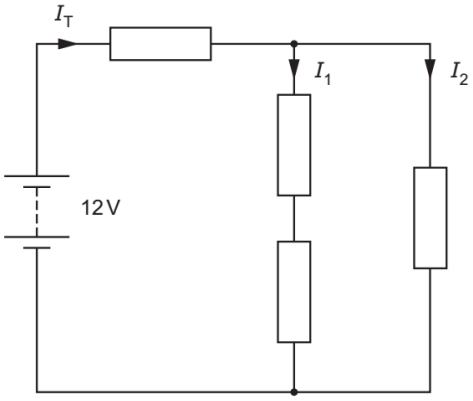
AS Level Physics B

H157/01 Foundations of physics

Question Set 3

1. In the circuit shown, all resistors have the same resistance of 100 Ω.
Assume the battery has negligible internal resistance.



(a) State the relationship between the currents I_T, I_1 and I_2. **[1]**

(b) Explain why I_2 is twice as large as I_1. **[2]**

(c) Show that the total resistance of the circuit is less than 170 Ω. **[2]**

(d) Calculate the power supplied by the battery.

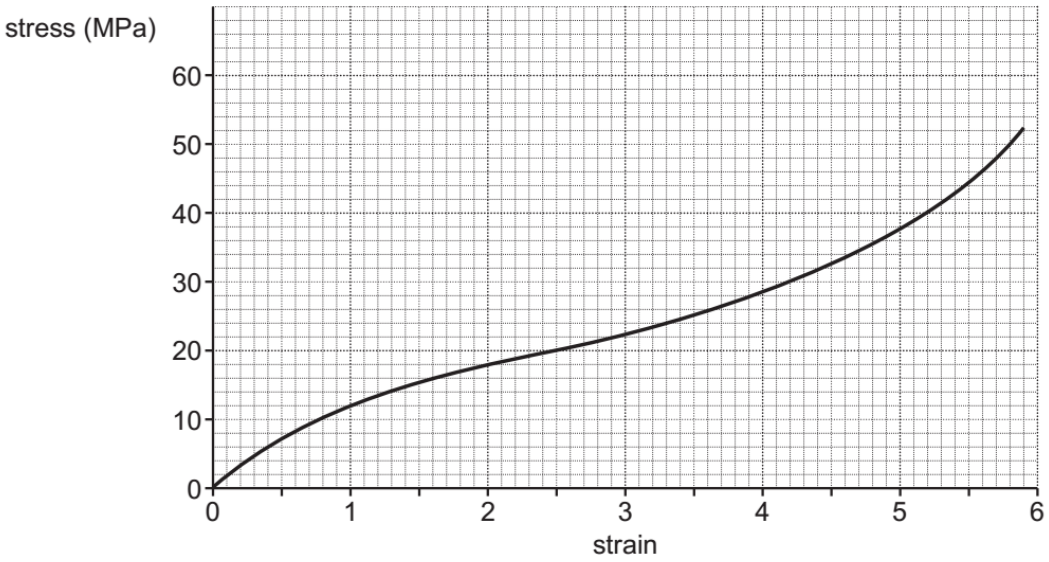
power = ……..W **[2]**

2. The lens in a digital camera has focal length, *f* = 2.0 cm.
The camera is used to take a picture of a cat that is 50 cm away.

Calculate the distance between the lens and image sensor (CCD) in the camera.
Give your answer to 2 significant figures.

image distance = …….. m **[3]**

3. The graph shows the stress-strain graph for a polymer material up to fracture.



(a) Describe what the graph shows in terms of the stiffness of this polymer at different strains.

