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2002 Past GCE Advanced Level Paper 2

SECTION I

Answer all questions in this section

1. Optical fibril are being increasingly used in modern technology
   (a) (i) What are optical fibres?
   (ii) State the main physical property that makes the use the use of optical fibres so important today.
   (b) Describe one use of optical fibres in medicine.
2. The stability of a nucleus depends on the binding energy per nucleon for the particular nucleus.
   (a) What is binding energy?
   (b) Sketch a graph to show the binding energy versus mass number for the natural exixting nuclei.

On this graph, indicate ranges for possible

   (i) Fission reactions and
   (ii) Fusion reactions

3. A series a thermodynamics processes are shown in the PV diagram of figure 1. In process ab 150J of heat are added to the system, and in process bd 600J of heat are added.

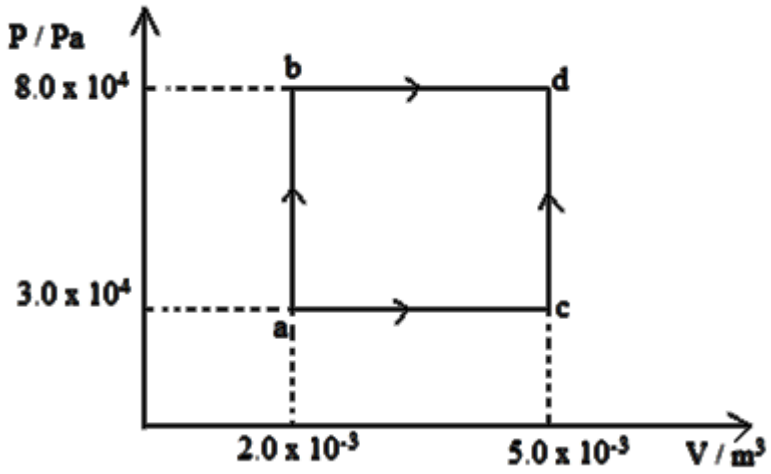

Figure 1

   (i) Calculate the internal energy change in the process a b.
   (ii) Calculate the internal energy change in the process a b d.

4. Rayleigh scattering by molecules is one cause of signal attenuation. Attenuation due to Rayleigh scattering depends on the

   (a) What do you understand by
      (i) Scattering and
      (ii) Signal attenuation
   (b) If a signal of wavelength 850nm is attenuated by 2.0dB km^{-1} because of Rayleigh scattering,
      (i) Calculate the attenuation of a 1500nm signal in the same medium.
      (ii) What physical quantity has as unit decibel?

5. (a) Describe in relation to molecular behavior,
      (i) One way in which gases are similar to liquids but different from solids and
      (ii) One way in which liquids are similar to solids but different from gases.
   (c) Describe one physical phenomenon in each case to demonstrate that
      (i) Matter is made up of tiny particles,

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(ii) These particles are in random motion.

6. (a) Explain why a charge particle moving with constant speed in a uniform magnetic field describes a circular path, if its initial velocity is perpendicular to the field lines.

(a) An electron enters a uniform magnetic field of 0.5T with a speed 3.0 x $10^5 ms^{-1}$.

(i) Calculate the centripetal force experienced by the electron.

(ii) Suppose the electron starts losing speed, what are the consequences to the path and the environment of the electron?

SECTION II

Answer either 8(a),(b) and (c) or 8(d),(e), and (f).

Either 8(a),(b) and (c)

7. (a) (i) Define the specific(latent) heat of fusion of a substance?

(ii) Describe an experiment to show how the specific (latent) heat of fusion of ice can be determined.

(b) (i) Ethyl alcohol has about one half, the specific heat capacity of water. If equal masses of ethyl alcohol and water in separate beakers are supplied with the same amount of heat, compare the temperature changes of the two liquids

(ii) 10kg of molten lead at its melting point of 327°C and 1.0kg of ice at 0°C are placed inside an insulated chamber where they reach a common final temperature. Calculate the final temperature and the heat loss by the lead in the process.

Specific heat of fusion of ice = 3.34 x $10^5 kg^{-1}$

Specific heat capacity of water = 4.2 x $10^3 Jkg^{-1}°C^{-1}$

Specific heat capacity of lead = 1.28 x $10^3 Jkg^{-1}°C^{-1}$

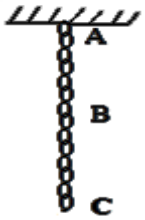
Specific latent heat of fusion of lead = 2.45 x $10^3 Jkg^{-1}$

(c) Why is it possible to hold a lit match, even when it is burning to within a few millimeters of your fingertips?

