P510/1
PHYSICS
Paper 1
March. 1998
SECTION A

1(a) What is meant by scalar and vector quantities? (2)

(ii)Identify scalar and vector quantities from the following; momentum , density , acceleraetion , impulse, pressure and temperature. (3)

(b) (i) What is meant by uniformly accelerated motion? (1)

(ii) Sketch speed-time and distance -time graphs for a body moving with uniform acceleration. (2)

(c) A ball is kicked from a spot 30m from the goal posts with a velocity of $20ms^{-1}$ at 30^0 to the horizontal ,the ball just clears the horizontal bar of the goal posts. find

(i) the height of the goal posts. (5)

(ii) the time of flight. (4)

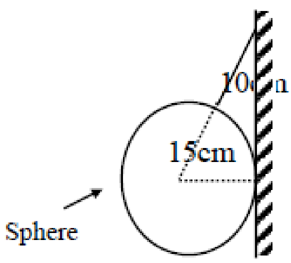
(iii) how far behind the goal posts the ball lands. (3)

2(a) (i) State Newton's laws of motion. (3)

(ii) Define linear omentum and state the law of conservation of linear momentum.(2)

(b) A truck of mass 10^4 kg moving at $10ms^{-1}$ rams into a truck of mass $4x10^6$ kg which is stationary. The trucks sticks together and skid to a stop along a horizontal surface, calculate the distance through which the trucks skid if the coefficient of kinetic friction is 0.25. (5)

(c) State the conditions which 20N and radius 15cm rests against a smooth vertical wall. the sphere is supported in this position by a string of length 10cm attached to a point on the sphere and to a point on the wall as shown below.



(i) Copy the diagram and show the forces acting on the sphere. (3)

(ii) Calculate the reaction on the sphere due to the wall. (2)

(iii) Find the tension in the string. (3)

3(a) (i) State Newton's law of gravitation and deduce the dimensions of the gravitational constant G. (4)

(ii) A body has weight of 10N on Earth. What will be the weight of the body on the Moon if the moon's radius to the Earth's radius is 0.27 and that of the mass to the Earth's mass is $1.2 x 10^{-2}$? (4)

(iii) Sketch a graph to show the variation of the acceleration due to gravity with distance from the centre of the earth, (2)

(b) A 103 kg satellite is launched in a parking orbit about the earth.

(i) Calculate the height of the satellite above the Earth's surface. (4)

(ii) Calculate the mechanical energy of the satellite. (3)

(iii) Expalain the effect of friction between such a satellite and the atmosphere in which it moves. (3)

4(a) (i) Sketch uisng the same axes , the stress-strain curves for a glass wier ,a metal wire and a rubber band. (3)

(ii) Discuss briefly the main features of the curves. (3)

(b) Define young's modulus and find its dimensions. (3)

(c) One end of a copper wire is welded to a steel wire of length 1.6m and diameter 1.0mm, while the other end is fixed . the length of the copper wire is 0.80m while its diameter is 0.5mm .A load of 10kg is suspended from the free-end steel wire. find the

(i) extension which results. (5)

(ii) energy stored in the compound wire. (4)

[Young 's modulus for copper = $1.0x10^{11}Nm^{-2}$

young 's modulus for steel =$2.0x10^{11}Nm^{-2}$

(d) Explain briefly the term plastic deformation in metals. (2)

SECTION B.

5(a)What assumptions are necessary in the derivation of the kinetic theory expression for the pressure of an ideal gas? (4)

(b) A beam of $2x10^{22}$ nitrogen atoms ,each of mass $2.32x10^{-26}$ kg is incident normally on a wall of a cubical container of edge 10.0cm .the beam is reflected through 180^0 if the mean speed of the atoms is $480ms^{-1}$, find the pressure exerted by the nitrogen gas.

(5)

(c) (i) State Dalton's law of partial pressures. (1)

(ii) Two containers A and B of volumes $3 \text{ x } 10^3cm^3$ and $6x10^3cm^3$ respectively contain helium gas at a pressure of 1.0x103 Pa and temperature 300K. Container A is heated to 373K while container B is cooled to 273K , find the final pressure of the helium gas.

(5)

(d) Use the kinetic energy of matter to explain the effect of increasing temperature on saturation vapour pressure. (5)

6(a) Show that the work done by an ideal gas in expanding from a volume V_1 to a volume V_2 is equal to $\int^{v2} pdv$ where p denotes pressure and V the volume (5)

(b) State the conditions requiredto effect the following process

(i) isothermal process (2)

(ii) adiabatic process. (2)

(c) A fire extinguisher is filledwith 1.0kg of compressed nitrogen gas at apressure of 1.2×10^6 Pa and a temperature of 20^0C ,if the gas escapes by expanding adiabatically to a pressure of 1.0×10^5 Pa when the nozzle of the fire extiguisher is opened, find the

(i) original volume of the gas. (4)

(ii) temperature of the gas expanded gas. (3)

[take $\gamma = \frac{C_p}{C_v} = 1.4$]

(d) By considering a gas confined in a cylinder by a movable piston , use kinetic theory to explain why a diabatic expansion of a gas results in cooling. (4)

7(a) (i) Define *thermal conductivity*. (1)

(ii) Explain the mechanism of heat transfer by conduction. (3)

(b) A wall 6mx3m consists of two layers A and B of blicks of thermal conductivities $0.6 Wm^{-1} k^{-1}$ ans $0.5 Wm^{-1} k^{-1}$ respectively. the thickness of each layer is 15.0cm. the inner surface layer A is at a temperature of 100^oC, calculate the

(i) the temperature of the interface of A and B (4)

(ii) rate of heat flow through the wall. (2)

(c) State the Stefan -Boltzmann law of blackbody radiation. (1)

(d) Consider the sun to be a sphere of radius 7.0×10^8 m whose surfsce temperature is 5900k.

(i) find the solar power incident on an area of $1m^2$ at the top of the Earth's atmosphere if this is a distance of 1.5×10^{11}, from the sun.

Assume that the sun radiates as a blackbody. (5)

(ii) Explain why the solar power incident on $1m^2$ of the earth's surface is less than the calculated value in (d) (i) above.(2)

(e) Explain briefly the greenhouse effect and its relation to global warming. (6)

SECTION C .

8(a) A high p.d is applied across two electrodes in air contained in a closed glass tube.Describe with the aid of labelled diagrams that will be observed when the pressure in the tube is progressively reduced down to very low pressures. (5)

(b) List four main properties pf cathode rays. (4)

(c) A charged oil drop of mass 3.27×10^{-15} kg is held stationary between two horizontal metal plates across which a p.d of 1.0×10^{3}V is applied. if the separation of the plates is 1.5cm . find the number of electrons on the drop. (5)

(d)With the aid of a labelled diagram describe the principle oparation of an ionized chamber. (6)

9(a) Draw a labelled diagram to show the main parts of ab X -ray tube. (4)

(b) Describe the energy changes which occur in an X-ray tube oparation. (2)

(c) Explain the production of the following spectra in an X -ray tube.

(i) continuous spectrum (2)

(ii) line spectrum. (3)

(d) Electrons of energy 75keV are stopped by the target of an X-ray tube. calculate the minimum wavelength of the X-ray produced. (3)

(e A monochromatic beam of X -rays of length 2.0×10^{-10} m is incident ona set of cubic plates in a potassium chloride crystal. first order differaction maxima are observed at a glancing angle of 18.5. find the density of potassium chloride if its molecular weight is 74.55. (6)

10(a) (i) What is meant by *nuclear bimding energy*? (1)

(ii) Calculate the binding energy per nucleon of an a -particle expressing your result in MeV.

Mass of proton = 1.0080u

Mass of neutron = 1.0087u

Mass of an a particle = 4.0026u

Iu = 931MeV. (4)

(iii) sketch a graph of binding energy per nuleon against mass number and use it to explain liberation of energy by nuclear fusion and nuclear fission. (6)

(b) Show that the half-life $T_{1/2}$ of a radioactive material is related to the disntergration constant λ through the expression.

$$T_{1/2} = \frac{0.693}{\lambda} \qquad (3)$$

(c) When $^{238}_{92}U$ decays , the end product is $^{206}_{82}Pb$. The half life is $1.4x10^{17}$s.

Suppose a rock sample contains $^{206}_{82}Pb$ and $^{238}_{92}U$ in the ratio 1:5 by weight , calculate the

(i) number of $^{206}_{82}Pb$ atoms in 1.0 g of the rock sample. (3)

(ii) age of the rock. (4)

[Assume the radioactive decay law

$N = N_o e^{-\lambda t}$]

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PHYSICS

Paper 2

March. 1998

SECTION A

1(a) Describe an experiment to determine the focal length of a concave lens using a convex of known focal length. (05marks)

(b) A convex lens and a concave length of focal lengths 17.5 and 15.0cm respectively are monuted coaxially 7.5cm apart with the concave lens facing a disatant object. find

(i) the final position of the image.

