1. Below is a list of words associated with circuits.

Current	Volt	Resistance
Ohm	Charge	Ampere

For each of the following choose **one** example from the above list.

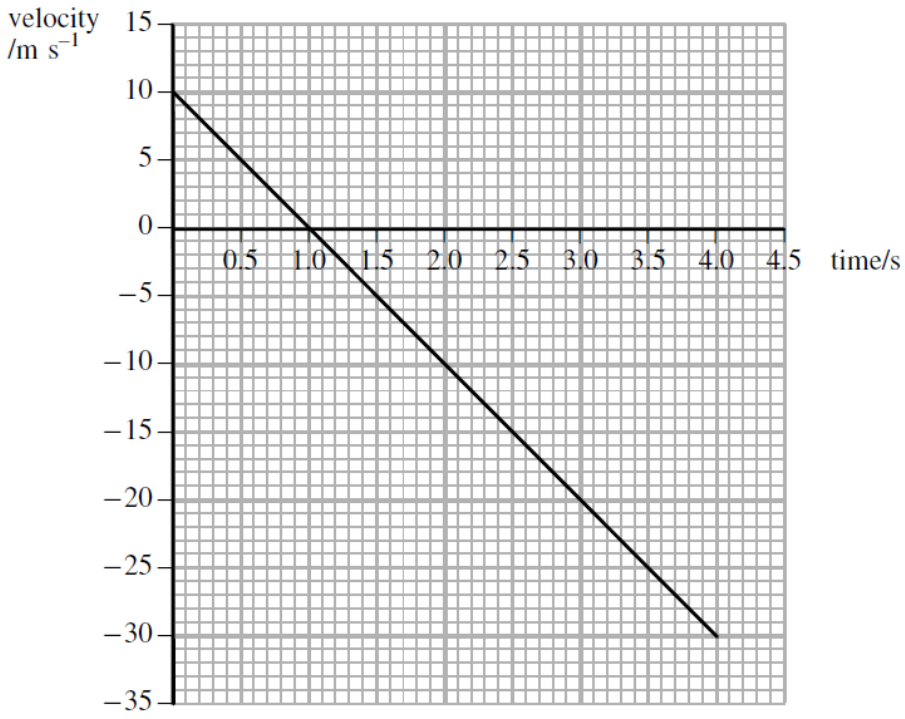
Base unit .....

Derived quantity .....

Derived unit .....

Base quantity .....[4]

2. A hot-air balloon is rising vertically at a speed of 10 ms^{-1}. An object is released from the balloon. The graph shows how the velocity of the object varies with time from when it leaves the balloon to when it reaches the ground 4 seconds later. It is assumed that the air resistance is negligible.



(a) Use the graph to

(i) show that the object continues to rise for a further 5 m after it is released. [1]

(ii) determine the total distance travelled by the object from when it is released from the balloon to when it reaches the ground.

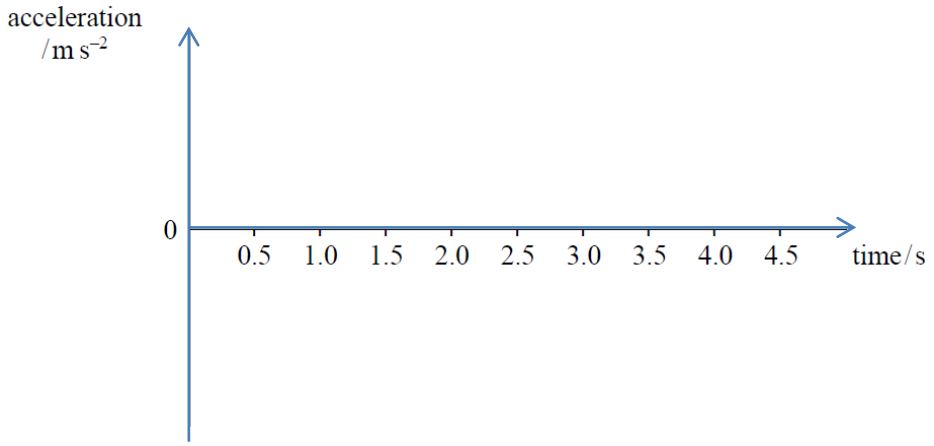
Total distance = ...m [2]

(b) Hence determine magnitude and direction of the object's final displacement from its point of release from the balloon.

Magnitude = ...m

Direction = ... [2]

(c) Using the axes below, sketch a graph showing how the acceleration of the object changes during the time from when it leaves the balloon to when it hits the ground. Mark any significant values on the axes.



[3]

3.

Figure 3.1

Figure 3.1 shows a pen, **drawn full size**, without its cap. The pen has a mass of 11.0 g and balances on a pivot.

(a) Calculate the weight of the pen.

Weight of the pen = ...N [2]

(b) The cap is now put on the pen. The cap has a weight W_c which acts at the point shown.
The pen together with its cap is then balanced as shown in Figure 3.2, which is also **drawn full size**.