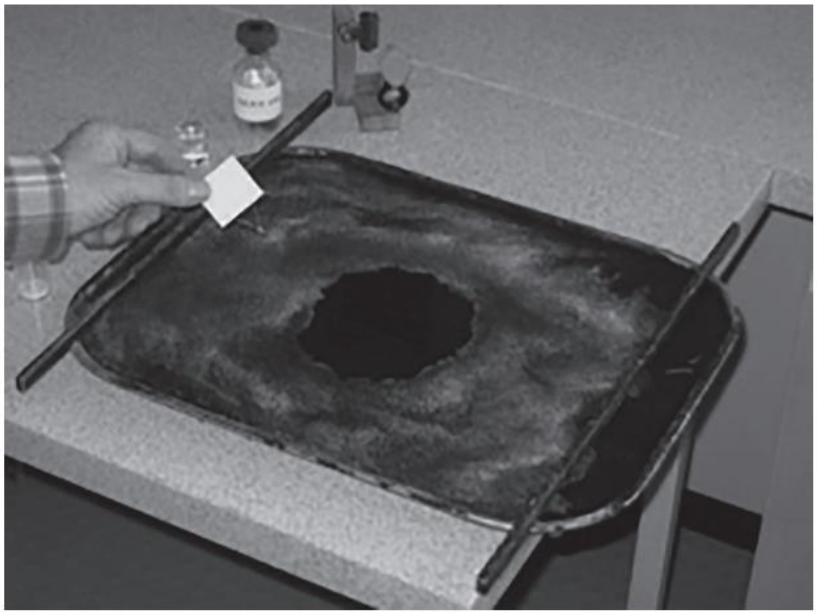
[2]

(b) Estimate the gradient of the graph just before fracture. Make your method clear.

gradient = ……MPa

[2]

4. An experiment to estimate the size of an oil molecule is shown below.



A drop of oil with diameter (0.5 ± 0.1) mm is dropped into water dusted with powder.

The oil spreads out to a diameter of 20 cm in a layer that is assumed to be one molecule deep.

Estimate the size of a molecule using this data.
One mark is for stating an assumption you make in your calculation.

size of molecule =…… m **[3]**

5. **Fig. 5.1** shows an aeroplane flying horizontally and towing a flag.

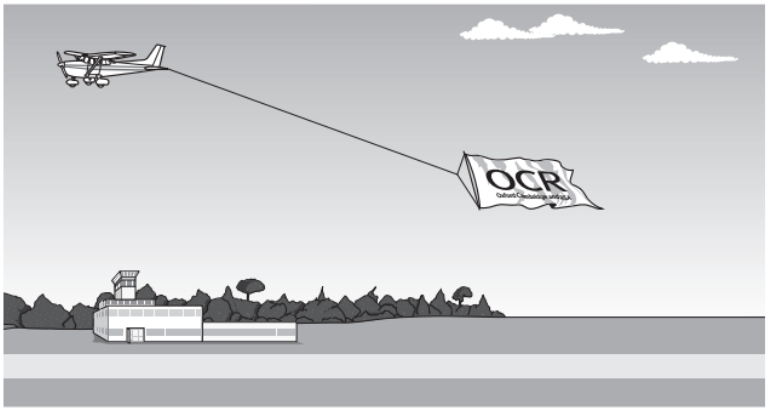


Fig. 5.1

The flag is attached to the aeroplane using a metal cable. **Fig. 5.2** shows that the cable is at an angle of 20° below the line of flight of the aeroplane.

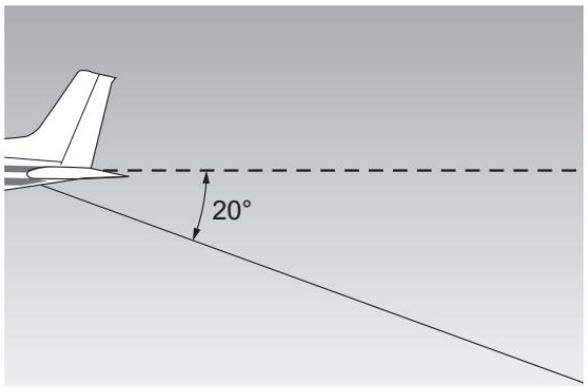


Fig. 5.2

(a) Show that the work done in towing the flag when the aeroplane travels 1 m in the line of flightis about 1.4 kJ. **[2]**

(b) Calculate the power required for towing the flag.

power = ... W **[1]**

(c) The diameter of the metal cable is 12 mm.
The Young modulus of the metal cable is 210 GPa.