(03marks)

(ii) the magnification of the image produced by the concave lens. ***(02marks)***

(c) Explain why a paraboloid mirror is used in search of lights instead of a concave mirror. (03marks)

(d) Describe how the angle of a prism can be measured using a spectometer.(05marks)

(e) Differentiate between chromatic and spherical aberrations. (02marks)

2(a) Define the terms refraction and refractive index. (02marks)

(b) Derive an expression for the apparent displacement of an object when viewed normally through a parallel sided glass block. (05marks)

(c) (i) A glass block of refractive index n_g is immersed in a liquid of refractive index n_1. A ray of light is partially reflected and refracted at the interface such that the angle between the reflected ray and the refracted ray is 90^0 , show that $n_g = n_1 \tan \alpha$, where α is the angle of incidence from the liquid to glass block. (05marks)

(ii) When the producer in (i) is repeated with the liquid removed , the angle of incidence increases by 8^0. Giiven that $n_1 = 1.33$, find n_g and the angle of incidence at the liquid glass interface. ***(06marks)***

(d) A point source of white light is placed at the bottom of a water tank in a dark room. The light from the source is observed obliquely at the water surface. Explain what is observed.
(03marks)

3(a) Use Huygen's principle to show the angle of incidence is equal to the angle of reflection for light falling on aplane reflecting surface. ***(05marks)***
(b) (i) Draw a ray diagram to showing the path of light rays through the experimental arrangement for the demostration of the wavelength of light using a single slit and biprism.
(02marks)
(ii) In a single slit and biprism experiment a prism of refracting angle 1.50 and refractive index 1.5 is used . The slit and the screen are 1.5 cm and 1m respectively from the biprism . if light of wavelength $5.80x10^{-7}$ is used, find the width of the fringes. ***(05marks)***
(iii) State one advantage of the biprism method over Young's doubleslit method.
(01mark)
(c) Distinguish between *continous* and *line emission spectra*. ***(03marks)***
(d) Describe one application of absorption line spectra. ***(4marks)***
4(a) Explain the terms wave length and wavefront as applied to wave motion.
(02marks)
(b) (i) Define the term resonance. ***(01mark)***
(ii) Describe how you would determine the velocityof sound in air using a resonance tube.
(05marks)
(c) Explain with the aid of suitable diagrams the terms fundamental note and overtone as applied to a vibrating wire fixed at both ends. ***(05marks)***
(d) A stretched wire of length 0.75m, radius 1.36mm and density $1380kgm^{-3}$ is clamped at both ends and plucked in the middle. The fundamental note produced by the wire has the same frequency as the first overtone in apipe of length 0.15m closed.
(i) Sketch the standing wave pattern in the wire. ***(01mark)***
(ii) calculate the tension in the wire.[The speed of sound a long the wire is ***(06marks)***
$\sqrt{(T/\delta)}$ where T is the tension in the wire and δ the mass per unit length. speed of sound in air = $330ms^{-1}$]

SECTION B

5(a) A circular coil of N turns of radius R carries current I.
(i) Write an expression for magnetic flux at the centre of coil. ***(01mark)***
(ii) Sketch the magnetic field pattern associated with the coil. ***(02marks)***
(iii) Describe a simple experiment to verify the expression in (i) when N and R are constant.

(06marks)

(b) (i) What is meant by magnetic moment of a current carrying a coil?

(ii) A circular coil of 10 turns each of radius 10 is suspended with its plane along a uniform magnetic field of flux density 0.1T . find the initial torque on the coil when a current of 1.0 A is passed through it. ***(03marks)***

(c)

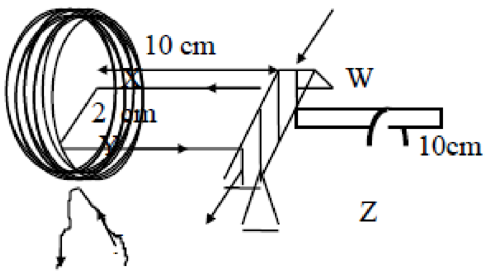

Fig. 1

A rectangular loop of wire WXYZ is balanced horizontally so that the length XY is at the centre of circular coil of 500 turns of mean radius 10.0cm as shown in figure 1. When a current I is passed through XY and the circular coil , a rider of mass

5.0×10^{-4} kg to be placed at a distance of 9.0cm from WZ restore balance . find the value of the current I. ***(06marks)***

6.(i) Derive the relationship between value and root - mean square value of a sinusoidal current. ***(04marks)***

(ii) Calculate the rrot mean square value of an alternating current which dissipates anergy in a heatig coil immersed in a liquid in a calorimeter at two times the rate at which direct current of 4A would if passed through the same coil under the same conditions. ***(03marks)***

(b) A source of sinusoidal voltage of amplitude V_o and frequency f is connected across a capacitor of capacitance C.

(i) Without using any formula explain why a current apparently flows through the capacitor and is out of phase with the voltage. ***(04marks)***

(ii) Find the amplitude of the current which flows and sketch a graph of the amplitude against frequency if the resistance of the connecting wire is negligible. ***(04marks)***

(c) Draw a labelled diagram of a moving coil galvanometer and explain why it cannot be used to measure an alternating current.

(05marks)

7(a) What is meant by

(i) *mutual induction*,***(02marks)***

(ii) *self induction?*. ***(03marks)***

(b) Describe an experiment to demostrate mutual induction.

(c)

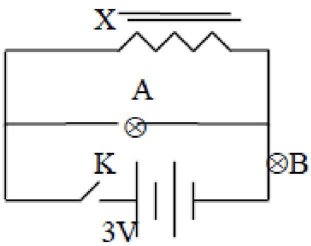

Fig. 2

Bulbs A and B rated 3W,6W are connected to an inductor , X of large inductance as shown in figure 2, explain what is observed when

(i) switch K is first closed. ***(04marks)***

(ii) switch K is opened. ***(02marks)***

(d) (i) Describe briefly the action of a transformer. ***(04marks)***

(ii) Describe briefly four causes of inefficiency in a transformer. ***(02marks)***

(e) A transformer is designed to work on a 240V .60W supply. it has 3000 turns in the primary and 200 turns in the secondary coil. ***(04marks)***

SECTION C.

(a) (i) Draw the circuit diagram of the metrebridge and use it ti derive the acondition for balance. ***(06marks)***

(ii) Explain why the meterbridge is unsuitable for comparison of low resistance. ***(02marks)***

(iii) When resistor of resistance 4Ω and 8Ω are connected respectively in the left and right gaps of a meterbridge . a balance point is obtained at a point a distance of 32.0cm from the left hand end of the bridge wire . On interchanging the resistors , a balance point is obtained at a point 68.0cm from the left hand end . The resistance of the uniform wire of the meterbridge is 5Ω , calculate the end errors. ***(04marks)***

(b)

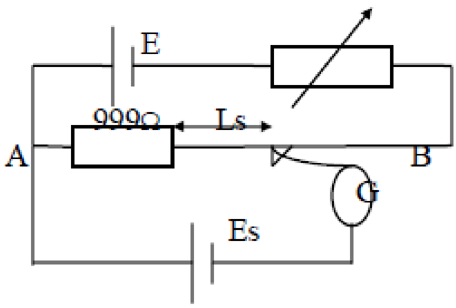

Fig . 3

In figure 3 above E is a driver cell e.m.f 2V and negligible internal resostance Es ,,is standard cell of e.m.f 1.00V and AB is a uniform wire of resistance 10Ω and length 100.0cm . The galvanometer G show no deflection when Ls = 10.0 cm . find

(i) The current flowing in the driver circuit. ***(02marks)***

(ii) The resistance of the rheostat. ***(04marks)***

(iii) The e.m.f of a thermocouple which is balanced by a length of 60.0cm of the slide wire AB. ***(02marks)***

9(a) (i)

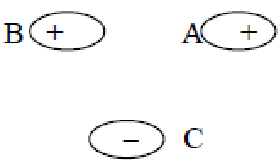

Fig. 4

In figure 4, A,B and C are point charges of equal magnitudes.

(i) Sketch the field lines due to the charges and show the position of the neutral point. (03marks)

(ii) Explain why a charged material attracts an uncharged conductor. (03marks)

(b) With the aid of a labelled diagram describe how a large electric potential can be built up using a Vander Graaf generator. ***(07marks)***

(c)

Two point charges of + 3.8mC and -5.2m C are placed in aira at P and Q as shown in figure 5, Determine the electric field intensity at R.

10,(a) What is meant by capacitance of a capacitor? ***(01mark)***

(b) Describe an experiment you would carry out to verify that the capacitance of a parallel plate capacptor is proportional to εA/d where d is the permittivity of the medium between the plates. ***(06marks)***

(c) (i) Derive an expression for the effective capacitance of three capacitors of capacitance C_1 , C_2 and C_3 connected in parallel. ***(03marks)***

(ii)

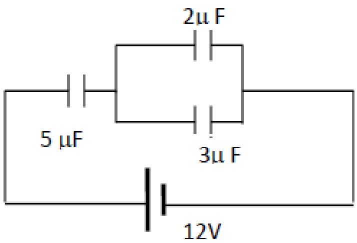

fig 6

A battery of e.m.f 12V is connected across a system of capacitors as shown in figure 6. calculate the total energy stored in the capacitors.

(d) (i)

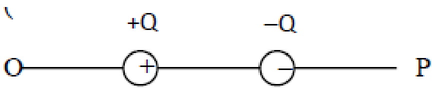

fig 7

Figure 7 shows two charges +Q and -Q placed along a line OP . sketch the variation of electric potential along OP. ***(02marks)***

(ii) Explain with the aid of a diagram the term electrostatic sheilding. ***(04marks)***

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PHYSICS

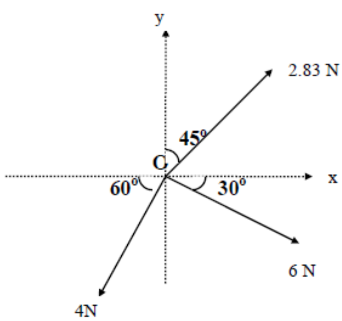
Paper 1

Nov/Dec. 1998

SECTION A

1. (a) State the conditions under which a rigid body is in equilibrium under the action of co-planar forces . ***(2 marks)***

(b) Describe how the center of gravity of a piece of cardboard having an irregular shape may be determined . ***(4 marks)***

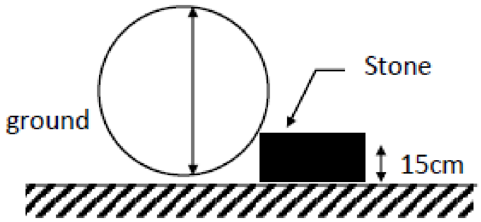


(c) Forces of 2.83 N , 4.00 N and 6.00 N act on a particle O as shown in figure 1 above . Find the resultant force on the particle .

(6 marks)

(d) (i) Explin the term *Unstable equilibrium.* ***(3 marks)***

(ii) An oil drum of diameter 75cm and mass 90kg rests against a stone as shown in figure 2.



