SECTION A

Answer ALL the questions in this section

1. **Figure 1.** shows the change in volume of waterin a measuring cylinder when an irregular solid is immersed in it

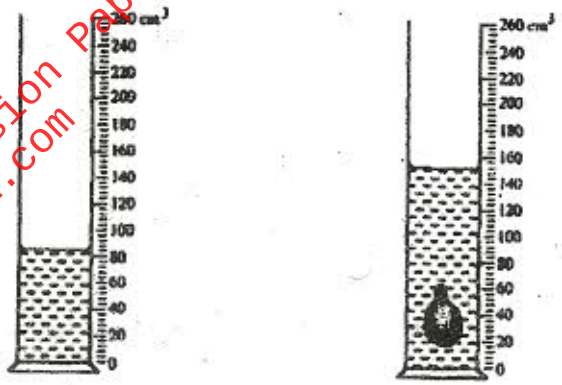


Figure 1

Given that the mass of the solid is 567g determine the density of the solid in gcm^{-3}
(Give your answer correct to 2 decimal places) (3 marks)

2. **Figure 2** (a) shows a body being acted on by two forces F_1 and F_2

(a)

On **Figure 2** (b) draw the force F_3 that has same effect on the body as the two forces.
(1 mark)

(b)

Figure 2

3. State Pascal's principle of transmission of pressure in fluids (1 mark)

4. Figure 3 shows a bimetallic strip with a wooden handle, suspended horizontally using a thin thread.

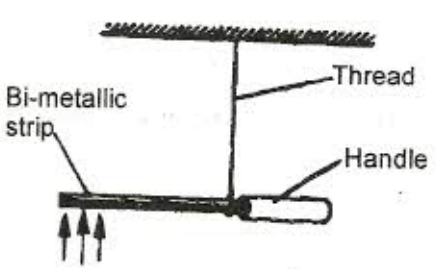


Figure 3

The strip is heated at the point shown. Explain why the system tips to the right. (2 marks)

5. The spiral springs shown in **figure 4** are identical. Each spring has a spring constant k = 300 N/m.

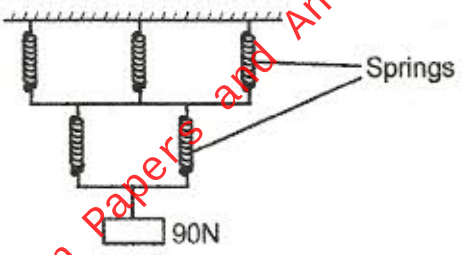
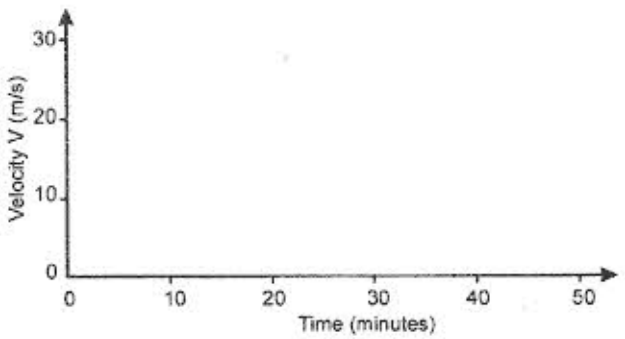


Figure 4

Determine the total extension caused by the 90N weight. (Ignore the weight of the springs and connecting rods) (3 marks)

6. A car starting from rest accelerates uniformly for 5 minutes to reach 30 m/s. It continues at this speed for the next 20 minutes and then decelerates uniformly to come to stop in 10 minutes. On the axes provided, sketch the graph of velocity against time for the motion of the car.

(1 mark)



7. **Figure 5** shows two pulley systems being used to raise different loads. The pulleys are identical.

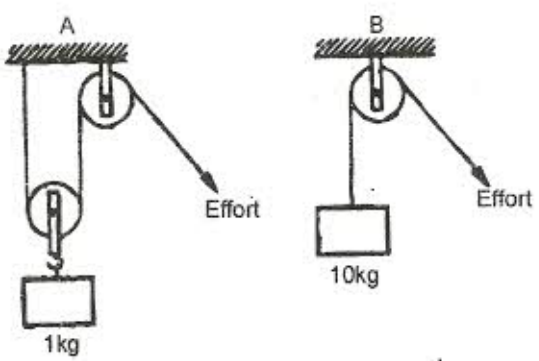
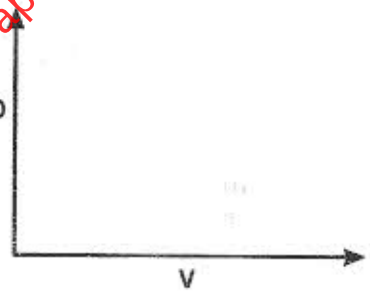


