.



Determine the maximum possible launch velocity of the marble when the spring is compressed by 5.4 cm.  
 spring constant =  $610 \text{ N m}^{-1}$   
 mass of marble = 4.1 g  
 mass of plunger = 35.4 g

(4)

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 Maximum launch velocity = .....

(c) The launch velocity was measured using a light gate and data logger. This produced a smaller value for the launch velocity than that calculated in (b).

Give a reason why this method produced a smaller value for the launch velocity.

(1)

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 (Total for question = 14 marks)