Find the least horizontal force applied through the centre of drum , which will cause the drum to roll up the stone of height 15cm. ***(5 marks)***

2. (a) State the laws if solid frictiom and explain them using molecular theory.
(6 marks)

(b) Describe how the coeffocient of static friction for an interface between a rectangular block of wood and aplane surface can be determined.***(4 marks)***

(c)

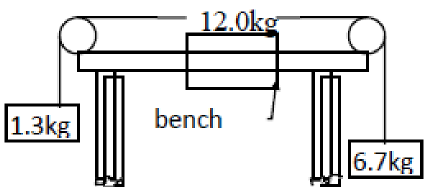


Fig 3

The diagram in figure 3 shows three masses connected by inextensible strings which pass over frictionless pulleys. The coefficient of friction between the bench and the 12.0kg mass is 0.25. If the system is released from rest , determine

(i) acceleration of the 12.0kg mass(6 marks)

(ii) tension in each string . (2 marks)

(d) Explain the occurrence of viscosity in gases. (2 marks)

3. (a) What is *simple harmonic motion*?
(1 mark)

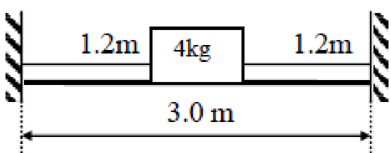


Fig. 4

(b) A body of mass 4kg rests on a smooth horizontal surface. Attached to the body are two pieces of light elastic strings each of length 1.2m and force constant $6.25Nm^{-1}$. The ends are fixed to two points A and B , 3.0 m apart as shown in figure 4. The body is then pulled through 0.1 m towards B and then released.

(i) Show that the body execute simple harmonic motion. ***(3 marks)***

(ii)Find the period of oscillation of the body. ***(3 marks)***

(iii)Calculate the speed of the body when it is 0.03m from the equilibriumposition. ***(4 marks)***

(c) Obtain an expression for the acceleration of a body moving in a circular path with uniform speed. ***(4 marks)***

(d) A car travels round a bend banked at an angle 22.60 if the radius of curvature of the bend is 62.5 m and the coefficient of friction between the type of the car and the road surface is 0.3, calculate the maximum speed at which the car negotiates the bend without skidding. ***(5 marks)***

4.(a) (i) Distinguish between lamina and turbulent flow. ***(2 marks)***

(ii) What are the origins of viscosity in liquids? ***(2 marks)***

(iii) Explain the temperature dependence of viscosity of a liquid. ***(3 marks)***

(b) (i) State Bernoulli's principle. *(1 mark)*

(ii) Account for the variation and velocity of a liquid flowing in a horizontal pipe of varying diameter. ***(4 marks)***

(c) (i) State Archimedes' principle and use a rectangular block immersed in a liquid to illustrate it. ***(5 marks)***

(ii) A cube of rubber of volume

1 x10 $^{-3}$ m^{-3} floats with half of its volume submerged in aliquid of density 1200kgm^{-3} . Find the depth to which the cube will be submerged in a liquid of density 1000kgm$^{-3.}$

(3 marks)

SECTION B.

5(a) Define *the specific latent heat of vaporization* ***(1 mark).***

(b) Decsribe an electrical method of determining the specific latent heat of vaporization of a liquid. ***(8 marks)***

(c) State any two advantages of the continous flow mehod over the method of mixtures for the determination of specific heat capacities of liquids.***(2 marks)***

(d)When electrical power is supplied at a rate of 8.6 x10^{-3} kg evaporates in 30 minutes . On reducing the power to 7.0W , 5x 10 $^{-3}$ kg of the liquid evaporates in the same time.

Calculate the

(i) specific latent heat of vaporization of the liquid . ***(4 marks)***

(ii) power loss to the surrounding.(2 marks)

(e) Explain why evaporation causes cooling. ***(3 marks)***

6.(a) Explain briefly why the centre of a fire appears white.*(2 marks)*

(b) With the aid of a labelled diagram describe how the temperature of a furnace may be measured. *(6 marks)*

(c) The resistance of a platinum thermometer is 5.7, 5.5 and 5.2Ω at boiling point of water, at an unknown temperature and at freezing point of water respectively. Determine the unknown temperature on the thermodynamic scale. ***(4 marks)***

(d) (i) State Stefan's law. ***(1 mark)***

(ii) Calculate the rate of loss of heat energy of a block body or area $40m^2$ at a temperature of 50^o C , if the radiation it receives from the sun is equivalent to a temperature in space of -220^oC.(4 marks)

(e) State one effect of the following radiations on matter.

(i) X - rays

(ii) Infra-red,

(iii) Radiowaves. ***(3 marks)***

7.(a) (i) What is meant by an ideal gas? *(1 mark)*

(ii) State three differences between a real and an ideal gas. ***(3 marks)***

(iii)What is meant by *kinetic theory of matter* ?***(2 marks)***

(iv) Describe briefly an experiment which you can carry out in support of kinetic theory of matter. ***(4 marks)***

(b) Derive the expression

$$P = \frac{1}{3}\rho\overline{c}^2$$

for a pressure of an ideal gas of density and mean square speed , $\overline{c}^2$. ***(5 marks)***

(c) An ideal gas of volume $100cm^3$ at S.T.P,expands a diabatically until its pressure drops to a quarter its original value. Finf the new volume and temperature if the ratio of the principal specific heat capacity is 1.4. ***(5 marks)***

SECTION C.

8(a) (i) What are cathode rays?(1 marks)

(ii) Describe an experiment to show that cathode rays travel in straight lines.

(4 marks)

(iii) An electron accelerated by a p.d of 1000V passes through a uniform electric field f intensity , E , crossed with a uniform magnetic field of flux density 0.3T.If the electron emerges undeflected, calculate the electric intensity , E.(4 marks)

(b) (i) State Bagg's law. (1 marks)

(ii) An X - ray tube is operated on apotential difference of 100KV . Calculate the highest possible frequency of the protons. ***(3 marks)***

(c) (i) With the aid of a labelled diagram , describe the operation of a Geiger- Muller tube. ***(6 marks)***

(ii) State the steps taken to measure activity of a source using the Geiger - Muller tube. ***(2 marks)***

9(a) Define the following terms :

(i) nuclear binding energy(1 marks)

(ii)isotopes , **(1 marks)**

(iii) unified atomic mass unit. (1 marks)

(b) Calculate the binding energy per nucleon for $^{56}_{26}Fe$ nucleus ***(5 marks)***

[mass of : $^{1}_{0}n = 1.008665U$; $^{1}_{1}p = 1.007277U$;

$^{0}_{-1}e = 5.4858 \times 10^{-4}$ U; 1u = 931MeV;

50Fe = 55.9349U.]

(c) (i) What is meant by half- life of a radio- active material ? (1 marks)

(ii) The silver isotope $^{108}_{47}Ag$ has life time of 2.4min. Initially a sample contains 2.0×10^{6} nuclei of $^{108}_{47}Ag$.

Find the number of radio - active nuclei left after 1.2 min ? ***(4 marks)***

[assume $N = N_o e^{-\lambda t}$]

(d) (i) Describe the structure and mode of operation of a cloud chamber . (6 marks)

(ii) List two harzards caused by radiations. (1 mark)

10.(a) State the main characteristics of photo-electric emission. ***(7 marks)***

(b) Describe with the aid of a diagram how the stopping potential of a metal can be measured. ***(5 marks)***

(c) Calculate the maximum speed of the photo electrons emitted by a Caesium surface irradiate with lightof wavelength 484nm if the work function of caesium is 3×10^{-19} J . ***(4 marks)***

(d) A charged oil drop of radius 7.26×10^{-7} m and of density880kg m^{-3} is held stationery in an electric field of intensity $1.72 \times 10^{4} Vm^{-1}$. How many electronic charges are on the drop? (3 marks)

[Density of air = 1.29kg m^{-3}]

PHYSICS
Paper 2
Nov/Dec. 1998
SECTION A

1. (a) (i) State the laws of reflection of light. ***(2 marks)***

(ii) Show that the relation between refractive index, n and a medium and critical angle , c, for a ray of light travelling from the medium to air is given by

$$n = \frac{1}{\sin c}$$ ***(3 marks)***

(b) Describe with the aid of a diagram how the refractive index of a transparent liquid may be determined. ***(5 marks)***

(c) Explain how light from the sun reaches an observer in the morning before the sun appears above the horizon . ***(4 marks)***

(d)

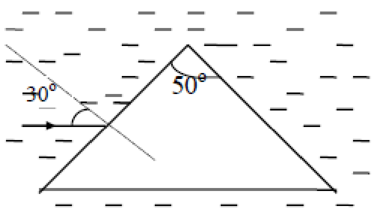


Fig. 1

(i) A ray of light propagating in a liquid is incident on a prism of refracting angle 50^0 and refractive index of 30^0 as shown in figure 1. if the ray passes symmetrically through the prism , find the refractive index of the liquid. ***(4 marks)***

(ii) Explain why white light is dispersed by a transparent medium. ***(2 marks)***

2. (a) (i) Define focal length of a lens.

(1 marks

(ii) A convex lens is contained in a cylindrical tube suth that its exact position in the tube is not accessible.

Describe how you would determine the focal length of the lens without removing the lens from the tube. Derive the formula used to obtain the final result. ***(6 marks)***

(b) (i) Define angular magnification of an optical instrument. ***(1 mark)***

(ii) Explain why the farthest vertical pole in the line with others of equal height looks shorter.***(2 marks)***

(c) With help of a labellel describe how a slide projector works. ***(5 marks)***

(d) A projector projects an image of area 1m2 onto a screen placed 5m from the projection lens, if the area of the object slide is $4cm^2$, calculate the

(i) focal length of the projection lens. (3 marks)

(ii) distance of the slide from the lens. (2 marks)

3. (a)(i) Define the terms amplitudes, frequency and wavelength as applied to wave motion. ***(3 marks)***

(b) A plane progressive wave is given by

$y = a \sin\left(100\pi t - \frac{10\pi x}{9}\right)$, where x and y are in millimetres and t is in seconds.

