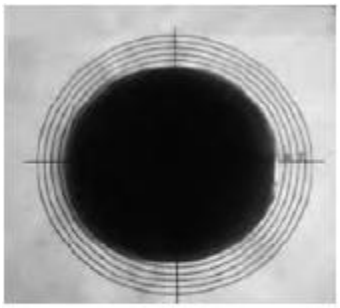
Name of the Student:_____
Max. Marks : 27 Marks **Time : 27 Minutes**

Q1.

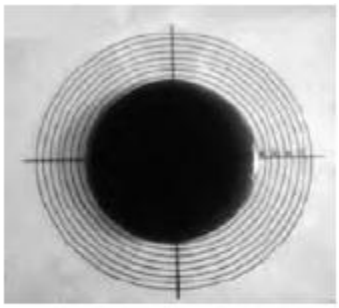
The photograph shows an image of two "pancake" volcanoes on the surface of the planet Venus. Scientists believe these types of volcano are formed from lava spreading out in all directions onto a flat landscape.



A student investigated the formation of pancake volcanoes. She observed the flow of a viscous liquid at two different temperatures as it spread out from a central spot. The photographs below show the liquid at both temperatures after it had been flowing for the same length of time.



High temperature test



Low temperature test

The student carried out an experiment to determine the viscosity of the liquid at room temperature. She observed a steel sphere falling through the liquid.

She had the following equipment:

- a long, wide cylindrical tube
- two steel spheres with diameters 7.0 mm and 22.0 mm
- video camera
- metre rule

The student observed the sphere with a diameter of 7.0 mm falling through the liquid. The sphere fell 0.80 m in 5.3 s at a constant velocity.

The viscosity η of the liquid can be calculated using the equation

$$\eta = \frac{Vg(\rho_s - \rho_l)}{6\pi rv}$$

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providing Stokes' law applies.

(i) Calculate the viscosity of the liquid.

density of liquid ρ_1 = 1430 kg m^{-3}
density of steel ρ_s = 7800 kg m^{-3}

(4)

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Viscosity of liquid = ... Pa s

(ii) If the student had used the larger sphere, the equation would not have produced the correct answer. Explain why.

(2)

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(iii) The student used the video camera to record the sphere falling through the liquid. State **one** benefit of using the video camera to record the motion of the sphere.

(1)

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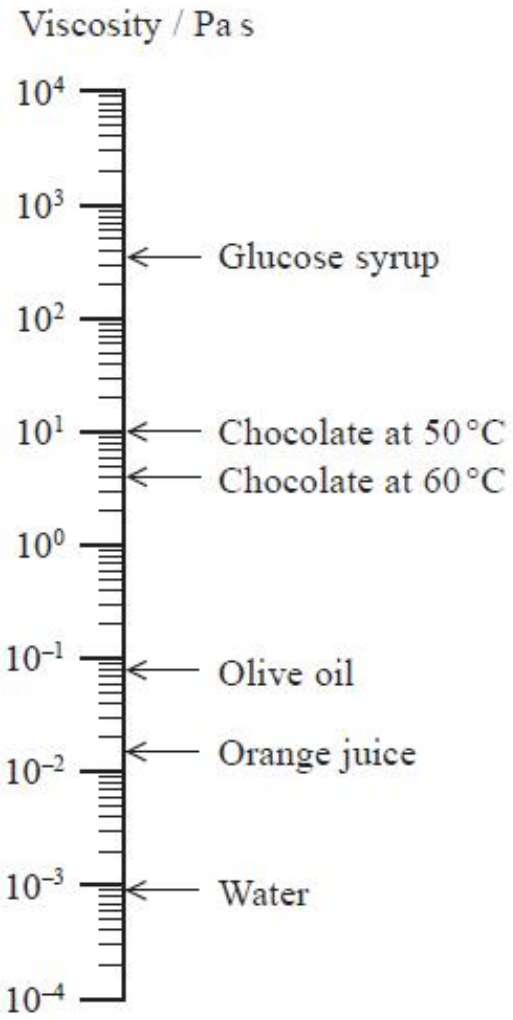
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(Total for question = 7 marks)

Q2.

The following chart shows the viscosity of some food products. Temperatures are at 20° unless otherwise indicated.

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(a) (i) Explain why there are two different values of viscosity for chocolate.