Figure 5

State one reason why system **B** may have a higher efficiency than system **A** (1 mark)

8. Beaker **A** contains 200g of water 0°C while beaker **B** contains 200g of a mixture of ice and water at 0°C. Two identical metal blocks are removed from a hot furnace. One block is dropped into beaker **A** while the other is dropped into beaker **B** at the same time. Explain why more water ecaporates from beaker **A** than from beaker **B** (2 marks)

9. On the axes provided sketch the graph of pressure **P** against volume **V** for a fixed mass of an ideal gas. (1 mark)



10. **Figure 6** shows the path taken by a matatu travelling on a horizotal level ground (a winding road)

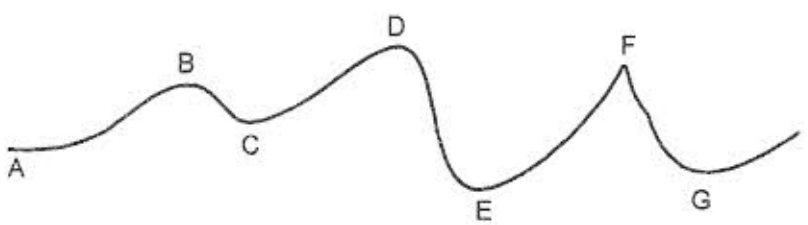


Figure 6

The speed of the matatu is constant. Identify with reason the point along the path at which a load placed loosely on the rack (carrier) of the matatu is most likely to roll off.
(2 marks)

11. A pipe of radius 6 mm is connected to another pipe of radius 9 mm. If water flows in the wider pipe at the speed of $2ms^{-1}$. What is the speed in the narrower pipe? (3 marks)

12. The uniform bar in **Figure** 7 is pivoted at its midpoint. It is in equilibrium under the action of two identical balloons filled with equal volumes of different light gases at the same temperature.

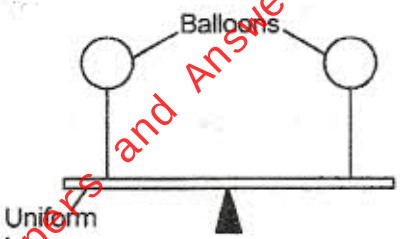


Figure 7

Explain why the bar may not remain in equilibrium if the temperature of the surrounding changes. (2 marks)

13. A footballer kicks a ball of mass 0.6 kg initially at rest sing a force of 720N. If the foot was in contact with the ball for 0.1 seconds, what was the take off speed of the ball? (3 marks)

SECTION B

Answer ALL questions in this section

14. (a) Distinguish between solid and liquid states of matter in terms of intermolecular forces (1 mark)

(b) In an experiment to estimate the diameter of an oil molecule, an oil drop of diameter 0.05 cm spreads over a circular patch whose diameter is 20 cm.

Determine

(i) The volume of the oil drop (2 marks)

(ii) The area of the patch covered by the oil (2 marks)

(iii) The diameter of the oil molecule (3 marks)

(c) State

(i) Any assumption made in (b) (iii) above (1 mark)

(ii) Two possible sources of error in this experiment (2 marks)

15. (a) You are provided with two wires of same material and same thickness. Describe how you would make two spiral springs of different spring constants (assume that other apparatus to make springs are available). (2 marks)

(b) In an experiment, two identical springs are attached end to end. One end of the combined spring is fixed to a rigid support such that the spring hangs vertically. Masses are then hang from the lower end.
The graph in Figure 8 shows the relation between the force (weight) and the extension for the combined springs.

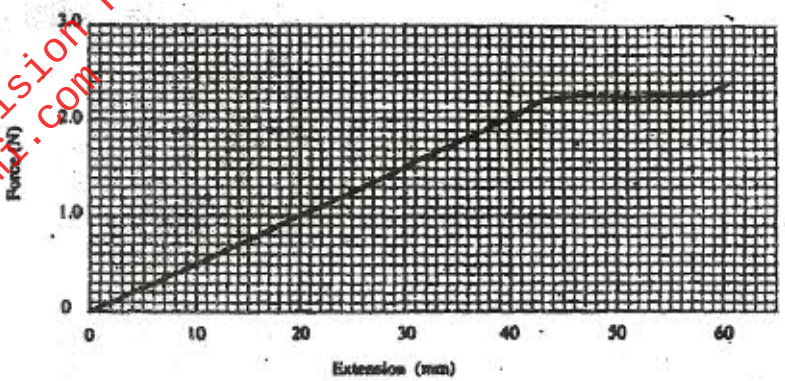


Figure 8

From the graph determine

(i) The elastic limit for the combined springs (1 mark)

