A'LEVEL PHYSICS PAPER ONE (P510/1) SEMINAR AT SEETA HIGH SCHOOL GREEN CAMPUS ON 24TH SEPT 2022

SECTION A (MECHANICS)

1. (a)(i) Define linear momentum.

   (ii) state the law of conservation of linear momentum

   (iii) show that the law of conservation in (a)(ii) above follows from Newton's laws of motion

   (b) A man whose weight is 490.5N , jumps onto ground from a 2.5m high wall.

   (i) explain why he has to bend his knees when landing on the ground.

   (ii) calculate the force with which his legs hit the ground if his body comes to rest in 0.5s on reaching the ground.

   (c) (i) Distinguish between perfectly elastic and perfectly inelastic collisions and give one example of each.

   (ii) Two bodies each of masses m_1 and m_2 initially moving with velocities u_1 and u_2 respectively collide perfectly inelastically. Show that the loss in kinetic energy is given by the expression

$$\frac{m_1 m_2 (u_1 - u_2)^2}{2(m_1 + m_2)}$$

   (iii) State any two applications of the law of conservation of linear momentum.

2. (a) define the following terms as applied to circular motion.

   (i) Centripetal acceleration

   (ii) Angular velocity.

   (b)(i) what is the purpose of banking a track.

   (ii) Derive an expression for the angle of banking foe a case of a car of mass M moving with a speed V round a banked track of radius, r.

   (iii) a car moves round a circular track of radius 65m which is banked at an angle $\tan^{-1} 5/_{12}$ to the horizontal. Find the speed at which the car should be driven for no tendency to slip.

   (c)(i) State the Kepler's laws of gravitation.

   (ii) Describe an experiment you would carry out in the laboratory to determine the universal gravitational constant.

   (iii) A body of mass 10kg is first weighed on a balance at the top of a tower 30m high and later transferred to the ground and is reweighed. Calculate the difference in the weights of the body.

3. (a) what is meant by the following terms as applies to mechanical properties of materials.

(i) Elasticity

(ii) Force constant

(b) a wire of length, l and cross-sectional area, A has a force constant , K. the wire is stretched to a length, $l + x$ by a constant force, F. show that;

(i) the force constant $K = \frac{EA}{l}$ where E is young's modulusof the material of the wire.

(ii) the energy stored per unit volume is $\frac{1}{2}E\left(\frac{x}{l}\right)^2$

(c) one end of a copper wire of length 1.0m and diameter 0.5mm is welded to a steel wire of length 0.5m and diameter 0.8mm, while its other end is fixed onto a rigid support. if a load of 12kg is suspended from the free end of the steel wire, calculate the;

(i) extension which results.

(ii) energy stored in the compound wire.

(d) A rubber cord of a catapult has an unstreched length of 10cm and cross-sectional area of 2.0mm^2. The catapult is loaded with a small mass of 20g and is stretched to 15cm. Calculate the velocity at which the mass is fired on releasing the cord given that young's modulus of rubber is $1.0 \times 10^8 Pa$.

4. (a)(i) State the Bernoulli's principle.

(ii) Explain why it is dangerous to stand close to a railway line on which a fast moving train is passing.

(b) Water flows steadily through a horizontal pipe of varying cross-sectional area. At a point A of crossectional area 10cm^2 the velocity is 0.2ms^{-1}. What is the pressure difference between A and B if the crossectional area of point B is 2.5cm^2

(c)(i) What is meant by the terms coefficient of viscosity and terminal velocity

(ii) Explain the temperature dependence of viscosity of a liquid.

(d) Describe by the aid of a labelled diagram an experiment to determine the coefficient of viscosity of water using Poiseuille's formulae.

SECTION B (HEAT)

5. (a)(i) Distinguish between isothermal and adiabatic changes.

(ii) State the condition under which an adiabatic change can take place.

(iii) Explain briefly why the passage of sound waves through air is considered as an adiabatic.

(b) a fixed mass of an ideal gas whose ratio of molar heat capacities $C_p : C_p = 5 : 3$ has a temperature of 27^0C, volume of $6.4 \times 10^{-2} m^3$. and a pressure of 243Nm^{-2}. It undergoes a reversible adiabatic compression to a volume of $2.7 \times 10^{-2} m^3$. The gas is then expanded isothermally to the original volume

(i) Show on an indicator diagram the above process.

(ii) Calculate the pressure at the end of the compression.

(c)(i) Define molar heat capacity at the constant pressure of a gas.

(ii) Derive the expression for the difference between molar heat capacity at a constant pressure and that at a constant volume for one mole of an ideal gas.

(d) Explain briefly why a gas heats up when it is compressed

6.(a)(i) Distinguish between conduction and convection.

(ii) Explain the mechanism of heat transfer in solids that is not a metal.

(b) With the aid of a well labelled diagram describe an experiment to determine the thermal conductivity of a piece of cork.

(c) (i) What is meant by a black body.

(ii) Sketch a graph of intensity against wavelength for black body radiation at three different temperatures.

(iii) State the three main features of the graphs.