(i) Write the equation of the progressive wave which would give rise to a stationary wave if superimposed on the one above.
(1 marks)

(ii) Find the equation of the stationarey wave and hence determine its amplitude of vibration. ***(3 marks)***

(iii) Determine the frequency and velocity of the stationary wave. ***(4 marks)***

(c) Describe how the velocity of sound in air may be determined using a resonance tube and tunning forks of known frequencies. ***(6 marks)***

4(a) State the conditions necessary for the production of interference effects with light and explain why these conditions are necessary. ***(4 marks)***

(b) (i) Decsribe with the aid of a labellel diagram the experiment set up for observing Newton's rings. ***(4 marks)***

(ii) Explain qualitatively how Newton's rings are formed. ***(5 marks)***

(c) Two glass plates 12.0cm long are in contact at one edge and separated at the other edge by a piece of metal foil $2.5\text{x}10^{-3}$ thick. when the plates are illluminated normally as shown in figure 2, by light of wave length 500nm.a system of fringes is formed.

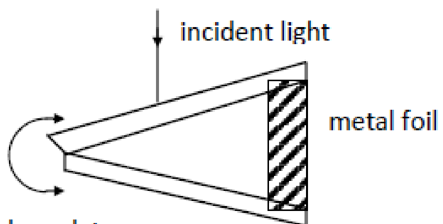


Fig . 2

Find the

(i) seperation of the fringes. ***(5 marks)***

(ii) number of dark fringes formed.
(2 marks)

SECTION B

5.(a) (i) Distinguish between root mean square value and peak value of an alternating current. ***(2 marks)***

(ii) What is the peak value of the voltage from a 240V a.c mains ?(2 marks)

(iii) What is meant by self-induction? (1 marks)

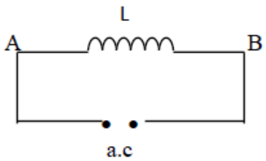


Fig. 3

A coil of inductance L is connected to a source of alternating current as shown in figure 3. if the current in the coli is given by

$I = I_0 \sin \omega t$.

(i) find an expression for voltage, V across the coil, (3 marks)

(ii) Sketch , using the same axes, graphs to show variation of V and I with time and comment on the graphs. ***(2 marks)***

(d) Explain why a capacitor allows the flow of alternating current but not of direct current yet it conducts direct current. ***(3 marks)***

(e) (i) With the aid of a diagram describe how a repulsion type of moving iron meter works. ***(6 marks)***

(ii) State two advantages of moving iron meter over coil one. (1 mark)

6.(a) State the laws of electromagnetic induction. (2 marks)

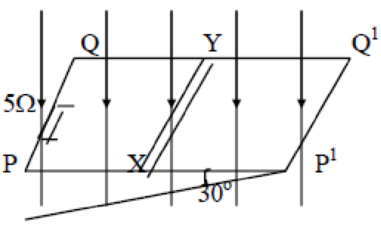


Fig. 4

A metal rod XY of mass 0.2kg , length ,0.8m and negligible rolls down frictionless metal rails PP' and QQ' inclined at 300 to the horizontal.

The rails lie in uniform vertical magnetic feild of flux density 0.4 T, the ends PQ of the rails are connected to a resistance of 5Ω as shown in the figure 4. Calculate the constant speed the rod attains. ***(5 marks)***

(c)

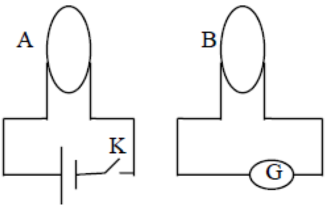


Fig 5

(i) Two coils A and B are placed close to each other with their planes parallel. A is connected in series with a cell and switch K. B is connected in series with a galvanometer, G as shown in figure 5. Explain what is observed when k is momentarily closed. ***(5 marks)***

(ii) Explain how the observations in (c) (i) above would be affected if a branch of soft iron wires rather than solid iron bar is placed inside the coils.

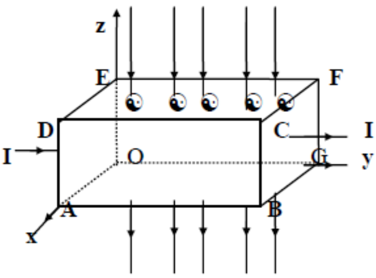


Fig. 6

In the diagram above OABCDEFG is a rectangular conductor carrying current in the direction OY . The conductor is situated in uniform magnetic field which is perpendicular to the face CDEF as shown in figure 6.

Explain why there is a p.d between faces ABCD and OEFG. ***(4 marks)***

7. (a) (i) Define the term magnetic flux density and state its units .***(2 marks)***

(ii) Describe the construction and working of a moving coil galvanometer.

(6 marks)

(iii) Explain the modifications on the features in (a) (i) above which are necessary to make it a ballistic galvanometer. ***(3 marks)***

(b) A capacitor of capacitance 2000μF is fully charged to 10V . when the capacitor is discharged through a ballistic galvanometer, the galvanometer gives a maximum throw of 20 divisions. A coil of 25 turns each of radius 10cm is placed with its plane perpendicular to a uniform magnetic field.

The coil is connected in series with the ballistic galvanometer. When the coil is rotated through 180^0 , the galvanometer gives a maximum throwof 15 divisions. Calculate the magnetic flux density , if the total resistance in the circuit is 3Ω. (5 marks)

(c) Describe , using a labellel diagram the man characteristics of the Earth's magnetic field.

(4 marks)

SECTION C

8 (a) (i) Define electrical resistivity.

(1 mark)

(ii) State the law of conservation of current at a junction in an electrical circuit?

(1 mark)

(b) A battery of emf .ε and internal resistance , r, is connected across a resistor of variable resistance , R . Derive the expression for the maximum power expended in the resistor. (5 marks)

(c)

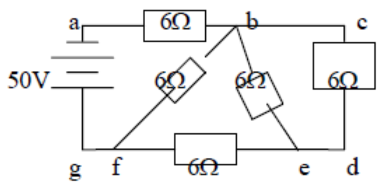


Fig. 7

Figure 7 shows a net work of resistors connected to a battery of emf.50V and interval resistance 0.4Ω . Calculate the

(i) effective resistance in the circuit. ***(4 marks)***

(ii) power dissipated in the battery. ***(3 marks)***

(d) Describe with the aid of circuit diagram , how the emfs of two cells can be compared using a potentiometer slide wire. (6 marks)

9.(a) (i) State Couloumb's law of electrostatics. (1 mark)

(ii) The electric density at the surface of the earth is about $1.2 \times 10^{2} Vm^{-1}$ and points towards the centre of the earth . Assuming that the earth is a sphere of radius 6.5×10^{6}m, find the charge held by the earth's surface. (3 marks)

(b) Two point charges +4.0μC are separated by 10.0cm in air as shown in figure 8.

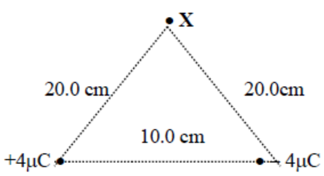


Fig. 8

Find the electric intensity at point x a distance of 20.0cm from each charge. ***(8 marks)***

(c) (i) What is meant by *corona discharge*? ***(4 marks)***

(ii) Explain how the lightening conductor works. ***(4 marks)***

10. (a) What is meant by

(i) *capacitance of a capacitor*, ***(1 mark)***

(ii) a *dielectric material*? (1 mark)

(b) (i) Explain the effect of a dielectric on the capacitance of a capacitor. (6 marks) (ii)Derive the expression for the effective capacitors in parallel. (4 marks)

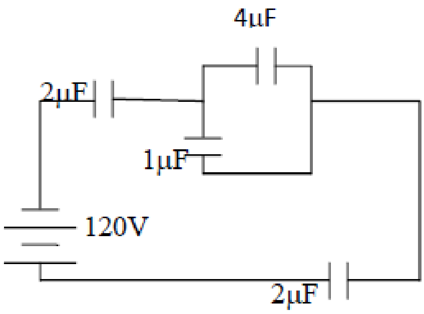


Fig. 9

(c) Figure 9 shows a network of capacitors connected to a d.c supply of 120V.calculate the

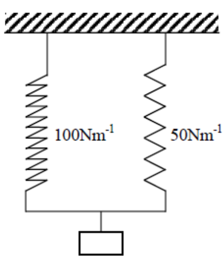
(i) charge on 4μFcapacitor, ***(5 marks)***

(ii) energy stored in 1 μF capacitors.
(3 marks)

P510/1
PHYSICS
Paper 1
Nov/Dec. 1999
SECTION A

1. (a) What is meant by conservative force? Give **two** examples.***(2 marks)***
   (b) (i) Explain the term damped and force oscillations. ***(4 marks)***
   (ii) Sketch displacement - time graphs for under damped and over damped oscillations. ***(2 marks)***

(c) A mass of 0.5kg is suspended from the free ends of two springs of force constants 100 Nm^{-1} and 50 Nm^{-1} respectively as shown in figure 1.



Calculate the

(i) extension produced (3 marks)

(ii) tension in each spring (2 marks)

(iii)energy stored in the springs, ***(3 marks)***

(iv) frequency of small oscillations when the mass is given a small vertical displacement. ***(4 marks)***

2. (a) (i) What is meant by dimensions of a physical quantity ? (1 mark)

(ii) Define coefficient of viscosity of a fluid. (1 mark)

(b) The viscous force on a small sphere of radius a , falling with velocity v in a liquid of coefficient of viscosity η, is given by

$F = K a^x \eta^y v^z$, where K is a dimensionless constant .

(i) Use the method of dimensions to determine the values of x , y and z. ***(5 marks)***

(ii) if the constant K is equal to 6π , obtain an expression for the terminal velocity of the sphere. Express your result in terms of a , density δ, of the liquid , density ρ , of the sphere and acceleration due to gravity g. (4 marks)

(c) (i) Describe briefly an experiment to measure the viscosity of motor oil of known density . ***(7 marks)***

(ii) Explain using kinetic theory , the effect on the viscosity of a liquid of increasing temperature. ***(2 marks)***

3. (a) What is meant by the gravitational field strength? (1 mark)

(b) Suppose you are provided with the following items : a spiral spring . a stop clock , a set of masses , a mass hanger , a paper pointer , ametre rule and a retort stand and clamps. Describe how you would determine the acceleration due to gravity. ***(7 marks)***

(c) A 3.0 kg block is held in contact with a compressed spring of force constant 120Nm^{-1}. The block rests on a smooth portion of a horizontal surface which is partly smooth and partly rough as shown in figure 2.