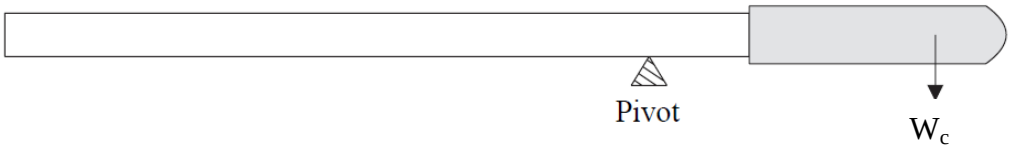


Figure 3.2

(i) Add to Figure 3.2 an arrow with label $\boldsymbol{W_p}$ to represent the weight of the pen without its cap. [1]

(ii) Calculate the weight W_c of the cap.

Weight of the cap = ...N [3]

(c) In addition to the two weights, a third force acts on the pen when balanced as in Figure 3.2.

(i) State where this force acts and give its direction.

.....
.....[1]

(ii) Calculate its magnitude.

Magnitude = ...N [1]

(iii) Explain why it produces no moment about the point of balance.

.....
.....[1]

4. A certain power station generates electricity from falling water. Figure 4.1 shows a simplified sketch of the system.

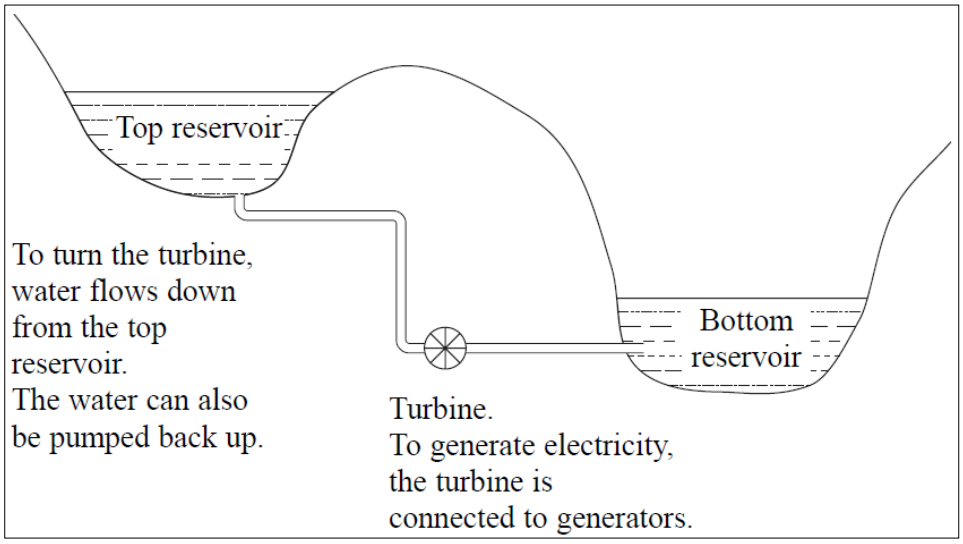


Figure 4.1

(a) (i) In what form is the energy of the water initially stored?

……[1]

(ii) What energy form is this transformed into in order to drive the turbine?

……[1]

(b) State the principle of conservation of energy.

……

……[1]

(c) The force of the water at the turbine is 3.5×10^8 N and the output power generated is 1.7×10^9 W. Use this data to calculate the minimum speed at which the water must enter the turbine.

Minimum speed = ...ms^{-1} [2]

(d) When working at this output power, 390 m^3 of water flows through the turbine each second. The top reservoir holds 7.0×10^6 m^3 of water. For how long will electricity be generated?

Time = ...s [1]

(e) This power station is used at peak periods, after which the water is pumped back to the top reservoir. The water has to be raised by 500 m. How much work is done to return all the water to the top reservoir?
(The density of water is 1000 kgm^{-3}.)

Work done = ...J [3]

5. (a) State what is meant by the diffraction of a wave.

……

……

……..……...[2]

(b) Two microwave source **A** and **B** are in phase with one another. They emit waves of equal amplitude and of wavelength 30.0 mm. They are placed 140 mm apart and at a distance of 810 mm from a line **OP** along which a detector is moved, as shown in Figure 5.1