(d) Explain the appearance of a metal ball placed in a dark room when its temperature is progressively increased from room temperature to just below melting.

(e) The wavelength that corresponds to maximum intensity for black body is 500nm. Calculate the temperature of the black body.

7.(a) Define the following

(i) Absolute zero temperature.

(ii) Fundamental interval.

(b) List two examples of the most common thermometer properties.

(c)(i) With the aid of a labelled diagram, describe the operation of an optical pyrometer.

(ii) State two advantages of a thermocouple thermometer.

(d)(i) State the Newton's law of cooling

(ii) Explain why a small body cools faster than a big one of the same material.

(e)(i) Oil of density $800kgm^{-3}$ at 15.6^0C, enters a long glass tube containing a heating coil and leaves out at 17.4^0C , the rate of flow being $25cm^3$ per minute for a power of 1.34W. The same temperature rise is obtained for a flow rate of $15cm^3$ per minute with power supply of 0.756W. Calculate the mean specific heat capacity of oil.

(ii) State why two sets of values are obtained in the continuous flow method.

SECTION C (MODERN PHYSICS)

8. (a) define the following

(i) Photoelectric emission (01 mark)

(ii) Threshold frequency (01 mark)

(b) With the aid of a labelled diagram, describe an experiment to determine the stopping potential for a given metal surface. (05 marks)

(c) Rutherford directed a beam of alpha particles onto a gold plate in evacuated glass tube.

(i) Explain the observations made by Rutherford (02 marks)

(ii) Derive an expression for the distance of closest approach R, between the gold nucleus and the alpha particle. Take atomic number of Gold as Z. (03 marks)

(iii) Distinguish between ionization energy and excitation energy (02 marks)

(iv) Explain the occurrence of the emission line spectrum in gaseous atoms. (02 marks)

(d) An electron of energy 20eV collides with a hydrogen atom in the ground state and the electron is scattered with a reduced speed. The atom return to its ground state with emission of radiation of wavelength $1.22x10^{-7}$m. Calculate the velocity of the scattered electron. (03 marks)

9. (a) Define the following terms

(i) Avogadro's number (01 mark)

(ii) Positive rays (01 mark)

(b) With the aid of a labelled diagram describe how the Bain bridge mass spectrometer is used to determine the charge to mass ratio of ions (06 marks)

(c) (i) state the Bragg's law of X-ray diffraction (01 mark)

(ii) Describe an experiment to show the wave nature of X-rays (03 marks)

(d) In the milkman's oil drop experiment, a charged oil drop is held stationary between two horizontal plates when a field of $576kVm^{-1}$ is applied between them. When the field is removed, the drop falls freely with a steady velocity of $1.2x10^{-4}ms^{-1}$. Calculate the charge on the drop assume the density of air is negligible. (05 marks)

(e) Explain the motion of cathode rays when directed in between two parallel plates across which a p.d is applied. (03 marks)

10. (a) (i) What are X-rays (01 mark)

(ii) With the aid of diagram explain how X-rays are produced in the X-ray tube. (05 marks)

(ii) State the energy changes that occur during production of X-rays in the X-ray tube.

(b) In the X-ray tube, the electrons strike the target with a velocity of 3.75x107ms-1 after travelling a distance of 5.0cm from the cathode. If a current of 10mA flows through the tube, find the;

(i) Tube voltage (02 marks)

(ii) Number of the electrons striking the target per second. (02 marks)

(iii) Number of electrons with in the space of 1cmlength between the anode and cathode. (05 marks)

(c) Briefly explain one medical application of X-rays (03 marks)

11. (a) define the following terms

(i) Specific charge (01 mark)

(ii) Cathode rays (01 mark)

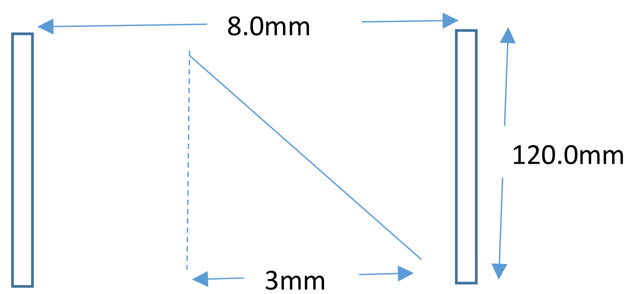
(b) (i) Describe with the aid of a labelled diagram the mode of action of a cathode ray oscilloscope (05 marks)

(ii) Explain the advantages of a C.R.O over a voltmeter when used to measure voltage.

(02 marks)

(iii) The gain control of a C.R.O set on $0.5Vcm^{-1}$ and on alternating voltage, produces a trace of 2.0cm long with time base off. Find the root mean square value of applied voltage.

(c)



A charged water drop of weight 6.0x10-14N falls at a terminal speed of 0.15mms-1 in air between two parallel plates 120mm long and placed 8.0mm apart. When the p.d of 15V is applied between the plates the path of the drop is shown in the figure above. Calculate the

(i) Electric force on the drop

(ii) Charge on the drop

(iii) Maximum p.d between the plates if the drop does not just hit the right hand of the plate.

WISH YOU SUCCESS