OR 8(d),(e) and (f)

(b)

(c) Figure 2 shows a chain hung from a support.



Where is there maximum stress on the chain: A, B, or C? Explain

(d) A load of 102kg is supported by a wire of length 2.0m and the cross-sectional area of 0.10cm^2. if the wire is stretched by 2.2mm, calculate

(i) The stress

(ii) The strain

(iii)

Answer either 9(a) and (b) or 9(c) and (d)

Either 9(a),(b)

8. (a)

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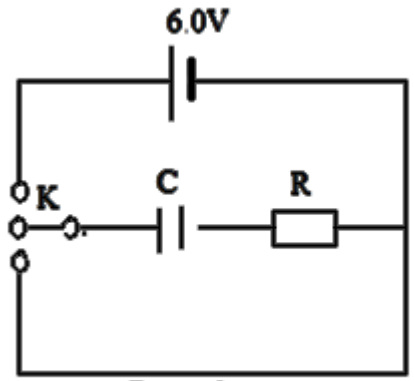


Figure 3

In the circuit in figure 3, the capacitor, is first fully charged by using a 6.0V battery and the two way witch K. it is then discharged. The figure 4 shows how the charge Q, on the capacitor C, changes with time during the discharge.

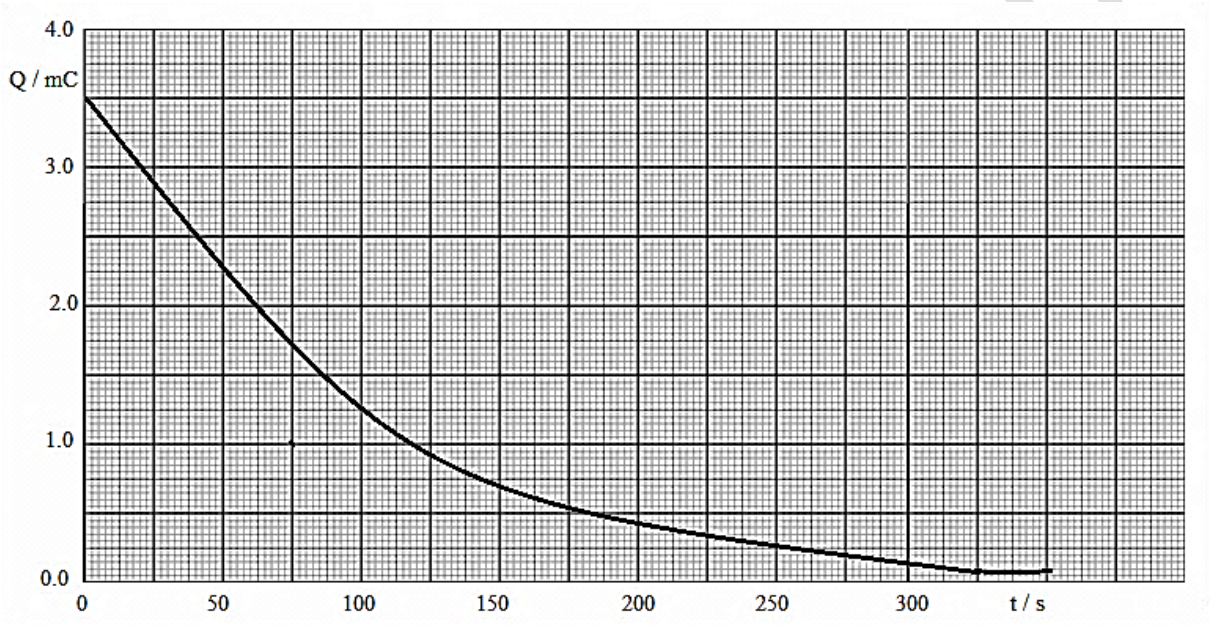


Figure 4

Use the graph to answer the following questions.

(i) What is the capacitance of the capacitor?

(ii) Estimate the initial current through the resistor during the discharging process, hence calculate the resistance of the resistor and the time constant.

(iii) On the same axes draw graphs to show how the voltage V_C across the capacitor and V_R across the resistor varies with time during charging.

Indicates values where appropriate.