(i) Calculate the operating stress in the cable during towing.

stress = ... Pa **[3]**

(ii) The breaking stress of the metal is 460 MPa.

Comment on the safety of the procedure. **[1]**

(iii) Calculate the strain in the cable.

strain = ... **[2]**

6.

A student is investigating a smartphone app which records voice messages. The sound is converted into an analogue electrical signal (input p.d.) by the microphone. The signal is shown in **Fig. 6.1**.

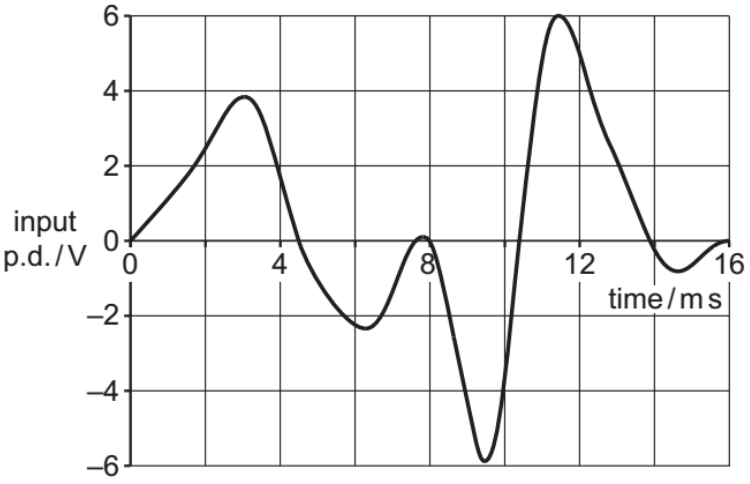


Fig. 6.1

(a) Explain how this signal can be digitised.
You may draw on **Fig. 6.1** to support your answer.

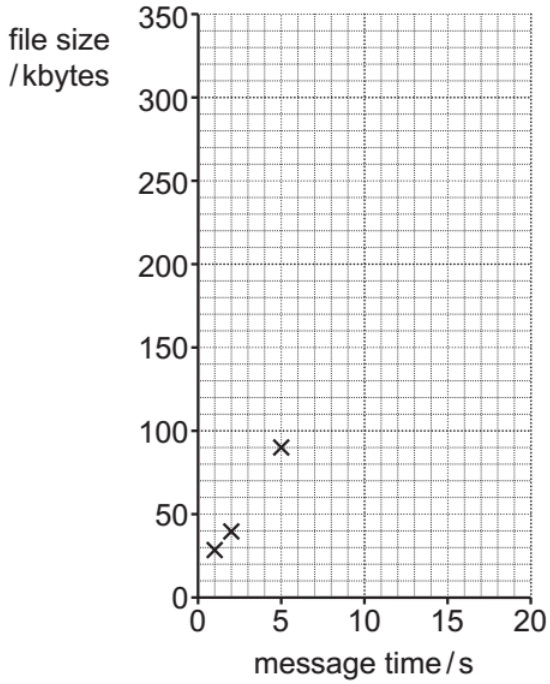
[3]

(b) The student records a number of messages of different lengths and records the size of the resulting (uncompressed) sound files. Her results are tabulated below.

Message Time/s	**File Size/10^3 bytes**
1	29
2	40
5	88
10	162
20	317

Fig. 6.2 shows a graph of the file size plotted against message time for the first three data points.

(i) Complete the graph and draw the best fit line.



[2]

Fig 6.2

(ii) State how the graph shows that there is a fixed amount of information transmitted with each file that is independent of the message time.

[1]

(iii) Use the data to estimate the number of **bits** stored in the file per second of sound recorded.

bits per second =…… **[2]**

Total Marks for Question Set 3: 34