Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

Conductive putty can easily be formed into different shapes to investigate the effect of shape on electrical resistance.

(a) A student uses vernier callipers to measure the diameter d of a uniform cylinder made of the putty.

Suggest **one** problem with using callipers to make this measurement.

_____

_____

_____

(1)

(b) The table below shows the calliper measurements made by a student.

d_1 / mm	d_2 / mm	d_3 / mm	d_4 / mm	d_5 / mm
34.5	34.2	32.9	33.4	34.0

Show that the percentage uncertainty in d is about 2.4%.
Assume that all the data are valid.

(2)

(c) The length of the cylinder is 71 ± 2 mm.

Determine the uncertainty, in mm^3, in the volume of the cylinder.

uncertainty = _____ mm^3

(4)

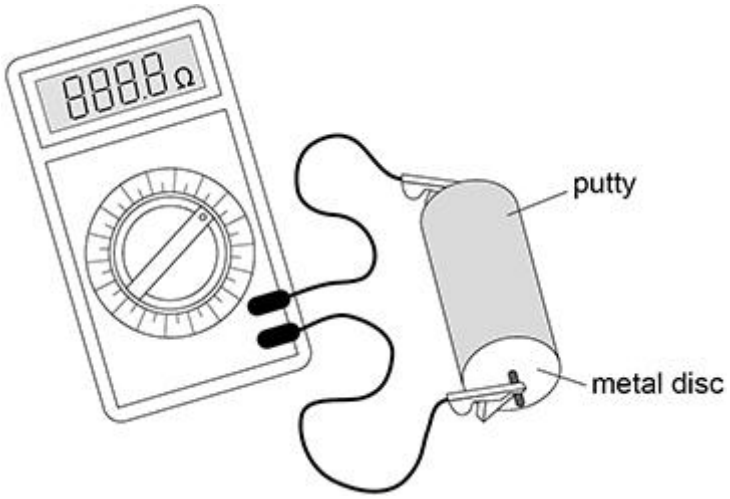
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(d) A student is given some putty to form into cylinders.

To find the resistance of a cylinder, metal discs are placed in contact with the ends of the cylinder and connected to a resistance meter.

Figure 1 shows the apparatus.

Figure 1



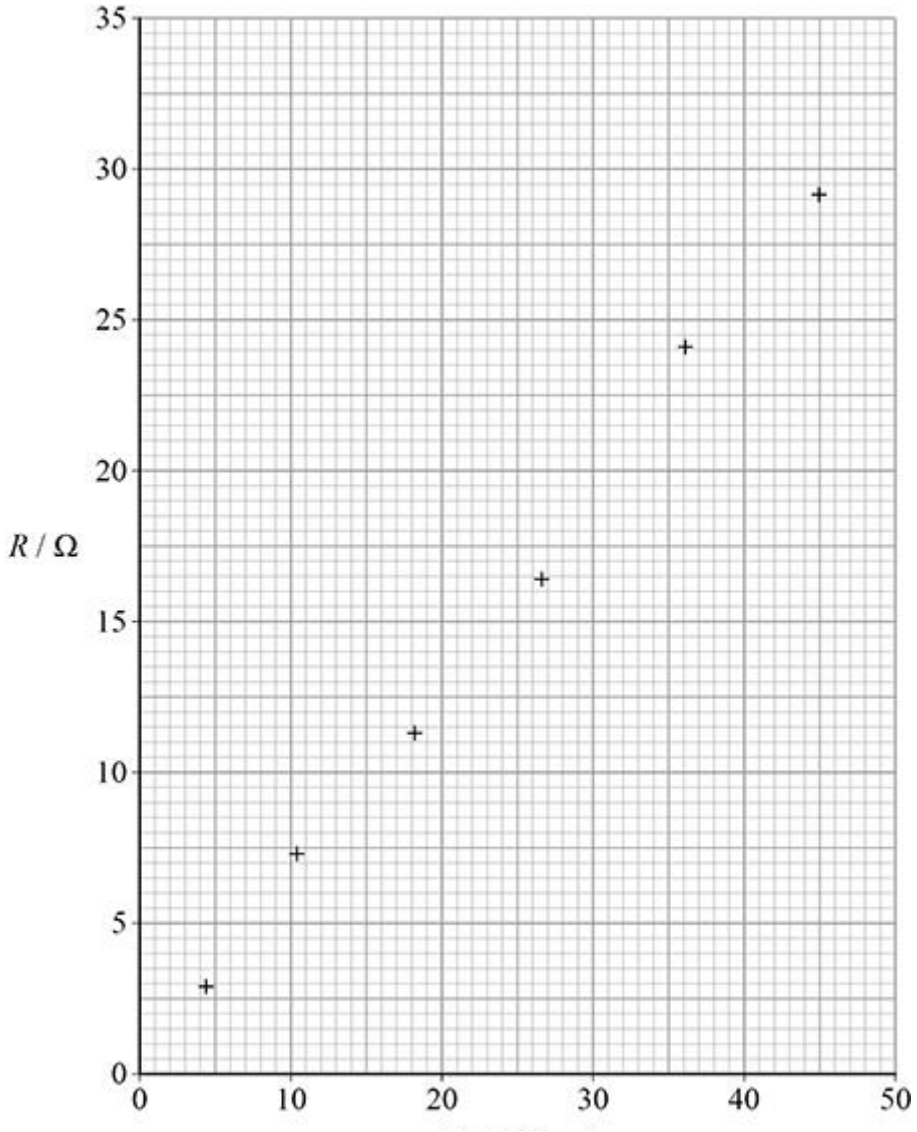
The student forms the putty into cylinders of different lengths, each of volume 5.83×10^{-5} m^3. The length L and resistance R are measured for each cylinder.