(b)

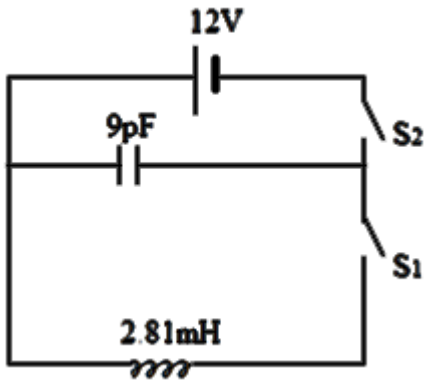


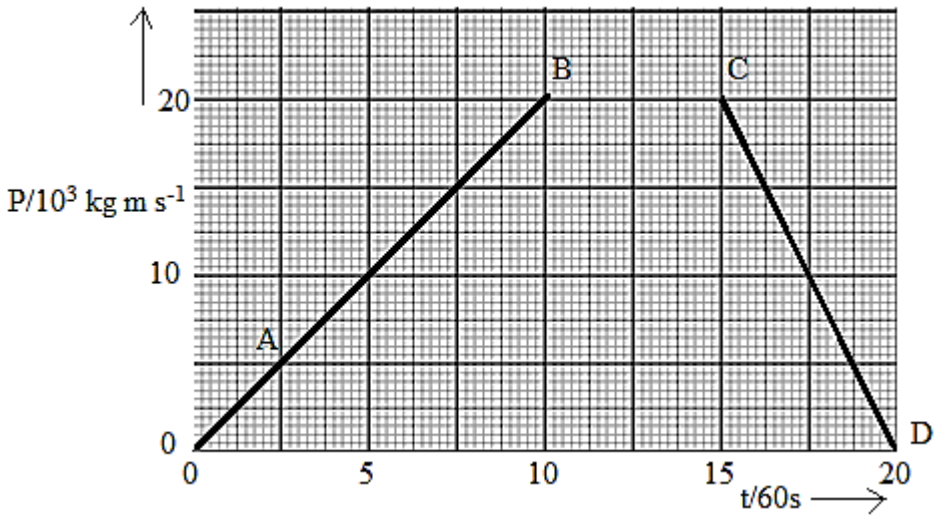
Figure 5 is an LC circuit with an inductance of 2.8mH and a capacitance of 9.0pF. The capacitor is initially charged with a 12V battery when switch S is opened and switch S_2 closed S_1 is then closed at the same instant that S_2 is opened. If the frequency of S_1 and S_2, opening and closing corresponds to the resonance frequency for LC circuit.

(i) Calculate this frequency

(ii) What are the maximum valves of the charge on the capacitor and current in the circuit?

OR 9(c) and (d)

(c) A car of mass 1000kg is initially at rest, it then moves along a straight road for 20 minutes and comes to rest again. The momentum-Time graph for the motion is shown in figure 6.



Use the graph to answer the following questions

(i) What are the resultant forces acting on the car during the parts of the motion labeled AB, BC, and CD?

(ii) Calculate the total displacement of the car for 20 minutes.

(iii) Sketch a displacement-time graph for the car during the 20 minutes.

(d) If, when travelling at the maximum speed, the car had struck and remained attached to a stationary vehicles of mass 1500kg.

(i) With what velocity would the interlocked vehicles have travelled immediately after collision?

(ii) Calculate the kinetic energy of the car just prior to this collision and the kinetic energy of the interlocked vehicles just afterwards.

Comments on the values obtained.

Answer either 10(a),(b) and (c) or 10(d),(e),(f)

EITHER 10(a),(b) and (c)

9. (a) explain briefly the difference between an emission spectrum and an adsorption spectrum,
Describe an observation to illustrates each of the spectra

(b)

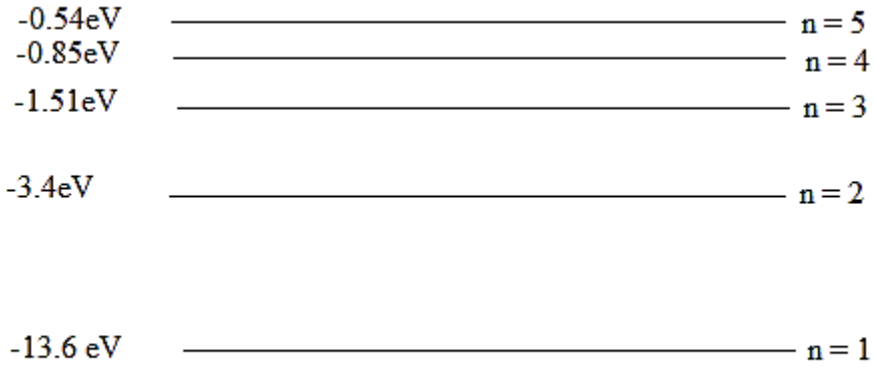


Figure 7

Figure 7 shows some of the possible energy levels of the hydrogen atom.