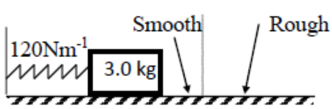


Fig. 2

When the block is released , it slides without friction until it leaves the spring and then continues to move along the rough portion for 8.0 m before it comes to rest. The coefficient of sliding friction between the block and the rough surface is 0.20.

Calculate the :

(i) maximum kinetic energy of the block ***(3 marks)***

(ii) compression of the spring before the block was released. ***(3 marks)***

(d) (i)State Bernouilli's principle.(1 mark)

(ii) An aeroplane has a wing area $40m^2$. At take off , the speeds of air above andbelow the wings are 120 ms^{-1} and $100ms^{-1}$ respectively . Find the lift on the aeroplane , if the density of air is
1.3 kg m^{-3}. ***(5 marks)***

4. (a) Show that the speed of an object moving in a circle of radius , r with uniform angular velocity ω is v = r ω.
(3 marks)

(b) A rigid body rotates about an axis with angular velocity ω. If the moment of inertia of the body about this axis is I show that the rotational kinetic energy of the body is $\frac{1}{2}I\omega^2$.

(5 marks)

(c) The oxygen atoms in an oxygen molecule at S.T.P are separated by distance of about 1.2×10^{-10} m. The mass of an oxygen atom is 2.66×10^{-27} kg . The mean molecular speed is 480 ms^{-1} while its angular speed is 6.5×10^{12} rad. s^{-1}.
Calculate for the molecule the
(i)moment of inertia about its centre of mass. (3 marks)
(ii) ratio of the rotational kinetic energy to the mean translational energy . (5 marks)

(d) A disc of radius a , starting from rest rolls without slipping down a plane inclined at an angle a to the horizontal .
Find , using the principle of conservation of energy the speed of the disc at the bottom of the incline if the length of the incline is *l*. ***(4 marks)***

[moment of inertia of the disc about an axis through the centre of mass = $\frac{1}{2}Ma^2$].

SECTION B.

5 (a) Outline the steps necessary in setting up a celsius scale of temperature.

(b) The resistance of a plantinum wire at the tripple point of water is 5. 16Ω.
What will its resistance be at 100^0C? ***(3 marks)***

(c) Describe , with aid of a well labelled diagram, how to measure high temperatures using an optical pyrometer. (6 marks)

(d) (i)Define a black body . (1 mark)

(ii) Assuming that the sun is a sphere of radius 7.0 x 10^8 m at a temperature of 6000K, estimate the temperature of the surface of mars if its distance from the sun is 2.28x 10^{11} marks. ***(5 marks)***

6. (a)State any two ways in which real gases differ from an ideal gas. ***(2 marks)***

(b) Using the same axes, sketch pressure versus volume graphs for a real gas :

(i) above the critical temperature,

(ii) at the critical temperature ,

(iii) below the critical temperature

Indicate in your sketch the different phases of the gas. ***(5 marks)***

(c) Use the kinetic theory of matter to explain why the specific latent heat of vaporization of water is higher at 20^0c that it is at its boiling point. ***(2 marks)***

(d) Describe an experiment to determine the temperature dependence of saturated vapour pressure of water. (6 marks)

(e) A volume of 4.0 x10^{-3} m $^{-3}$ of air is saturated with water vapour at 100^0C. The air is cooled to 20^0C at constant pressure of 1.33 x 10^5 Pa . Calculate the volume of air after cooling , if the saturated vapour pressure of water at 200c is 2.3 x 10^3 Pa .[Atmosphereric pressure = 1.10 x 10^5 Pa]

(5 marks)

7. (a) Define specific heat capacity . (1 marks)

(b) Describe an electrical method of measuring the specific heat capacity of a metal. ***(6 marks)***

(c) In a continous flow calorimeter for measurement of specific heat capacity of a liquid , 3.6 x10^{-3} m ^{3} of liquid flows through the apparatus in 10 minutes.
When electrical energy is supplied to the heating coil at the rate of 44W, a steady difference of 4 K is obtained between the temperatures of the outflowing and inflowing liquid. When the flow rate is increased to 4.8 x10 $^{-3}$ m ^{3} of liquid in 10 minutes , the electrical power required to maintain the temperature difference is 58 W. Find the

(i) specific heat capacity of the liquid.

(6 marks)

(ii) rate of loss of heat to the surroundings. (2 marks)

[Density of liquid = 800kg m $^{-3}$]

(d) Explain why the difference between the specific heat capacity at constant pressure , C_p and that at constant volume ,

C_v is negligible for solids but not for gases . hence show that for one mole of gas
$C_p - C_v = R$. ***(5 marks)***

SECTION C

8. (a) What is meant by work function of a metal. ***(1 marks)***

(b) Describe the main features of photoelectric emission. ***(4 marks)***

(c) A 100m .W beam of light of wavelength $4.0\text{x}10^{-7}$ m falls on a Caesium surface of a photocell

(i)How many photons strike the Caesium surface per second? ***(5 marks)***

(ii) If 80 % of the photons emit photoelectrons, find the resulting photocurrent . ***(4 marks)***

(iii) Calculate the kinetic energy of each photoelectron if the work function of Caesium is 2.15eV. ***(3 marks)***

(d) Describe one application of a photocell. ***(3 marks)***

9. (a) (i) Explain what is observed when a beam of α - particles is incident on a gold foil. ***(6 marks)***

(ii) A beam of α - particles of energy 4.2 Me V is incident normal to a gold foil. What is the closest distance of approach by the α - particle to the nucleus of a gold atom?
(4 marks)

[Atomic number of gold = 79]

(b) State Bohr's postulate of the hydrogen atom.. ***(2 marks)***

(c) The energy levels of the hydrogen atom are given by

$E_n = \frac{21.7\text{x}10^{-19}}{n^2}$ joules , where n takes on the values 1,2,3------

(i) Use this result to account for the occurrence of emission and absorption line spectra..
(5 marks)

(ii) Find the shortest wavelength of radiation which can be emitted by the hydrogen atom.
(3 marks)

10 (a) With the aid of a labelled diagram , describe how an X- ray tube works . (5 marks)

(b) A beam of cathode rays is directed midway between two parallel metal plates of length 4.0cm and separation 1.0cm.

The beam is deflected through 10.0 cm of a fluorescent screen placed 20.0cm beyond the nearest edge of the plates when a potential difference (p.d) of 200V is applied across the plates.

If this deflection is annulled by a magnetic field flux density of 1.14 x10^{-3} T applied normal to the electric field between the plates , find the charge to mass ratio of cathode rays. ***(5 marks)***

(c) (i) Draw alabelled diagram showing the essential features of a cathode ray oscilloscope (CRO) . State the uses of these features. ***(8 marks)***

(ii) Explain the use of a time - base in a cathode ray oscilloscope.(2 marks)

P510/2
PHYSICS
Paper 2
Nov/Dec. 1999
SECTION A

1(a) Define refraction. ***(1 mark)***

(b) (i) With the aid of suitable ray diagrams explain the terms critical angle and total internal reflecti(b) (i) . With the aid of suitable ray diagrams explain the terms critical angle and total internal reflection. ***(4 marks)***

(ii) Monochromatic light is incident at an angle 45^0 on a glass prism of refracting angle 70^0 in air. The emergent light grazes the other refracting surface of the prism . Find the refractive index of the glass. ***(6 marks)***

(c) (i) With the aid of a labelled diagram describe the structure and action of prism binoculars. ***(4 marks)***

(ii) Explain why prisms rather plane mirrors are used in binoculars .
(2 marks)

(iii) In a pair of prism binoculars the optical path from the objective to the eye-piece is 50.0cm. The eye-piece has a focal length of 2.5cm. Find the magnifying power in normal adjustment.***(3marks)***

2.(a)Describe how the focal length of a deverging lens may be determined.
(6 marks)

(b) A lens L_1 casts a real image of a distant object on a screen placed at a distance 15cm away. When another lens L_2 is placed 5cm beyond lens L_1 the real image formed. Determine the focal and the type of lens L_2.
(5 marks)

(c) A convex lens of focal length 60cm is arranged co-axially with a deverging lens of focal length 5cm , to view a distant star.

(i) If the final image is at infinity , draw a ray diagram to show the formation of the image of the star. ***(3 marks)***

(ii) Calculate the magnifying power obtained if the image of the star is formed at a distance of 25 cm infront of the eye-piece. ***(4 marks)***

(iii) List one advantage and one disadvantage of this type of arrangement over the astronomical telescope. ***(2 marks)***

3(a) (i) What is meant by coherent sources of waves? ***(3 marks)***

(ii) Distinguish between interference and diffraction of ligth.
Give one example of each ***(4 marks)***

(b) With the aid of suitable sketches , explain the following

(i) division of wave front ***(2 marks)***

(ii) division of amplitude. ***(2 marks)***

(c) Monochromatic light wave length $5x10^{-7}$ m is incident on two slits of separation $4\ x10^{-4}$ m. Calculate the fringe separation on a screen placed 1.5 m from the slits. ***(3 marks)***

(d) A car travelling $72kmh^{-1}$ has a siren which produces sound of frequency 500Hz. Calculate the difference between the frequency of sound heard by an observer by the roadside as the car approaches the receds from the observer [speed of sound in air = $320ms^{-1}$] ***(6 marks)***

4. (a) What is meant by the terms *free* , *damped* and *forced oscillations*.***(6 marks)***

(b) The displacement of a particle in a progressive wave is
$y = 2\sin [2\pi(0.25x-100t)]$, where x and y are in cm and the is in seconds. Calculate the :

(i) Wavelength , ***(3 marks)***

(ii) velocity of propagation of the wave. ***(3 marks)***

(c) (i) Explain how beats are produced.