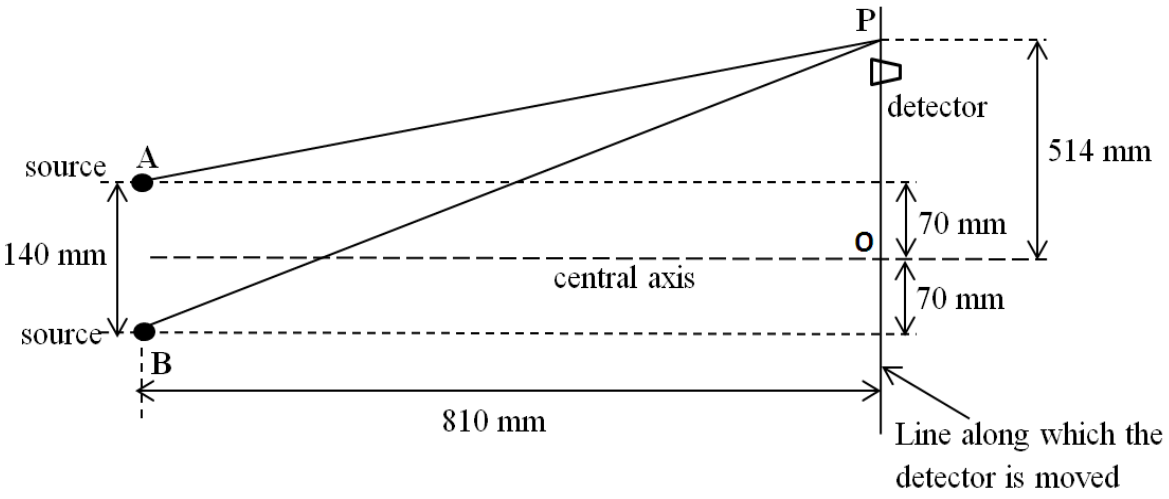


Figure 5.1

(i) Show that the distance **AP** is 923. 7 mm. [1]

(ii) Calculate the number of wavelengths between source **A** and point **P**.

Number of wavelengths = ... [1]

(iii) State the intensity of the microwaves that will be received by the detector when it is at **P**. Explain.

……

……

…… [2]

(iv) How many maxima are detected as the detector moves from **P** to the point **O** on the central axis.

Number of maxima detected = ... [1]

6. (a) Define electric field strength.

……..……...

……..... [1]

(b) A proton is moved in vacuum by an electric field of 3.75×10^5 NC^{-1} from A to B, a distance of 8.5 mm as shown in Figure 6.1

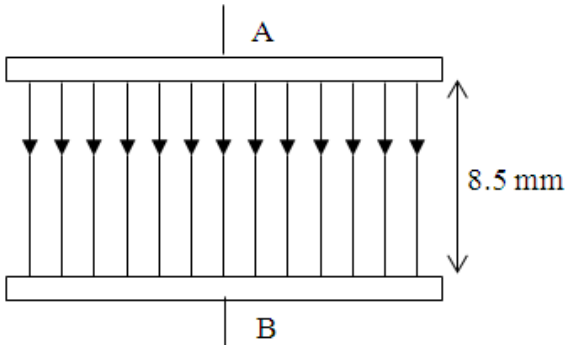


Figure 6.1

(i) Calculate the potential difference between A and B.

Potential difference = ...V [2]

(ii) What is the speed of the proton when it reaches B?

Speed = ...ms^{-1} [2]

(iii) State whether A or B is at the lower potential.

……..

…..…… [1]

7. (a) What is meant by an e.m.f of a source of 120 V.

……..……

……..……

…….. [2]

(b) 15 identical lamps are connected in series to a 120 V supply. The total power consumed is 38.4 W. Calculate the resistance of a single lamp in the set.

Resistance = ...Ω [2]

(c) If the set of 15 lamps were to be connected in parallel, what would have been the total power consumed?

Total power consumed = ...W [2]

8. In the circuit shown in Figure 8.1, cell A has an e.m.f. of 2.0 V and negligible internal resistance. XY is a uniform wire of length 100 cm and resistance 5.0 Ω. Cell B has an e.m.f. of 1.5 V and internal resistance 0.80 Ω.

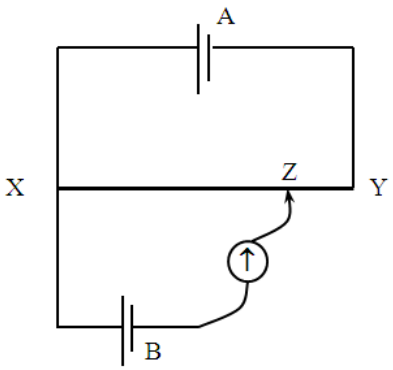


Figure 8.1

Calculate the length of XZ required to produce zero deflection in the galvanometer

(a) in the circuit as shown in Figure 8.1

Length of XZ = ...cm [2]

(b) when a 1.0 Ω resistor in placed in series with A.

Length of XZ = ...cm [2]

(c) when this resistor is removed from A and place in series with B.

Length of XZ = ...cm [2]

9. (a) Given the approximate values for the radius of a gold atom and the radius of a gold nucleus are 10^{-10} m and 10^{-15} m respectively. The density of gold is 19 000 kgm^{-3}. Estimate the density of a gold nucleus, stating the assumption that you make in your answer. [3]

(b) A nucleus of $^{238}_{92}U$ absorbs a slow neutron and it subsequently emits two β-particles. Write an equation for this nuclear reaction. Use symbol X to represent the resulting nucleus. [2]