(i) Why are the energy values negative?

(ii) Explain briefly how figure 7 can be used to account for the fact that the ionization energy of the hydrogen atom is 13.6eV

(iii) Calculate the highest possible frequency in the line spectrum of hydrogen from transition between the five spectral lines shown in the diagram. In what region of the electromagnetic spectrum does this radiation lie?

(iv) Which transition in figure 7 corresponds to the maximum wavelength that would be visible to the eye?

-scattering experiment, the fraction of incident alpha particles reflected back through more than 90° is very small. How does this result lead to the idea that an atom has a nucleus,

(i) Whose diameter is small compared with the atomic diameter, and

(ii) Which contains most of the atomic mass?

OR 10(d),(e) and (f)

10. (d) Explain briefly the difference between electromagnetic waves and mechanical waves.
Give an example of a mechanical wave.

(e) Distinguish between stationary and progressive wave?
Describe briefly how best stationary waves can be produced from two progressive waves. Draw diagrams to show the superposition of the waves involved to produce the resultant effect.

(f) In an experiment to investigate the properties of stationary waves, one end of a rubber cord is attached to a vibrator, the frequency of which can varied, and the other end to a rigid support. Figure 8 is a diagram of the cord drawn to scale showing the cord vibrating at one of its harmonics.

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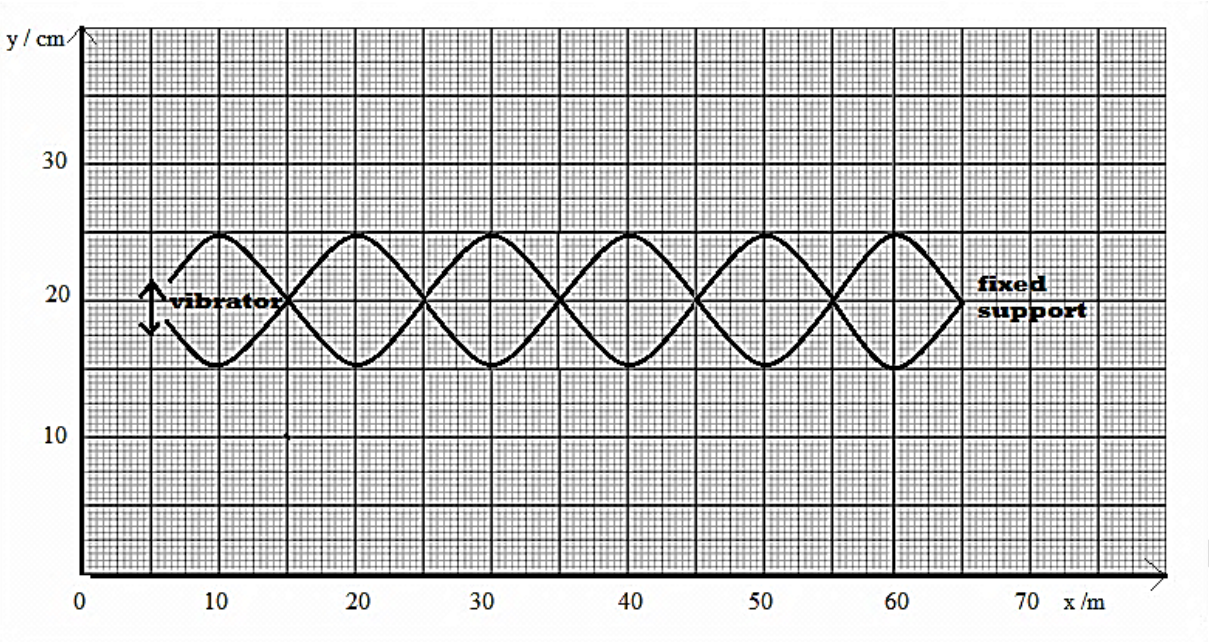

Figure 8

(i) What are harmonics

(ii) Determined the wavelength and amplitude of the wave portrayed.

(iii) If the frequency of the vibrator is 600Hz, calculate the wave speed, and the fundamental frequency of the cord when supported in this manner.

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