(ii) An observer moving between two identical staionary sources of sound along a staright line joining them hears beats at the rate of $4.0s^{-1}$. At what velocity is the observer moving if the frequencies of the sources are 500Hz and velocity of sound when the observer makes the observation is $340ms^{-1}$? ***(5 marks)***

5(a) Explain the following terms as applied to the Earth's magnetic field:

(i) magnetic meridian, (1 mark)

(ii) angle of dip (1 marks)

(iii) declination. (1 marks)

(b) Draw sketch diagrams to show the magnetic field pattern due to an electric current flowing through a circular coil and along solenoid. (4 marks)

(c) A circular coil of 20 turns aech of radius 10.0cm lies flat on a table . The Earth's magnetic field intensity at the location of the coil is $43.8Am^{-1}$ while the angle of dip is 67.0^0. Find the :
(i) magnetic flux threading the coil. (4 marks)
(ii) toque on the coil if a current of 2.0A is passed through it.(3 marks)

(d) If you are given a coil of known number of turns N, known area A and known resistance , a resistance box , a compass needle and a calibrated ballistic galvanometer , describe briefly how you would determine the horizontal component of the Earth's magnetic flux density. (6 marks)
6. (a) What is meant by the following terms:
(i) *self - induction*? ***(2 marks)***
(ii) *mutual - induction*? ***(2 marks)***
(b) Two coils X and Y are placed coaxially near each other as shown in figure 1.

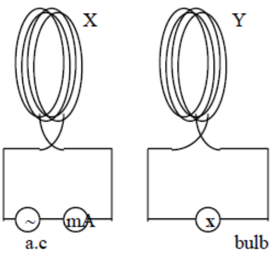


Fig. 1

Explain the following observations.
(i) When the a.c supply is switched on , the lights up. ***(2 marks)***
(ii) The brightness of the buld increases when a soft iron rod is placed inside and along the common axis of the coils. ***(2 marks)***
(iii) The brightness of the bulb varies with distance between the coils.
(2 marks)
(c) An air-cored long solenoid of 500 circular turns per metre and radius 8.0cm has a secondary coil of 20 turns tightly wound around its middle. The current in the solenoid is 2.0A. Find the e.m.f induced in the coil when current in the solenoid is reduced to zero in 10^{-2} s. (6 marks)
(d) With the aid of circuit diagram, describe the mode of action of a full -wave rectifier.
(4 marks)
7(a) (i) With the aid of a labelled diagram describe the structure and mode of operation of an a.c generator. ***(4 marks)***
(ii)Sketch a graph of the output voltahe against time. (1 mark)

(b) A flat circular coil with500 turns eack of radius 10 cm is rotated at a frequency of 200 revolutions per minute about its diameter at right angles to a uniform magnetic field of flux density 0.18T. Calculate the :

(i) Maximum magnetic flux linking the coil. (3 marks)

(ii) e.m.f induced in the coil when the plane of the coil makes an angle of 30^0 with the magnetic field. ***(3 marks)***

(iii) root mean square value of the e.m.f induced in the coil. ***(2 marks)***

(c) (i) State any three factors which limit the efficiency of a transformer and indicate how they are minimized in practice. ***(3 marks)***

(ii) Show that the power loss , P_L ,in a transmission line of total resistance R_l , is given by

$$P_L = \frac{P_T^2 R_L}{V^2}$$

where P_T and V are the power transmitted and the voltage delivered to the user , respectively.***(4 marks)***

SECTION C:

8.(a) What is meant by the *e.m.f* and *internal resistance* of a battery ?(2 marks)

(b) A d.c source of e.m.f 16V and negligible internal resistance is connected in series with two resistors of 400 and R ohms , respectively . When voltage is connected a cross the 400Ω resistor, it reads 4.0 V while it reads 6.0V when conneted across the resistor of R ohms . Find the :

(i) resistance of the voltmeter ***(6 marks)***

(ii) value of R. ***(1 marks)***

(c) Describe how you would use a slide wire potentiometer to measure the inter resistance of a dry cell. ***(5 marks)***

(d) In figure 2, AB is a uniform resistance wire of length 1.00m and resistance 10.0 Ω. E is an accumulator of e.m.f 2.0V and internal resistance 1.0Ω.

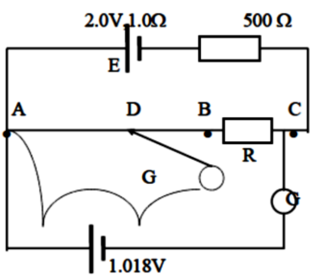


Fig.2

When a standard cell of e.m.f 1.018 V is connected in series with the galvanometer, G across AC , the G shows no deflection . When the standard cell is removed and a thermocouple connected via the galvanometer, Gas shown by the dotted line, G shows no deflection when AD = 41.0cm.

Calculate the :

(i) the value of R (3 marks)

(ii) e.m.f of the thermocouple.

(3 marks)

9.(a) Define *electric potential* and *electric field intensity*. (2 marks)

(b) Consider two points A and B at distance of 15.0 cm and 20.0 cm respectively, from a point charge of 6.0μC as shown in figure 3.

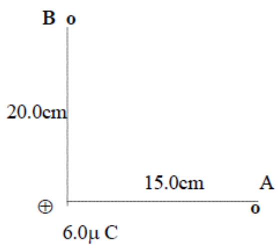


Fig . 3

(i) Find the electric potential difference between A and B. (6 marks)

(ii) Calculate the energy required to bring a charge of +1.0μC from infinity to point A.

(3 marks)

(c) Alpha particles (charges = +2e) , each having kinetic energy 1.0 x10^{-12} J are incident head -on , on gold nuclei (charge = + 79e) in a gold foil. Calculate the distance of closest approach of an α - particle to a gold nucleus.[e = 1.6 x10^{-19} C] (4 marks)

(d) Describe and experiment to show that charge resides only on the outside surface of a hollow coductor. (5 marks)

10. (a) Describe and account for the difference between the structures of a moving coil galvanometer and the ballistic form of the instrument . (4 marks)

(b) With the aid of a circuit diagram , describe how you would compare capacitances of two capacitors using a ballistic galvanometer .(5 marks)

(c) Two large oppositely charged plates are fixed 1.0cm apart as shown in figure 4. The p.d between the plates is 50V.

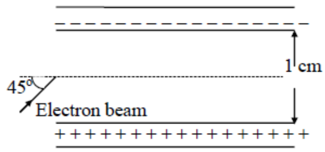


Fig. 4

An electron beam enters the region between the plates at an angle of 45^0 as shown . Find the maximum speed the electrons must have in order for them not to strike the upper plate.
[mass of an electron 9.11x 10^{-31} kg] (8 marks)

(d) Describe the energy changes which occur when a capacitor is being charged from a battery. (3 marks)

P510/1
PHYSICS
Paper 1
Nov/Dec. 2000
SECTION A

SECTION A

1.(a).(i).State Newton's laws of motion.

(ii) Define impulse and derive its relation to linear momentum of the body on which it acts. (3 marks)

(b). A body of mass m_1 and velocity,u_1 collides head on with a body of mass m_2 . m_2 have velocity u_2 in the same direction as u_1. Use Newton's laws to show that the quantity, $m_1 u_1+m_2 u_2$ is conserved. (5 marks)

(c). A ball of mass 0.5 kg is allowed to drop from a point a distance of 5.0m above a horizontal concrete floor. When the ball first hits the floor, it rebounds to a height of 3.0m.

(i.) What is the speed of the ball just after the first collision with the floor?

(ii). If the collision lasts 0.01s, find the average force which the floor exerts on the ball. (5 marks)

2.(a). (i).State Archimedes's principle. (1 marks)

ii. What is simple harmonic motion? (2 marks)

(b). A uniform cylindrical rod of length 0.08m, cross sectional area 0.02m and density 900kgm^{-3} floats vertically in a liquid 100kg^{-3}.The rod is depressed through a distance of 0.005m and then released.

(i). Show that the rod performs simple harmonic motion. (5 marks)

(ii). Find the frequency of the resultant oscillations. (4 marks)

(iii). Find the velocity of the rod when it is at a distance of 0.004m above the equilibrium position. (3 marks)

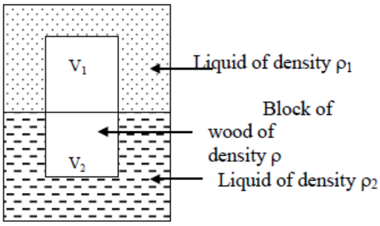


Fig. 1

A block of wood of density ρ floats at the interface between immiscible liquids of densities ρ_1 and ρ_2 as shown in figure 1

(i). Show that the ratio of the volume V_1 to V_2 of the block in the two Liquids is given by

$$\frac{V_1}{V_2} = \frac{\rho_2 - \rho}{\rho - \rho_1}$$ (4 marks)

(ii.) What happens when this block of wood is replaced with a denser one? (1 mark)

3.(a). Distinguish between scalar and vector quantities. Give **two** examples of each. (3 marks)

(b). (i). Define the terms time of flight and range as applied to projectile motion. (2 marks)

(ii). A projectile is fired in air with speed u ms^{-1} at an angle θ to the horizontal. Find the time of light of the projectile. (2 marks)

(d) State the conditions for equilibrium of a rigid body under the action of coplanar forces. (2 marks)

(d)A mass of 5.0 kg is suspended from the end A of a uniform beam of mass 1.0kg and length 1.0 m. the end B of the bean is hinged in a wall. The beam is kept horizontal by a rope attached to A and to a point C, in the wall at a height 0.75 m above B.

b.Draw a sketch diagram to show the forces acting on the beam. (2marks)

c.Calculate the tension in the rope. (4marks)

d.What is the force exerted by the hinge on the beam? (5 marks)

4.(a). State Kepler's laws of gravitation. (3 marks)

b. i) Show that the period of a satellite in a circular orbit r about the earth is given by:

$$T = \left[\frac{4\pi^2}{GM_E}\right]^{1/2} r^{3/2},$$

Where G is the universal gravitational constant and M_E is the mass of the earth (5 marks)

ii) Explain briefly how world-wide radio or television communications can be achieved with the help of satellites. (4marks)

(c.) A satellite of mass 100 kg is in a circular orbit at a height of 3.59×10^7 m above the earth's surface.