It can be shown that $R = \frac{\rho L^2}{5.83 \times 10^{-5}}$ where ρ is the resistivity of the conductive putty.

The student plots the graph shown in **Figure 2**.

Figure 2

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Determine ρ.
State an appropriate SI unit for your answer.

ρ = _____ unit = _____

(4)

(Total 11 marks)

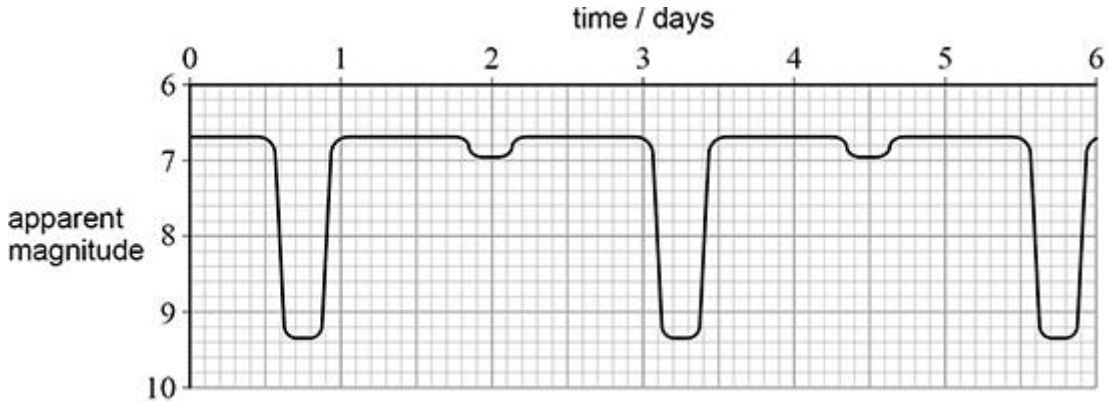
Q2.

U Cephei is an eclipsing binary system consisting of two stars that orbit their common centre of mass.
The primary star is class B; the secondary star is class G.

The figure below shows the variation of apparent magnitude of U Cephei with time as observed from

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Earth.



(a) Explain the shape of the graph in the figure above.

_____

_____

_____

_____

_____

_____

(2)

A particular spectral line has a wavelength of $486.136\ \text{nm}$ when measured from a source in the laboratory.
This line is also present in the absorption spectrum of the primary star of U Cephei. When observed from Earth, the wavelength of the primary star's absorption line varies as shown in the table below.

	Wavelength / nm
maximum value	486.498
minimum value	485.672

(d) State why the average of the values in above table is different from the laboratory value.

_____

_____

(1)

(c) Show that the orbital speed of the primary star is about $250\ \text{km s}^{-1}$.

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(3)

(d) Calculate the orbital radius of the primary star.

orbital radius = _____ m

(2)

(e) Which absorption lines would be most prominent in the spectrum of the primary star?

Tick (✓) **one** box.

- hydrogen ☐
- hydrogen and helium ☐
- ionised metals ☐
- neutral metals ☐

(1)

(f) A different eclipsing binary star system is thought to consist of a white dwarf star and a neutron star.

Discuss how astronomers could confirm this.

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

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