(ii) The spring constant of the combined spring and hence for each spring (4 marks)

(iii) The work done in stretching the combined spring from 15 mm to 32 mm. (3 marks)

16. (a) State what is meant by an ideal gas (1 mark)

(b) The pressure acting on a gas in a container was changed steadily while the temperature of the gas was maintained constant. The value of volume V of the gas was measured for various values of pressure. The graph in **Figure 9** shows the relation between the pressure, p, and the reciprocal of volume. $\frac{1}{V}$

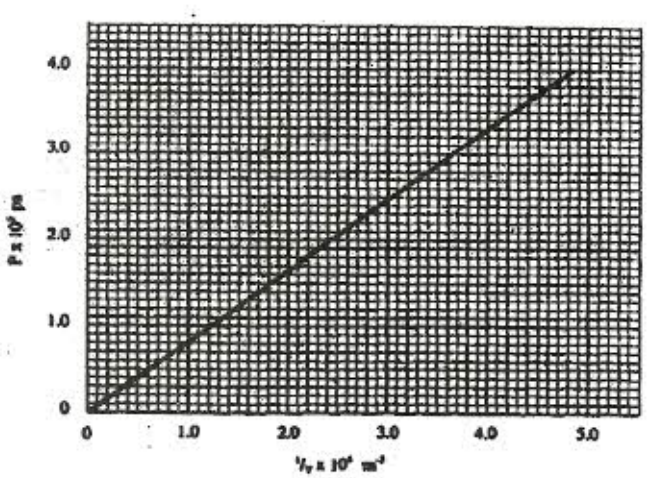


Figure 9

(i) Suggest how the temperature of the gas could be kept constant. (1 mark)

(ii) Given that the relation between the pressure P_1 and the volume V_1 of the gas is given by $PV = k$

When k is a constant, use the graph to determine the value of k. (4 marks)

(iii) What physical quantity does k represent? (1 mark)

(iv) Stae one precaution you would take when performing such an experiment (1 mark)

(c) A gas occupies a volume of 4000 litres at a temperature of 37°C and normal atmospheric pressure. Determine the new volume of the gas if it is heated at constant pressure to a temperaure of 67°C (normal atmosphere pressure $p = 1.01 \times 10^5 p_a$) (4 marks)

17. (a) State Archimedes Principle (1 mark)

(b) In an experiment to determine the relative density of methylated spirit applying Archimedes Principle, the following were provided: a spring balance, some masses, a piece of thread, water in a beaker and methylated spirit in a beaker. The table below shows the results obtained.

Mass (g)	100	150	200
Weight in air (N)	1.00	1.50	2.00
Weight in water (N)	0.88	1.32	1.76
Weight in spirit (N)	0.91	1.36	1.82

(i) Draw labelled sketch diagrams to show how the readings in the table were obtained (1 mark)

(ii) For each mass, determine the upthrust in water and the upthrust in the spirit (2 marks)

(iii) Determine the average relative density of the spirit (3 marks)

(c) A weather baloon of volume $1.2m^3$ is tied to a rigid support while being filled with helium gas. The mass of the fabric making the baloon is 0.30 kg.
Determine the maximum tension on the string tying the baloon to the rigid support.
(Density of air is 1.25 kg m^{-3} and density of helium is 0.18 kg m^{-3}). (4 marks)

18. (a) Define specific latent heat of fusion of a substance (1 mark)

(b) Water of mass 200g at a temperature of 60°C is put in a well lagged copper calorimeter of mass 80g. A piece of ice at 0°C and mass 20g is placed in the calorimeter and the mixture stirred gently until all the ice melts. The final temperature, T, of the mixture is then measured.

Determine

(i) The heat absorbed by the melting ice at 0°C (2 marks)

(ii) The heat absorbed by the melted ice (water) to rise to temperature T (answer may be given in terms of T) (2 marks)

(iii) The heat lost by the warm and the calorimeter (answer may be given in terms of T) (2 marks)

(iv) The final temperature T of the mixture.
(Specific latent heat of fusion of ice = 334000 J kg^{-1}
Specific heat capacity of water = 4200 J kg^{-1} k^{-1}
Specific heat capacity of copper = 900 J kg^{-1} k^{-1}) (4 marks)