(i) Find the mechanical energy of the satellite. (4 marks)

(ii) Explain what would happen if the mechanical energy was decreased. (4 marks)

SECTION B

5. (a) (i) Describe Searle's method of determining the thermal conductivity of a good conductor of heat. (7 marks)

ii. Why is the method in (a). (i) best suited for a good conductor of heat? (2 marks)

(b). The two ends of a metal bar of length 1.0 m are perfectly lagged up to 20 cm from either end. The ends bar is maintained at 100^0C and 0^0C respectively.

i) Sketch a graph of temperature versus distance along the bar. ***(2 marks)***

ii) Explain the features of the graph in b. i. (3 marks)

(c). The external walls of a house consists of two layers of brick separated by an air cavity. The outer face of the wall is at a temperature of 45^0C while the inside of the house is at 20^0C. If the thickness of each brick layer is 15 cm and of air cavity is 5 cm. Calculate the temperatures of the walls in contact with air in the cavity. (6 marks)

6.(a).(i)State Boyle's law. (1mark)

(ii) What is meant by partial pressure of a gas? (1 mark)

iii

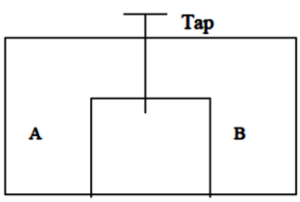


fig 2

Two cylinders A and B of volumes V and 3V respectively are separately filled with gas. The cylinders are connected as shown in figure 2 with the tap closed. The pressures of the gas in A and B are P and 4P respectively. When the tap is opened the common pressure becomes 60Pa. Assuming isothermal conditions find the value of P. ***(4 marks)***

(b).(i). State **three** differences between ideal and real gases. ***(3 marks)***

(ii). Sketch a pressure versus volume curve for a real gas undergoing compression below its critical temperature (1mark) (iii). Explain the main features of the curve. (3marks)

(c) Two similar cylinders P and Q contain different gases at the same pressure. When a gas is released from P the pressure remains constant for sometime before it starts dropping. When the gas is released from Q the pressure continuously drops. Explain the observations above. (5marks)

(d). Using the expression for the kinetic pressure of an ideal gas, deduce the ideal gas equation if $\frac{1}{2} mc^2 = {}^3/_2 K_BT$. (2marks)

7.(a). (i).State the desirable properties a material must have to be used as a thermometric substance. (2 marks)

(ii). Explain why scales of temperature based on different thermometric properties may not agree. (1 mark)

(b.) (i). Draw labeled diagram to show the structure of a simple constant volume gas thermometer. (3marks)

(ii)Describe how a simple constant- volume gas thermometer can be used to establish a Celsius scale of temperature. (5marks)

(iii). State the advantages and disadvantages of a mercury in glass thermometer and a constant-volume gas thermometer. (3marks)

(c). The resistance of the element of a platinum resistance thermometer is 4.00Ωat the ice-point and 5.46Ω at the steam point. What temperature on the platinum resistance scale would correspond to a resistance of 9.84Ω? (3 marks)

(d). The mean kinetic energy of one mole of helium gas at room temperature is 3.74×10^3 J. Calculate room temperature. (3 marks)

SECTION C

8.(a). State the laws of photo electric emission. (4 marks)

(b).(i). Describe an experiment to determine Plank's constant. ***(5 marks)***

(ii). Violet light wavelength 0.4 μm is incident on a metal surface of threshold wavelength 0.65 μm. find the maximum speed of emitted electrons. (4 marks)

(iii). Explain why light whose frequency is less than the threshold frequency cannot cause photo emission. ***(2marks)***

(c).(i). What are X-rays? (1mark)

ii. Explain how the intensity and penetrating power of X-rays produced by an X-ray tube can be varied. ***(4 marks)***

9.(a.) (i.)Define the terms half life and decay constant as applied to radio activity. (2 marks)

(ii). State the relationship between half life and decay constant? (1 mark)

(b). The radio isotope ^{60}Co decays by emission of β particle and γ-ray. Its half life is 5.3 years.

(i)Find the activity of a source containing 0.10g of ^{60}Co. ***(4 marks)***

(ii)In what ways do γ -rays differ from β particles? ***(3 marks)***

(c).(i). What is meant by mass defect in nuclear physics? ***(1 mark)***

(ii). Calculate the mass defect for $^{59}_{26}Fe$, given the following information:

Mass of $^{59}_{26}Fe$ nucleus = 58.93488U

Mass of a proton = 1.00728 U

Mass of a neutron = 1.0086 U ***(4 marks)***

(d). Describe the structure and action of an ionization chamber. (5 marks)

(10).(a).What is meant by specific charge of an ion? (1mark)

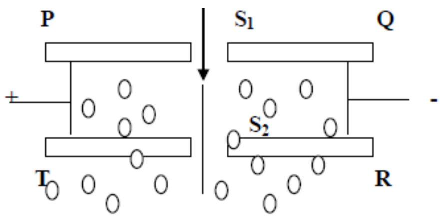


Fig.3

Positive ions of the same charge are directed through slit S1 into the region PQRT as shown in figure 3. There is a uniform electric field of intensity 300 NC^{-1} between the plates PT and QR. A uniform magnetic field of flux density shown above.

(i). Calculate the velocity of the ions which go through slit S_2. ***(3marks)***

(ii). Describe the motion of ions in the region below TR. ***(3marks)***

(c). When fast moving electrons strike a metal target in a X-ray tube, two types of X-ray spectra are produced.

(i). Draw a sketch graph of intensity against wavelength of the X-rays. ***(2marks)***

(ii). Account for the occurrence of the two types of spectra. ***(5 marks)***

d. Outline the experimental evidence for the quantum theory of matter. ***(6marks)***

P510/2

PHYSICS

Paper 2

Nov/Dec. 2000

SECTION A

1(a) Define principal focus of a converging lens ***(1 mark)***

(b) A converging lens focal length f is placed between a finite object and a screen. The position of the screen is adjusted until a clear magnified image is obtained on the screen. Keeping the screen fixed in this position at a distance λ from the object, the lens is displaced through a distance d to obtain a clear diminished image on the screen.

(i) Draw a ray diagram to show the formation of the images in the two cases. ***(2 marks)***

(ii) Show that $\lambda^2 - a^2 = 4df$ ***(5 marks)***

(iii) Find the product of the magnifications produced in the two cases ***(2 marks)***

(c) (i) Draw a ray diagram to show how two converging lenses , one of long focal length, f_1 and the other shorter focal length, f_2 can be arranged to make an telescope in normal adjustment ***(2 marks)***

(ii) Derive the expression for the magnifying power of the telescope in this setting. ***(3 marks)***

(d) The objective of a compound microscope has a focal length of 2.0 cm while the eye piece has a focal length of 5.0cm. An object is placed at a distance of 2.5 cm infront of the objective. The distance of the eyepiece from the objective is adjusted so that the final image is 25cm infront of the eyepiece. Find the distance between the objective and eyepiece. ***(5 marks)***

2 (a) (i) What is meant by reflection of light? (1 marks)

(ii) State the laws of reflection. ***(2 marks)***

(b) Describe how the refractive index of a material of a glass prism of known refracting angle can be determined using a spectrometer. ***(6marks)***

c)

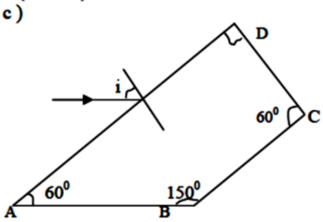


Fig.1

A ray of light is incident on the face AD of a glass block as shown in figure 1. The refractive index of the material of the glass block is 1.52. If the ray emerges normally through face BC after total internal reflection, calculate the angle of incidence I ***(5 marks)***

(d) Explain how a mirage is formed . ***(3 marks)***

(e) An object at a depth of 3.0m below the surface of water is observed directly from above the surface. Calculate the apparent displacement of the object if the refractive index 1.33 ***(3 marks)***

3(a) State the principle of superposition of waves ***(1mark)***

(b) Two loud speakers producing sound of the same frequency are placed 50m apart facing each other. An observer walks from one speaker to the other along the line of the speaker

(i) What does the observer hear? ***(2 marks)***

(ii) Explain the observation in (b) (i) (4 marks)

(c) Describe with the aid of a diagram how you can determine the velocity of sound in air by a method which uses interference of sound (6 marks)

(d) A progressive and a stationary wave each has a frequency of 240Hz and a speed of $80ms^{-1}$ calculate:

(i) Phase difference between two vibrating points in the progressive wave which are 6 cm apart ***(4 marks)***

(ii) Distance between nodes in the stationary wave ***(3 marks)***

4 (a) What is meant by coherent source of light? ***(3 marks)***

(b) (i) Outline the principle of Young's double slit interference and derive the expression for the fringe separation ***(7 marks)***

(ii) What would be the effect of replacing monochromatic light by white light by white light in Young's double slit experiment? ***(3 marks)***

(c) An air wedge is formed by placing two glass slides of length 5.0 cm in contact at one end and wire at the other end as shown in figure 2.

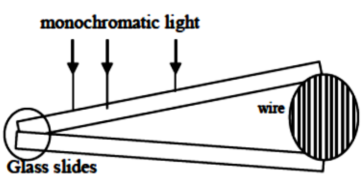


Fig.2

Viewing from vertically above, 10 dark fringes are observed to occupy a distance of 2.5 mm when the slides are illuminated with light of wave length 500 mm.

(i) Explain briefly how the fringe are formed (3 marks)

(ii) Determine the diameter of the wire (4 marks)

SECTION B

5 (a) Write down an expression for the magnetic flux density at:

(i) A perpendicular distance, d, from along straight wire carrying a current, I in a vacuum. (1 mark)

(ii) The centre of a circular coil of, N turns each of radius, R and carrying a current I (1 mark)

(iii) The centre of an air-cored solenoid of n turns per meter each carrying a current I

(b) Sketch the magnetic field pattern around a vertical current carrying straight wire in the earth's magnetic field used to explain a neutral point in a magnetic field ***(4 marks)***

(c) What is meant by the terms?