(2)

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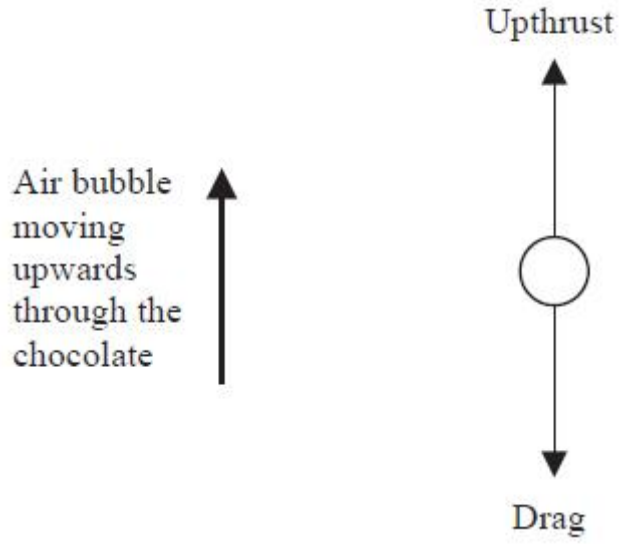
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(ii) The viscosity of a sample of chocolate at 40°C is measured.
Mark the approximate position of its viscosity onto the chart above.

(1)

(b) Some chocolate is poured into a mould. Within the chocolate a bubble of air, of negligible weight, is formed and moves upwards at a constant velocity.

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radius of air bubble = 1.0×10^{-3} m

temperature of chocolate = 50 °C

upthrust on air bubble = 3.7×10^{-5} N

Calculate the approximate velocity of the air bubble.

(3)

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Approximate velocity = ...

(c) The following table is an incomplete entry from a chocolate producer's website offering advice on chocolate moulding.

Complete the entry.

(3)

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Problem	Air bubbles become trapped in the chocolate because they cannot rise to the surface in time to escape before the chocolate has solidified.
Solution	....
Explanation	....

(Total for question = 9 marks)

Q3.

A seiche is a standing wave that can form on the surface of a lake in strong winds, causing flooding and erosion.

Erosion causes clay particles to be washed into the lake, making the lake cloudy. The lake can remain cloudy to a depth of about 4 m for more than 6 months.

One spherical clay particle has a radius of 2.5×10^{-7} m.

Deduce whether this particle takes more than 6 months to fall 4 m.
You should assume that the water in the lake remains still.

viscosity of water = 1.0×10^{-3} kg m^{-1} s^{-1}
density of water = 1000 kg m^{-3}
density of clay = 2650 kg m^{-3}

(6)

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(Total for question = 6 marks)

Q4.

A student was given a block of conducting putty of mass 43 g.

(i) Show that the volume of the block of conducting putty was about 8×10^{-6} m^3.

density of conducting putty = 5300 kg m^{-3}

(2)

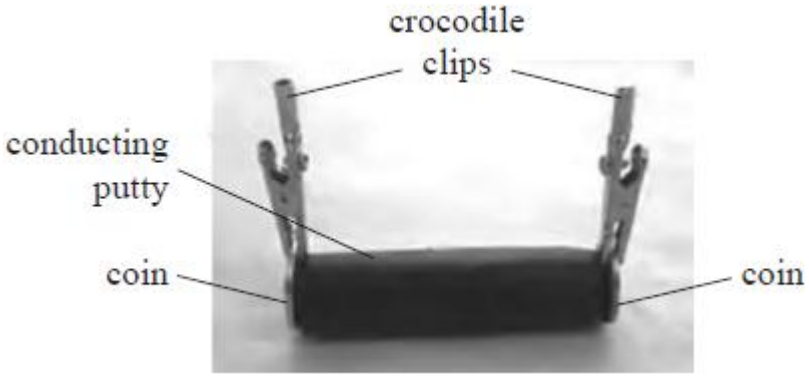
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(ii) The student formed the putty into a cylinder. Coins were pushed onto the ends of the cylinder as shown. The coins each had a crocodile clip attached and an ohmmeter was connected across the putty.



Determine the resistance of the cylinder of putty.
diameter of cylinder = 12 mm
resistivity of conducting putty = 4.0×10^{-3} Ω m

(3)

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Resistance = ...

(Total for question = 5 marks)

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