(i) Magnetic meridian? (1 mark)

(ii) Angle of dip? (1 mark)

(d) A circular coil of 10 turn and diameter 12 cm carries current I. the coil is placed with its plane in the magnetic meridian. A small magnetic needle placed at the centre of the coil makes 30 oscillations per minute about a vertical axis. When the current is cut off, it makes 15 oscillations per minute. If the horizontal component of the earth's magnetic flux density is 2.0×10^{-5}T, calculate the magnitude of I

[Assume that the square of frequency of oscillation is proportional to the magnetic flux density] ***(7marks)***

(e) Explain what is meant by eddy currents and give four of their applications. ***(4 marks)***

6 (a) State the law of electromagnetic induction ***(2 marks)***

(b) (i) With the aid of a labeled diagram, describe the structure and mode of action of an a.c transformer ***(5 marks)***

(ii) What are the main energy losses in a transformer and how are they minimized? ***(4 marks)***

(c) An a.c transformer operates on a 240 V mains. The voltage across the secondary which has 960 turns is 20V

(i) Find the number of turns in the primary ***(2 marks)***

(ii) If the efficiency of the transformer is 80%, calculate the current in the primary coil when a resistor of 40Ω is connected across the secondary. ***(4 marks)***

(d) Two long parallel wires X and Y are separated by 8 cm in a vacuum. The wires carry currents of 10A and 5A respectively in the same direction. At what points between the wires is the magnetic flux density zero? (3 marks)

7(a) Define the terms amplitude and root mean square (r.m.s) value of an alternating current. ***(2 marks)***

(b) A sinusoidal alternating current

I = 4sin(100πt) amperes flows through a resistor of resistance 2.0Ω. Find the mean power dissipated in the resistor. Hence deduce the r.m.s value of the current.

(4 marks)

(c) Describe, with the aid of a labeled diagram, how a hot wire ammeter works.

(5 marks)

(d) An inductor of inductance L connected across a source of alternating voltage,

V= Vo Sin wt

(i) Find the current which flows. ***(3 marks)***

(ii) Sketch, using the same axes, the variation with time the value of the voltage across the inductor and the current through it, and explain the phase difference between them. ***(6 marks)***

SECTION C

8. (a) Distinguish between e.m.f and terminal p.f of a battery ***(2marks)***

(b) (i) Define electrical resistively ***(1 mark)***

(ii) Explain any two factors on which resistance of a conductor depends. ***(5 marks)***

(c) Two wires A and B have lengths which are in the ratio 4:5, diameters which are in the ratio 2:1, and resistances in the ratio of 3:2. if the wires are arranged in parallel and current of 1.0 A flows through the combination , find the:

(i) Ratio of resistance of wire A to that of wire B ***(4 marks)***

(ii) Current through wire A ***(3 marks)***

(d) Explain why a wire becomes hot when current flows through it. ***(5 marks)***

9 (a) (i) State Ohm’s law ***(1mark)***

(ii) State the factors which affect the resistance of a conductor

(2 marks)

(iii) A conductor of length l and cross section area A has n free electrons per unit volume each of charge e. Find the drift velocity, v, of these electrons if a current I flows through the conductor.

(4 marks)

(b) Outline the principle of operation of a slide wire potentiometer. ***(4 marks)***

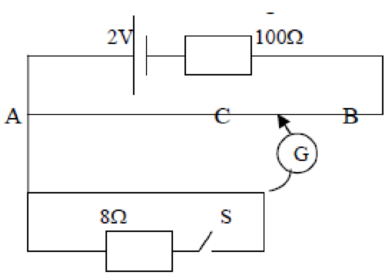


Fig. 3

In the figure 3 the slide wire AB is 1m long and has a resistance of 4Ω . When switch S is:

(i) Open, the balance length AC is 88.8 cm. Find the value of the e.m.f of the cell. ***(3 marks)***

(ii) Closed, the balance length is found to be 82.5cm. Calculate the internal resistance of this cell.

(4 marks)

(d) State two advantages of using a potentiometer for measuring voltage

(2 marks)

10. (a) what is a dielectric material? (1 mark)

(b) A capacitor filled with a dielectric is charged and then discharged through a milliammeter. The dielectric is then withdrawn half way and the capacitor charged to the same voltage, and discharged through the milliammeter again; show that the relative permittivity, ε_r of the dielectric is given by

potentiometer $\varepsilon_r = \dfrac{I}{2I^1 - I}$ where l and l^1 are the readings of the milliammeter respectively.

(6 marks)

(c) Describe with the aid of a diagram how you would determine the capacitance of a capacitor (5 marks)

(d)

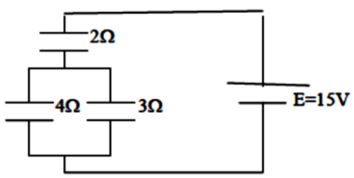


Fig. 4

A battery of e.m.f 15 V is connected across a system of capacitors as shown in figure 4. Find the:

(i) charge on the 4μF capacitor. ***(4 marks)***

(ii) energy stored in the 3μF capacitor ***(4marks***

P510/1
PHYSICS
Paper 1
Nov/Dec. 2001
SECTION A

1. (a) (i) State the principle of conservation of mechanical energy (1 mark)

(ii) Show that a stone thrown vertically upwards obeys the principle in (i) above throughout its upward motion

(4 marks)

(b) (i) A wind turbine made a blade of radius , r , is driven by a wind of speed , v . If ρ is the density of air , derive an expression for the maximum power , P, which can be developed by the turbine in terms of ρ , r and v. (3 marks)

(ii) Explain why the power attained is less than the maximum value in b(i) above

(2 marks)

(c) State the conditions under which the following will be conserved in a collision two bodies .

(i) Linear moment (I mark)

(ii) Kinetic energy (1 mark)

(d) Two pendula of equal length l , have bobs A and B of masses 3M respectively. The pendula are hung with bobs in contact as shown in figure 1

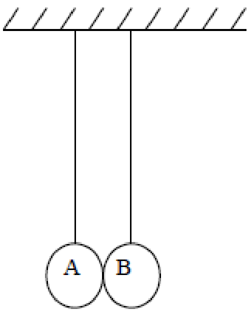


Fig. 1

The bob A is displaced such that the string makes an angle θ with the vertical and released. If A makes a perfectly inelastic collision with B, Find the height to which B rises.

(8 marks)

2(a) Define the following terms

(i) stress ***(1 mark)***

(ii) strain ***(1 mark)***

(b) The velocity , V, of sound traveling along a rod made of material of young's modulus , Y ,and density ρ is given by $V=\sqrt{\frac{Y}{\rho}}$ show that the formula is dimensionally consistent

(3 marks)

(c) State the measurements necessary in the determination of young's modulus of a metal wire ***(2 marks)***

(d) Explain why the following precautions are taken during an experiment to determine young's modulus of a metals wire.

(i) Two long , thin wires of the same materials are suspended from a common support (2 marks)

(ii)the readings of the vernier are also taken when the loads are gradually removed in step (1 mark)

(e) The ends of a uniform wire of length , 2.00m are fixed to point A and B which are 2,.00m apart in the same horizontal line . when a 5kg mass is attached to the mid-point c of the wire , the equilibrium position of C is 7.5 cm below the line AB. Given the Young's modulus for the material of the wire is 2.0×10^{11} Pa , find

(i) The strain in the wire (3 marks)

(ii) The stress in the wire (2 marks)

(iii) The energy stored in the wire

(4 marks)

State any assumption made

3. (a) Define surface tension and derive its dimensions (3 marks)

(b) Explain using the molecular theory the occurrence of surface tension ***(4 marks)***

(c) Describe an experiment to measure surface tension of a liquid by the capillary tube method. ***(6 marks)***

(d) (i) Show that the excess pressure in a soap bubble is given by

$$P = \frac{4\gamma}{r}$$ (3 marks)

(ii) Calculate the total pressure within a bubble of air of radius 0.1mm in water if the bubble is formed 10cm below the water surface and surface tension of water is 7.27×10^{-2} Nm^{-1} (atmosphereric pressure = 1.01^{5} Pa) ***(4 marks)*** (4 marks)

4. (a) (i) Define coefficient of viscosity and determine its dimension ***(4 marks)***

(ii) The resistive force on a steel ball bearing of radius, r falling with speed, V, in a liquid of viscosity, η, is given by $F = K\eta rV$, where K is a constant . Show that K is dimensionless. (4 marks)

(b) Write down Bernoulli's equation for fluid flow, defining all symbols used. (3 marks)

(c) A venturi metre consists of a horizontal tube with a constriction which replaces part of the piping system as shown in figure 2

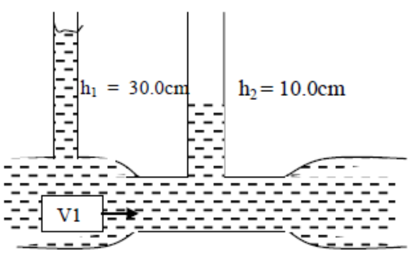


Fig 2

If the cross- section area of the main pipe is 5.81×10^{-3} m^2 and that of the constriction is 2.58×10^{-3} m^2 , find the velocity v_1 , of the liquid in the main pipe. (5 marks)

(d) Explain the origin of the lift on an aeroplane at take- off

SECTION B

5(a) Define thermal conductivity of a substance and state its units (2 marks)

(b) The flux of solar energy incident on the earth's surface is 1.36 x 10^3 wm^{-2}

Calculate

(i) the temperature of the surface of the sun

(4 marks)

(ii) the total power emitted by the sun

(3 marks)

(iii) the rate loss of mass by the sun.

(3 marks)

(c) (i) explain how heat is conducted through a glass rod ***(3 marks)***

(ii) Why is a metal better conductor of heat than glass ***(2 marks)***

(iii) Explain briefly why it is necessary to use a thin specimen of a large cross- sectional are in determining thermal conductivity of a poor conductor of heat

(3 marks)

6. (a) (i) Explain what happens when a quantity of heat is applied to fixed mass of gas

(2 marks)

(ii) Derive the relation between the principal molar heat capacities C_P and C_V for an idea gas.

(5 marks)

(b) (i) What is an adiabatic process? (1 mark)

(ii) A bicycle pump contains air at 290K. The piston of the pump is slowly pushed in until the volume of the air enclosed is one fifth of the total volume of the pump. The outlet is then sealed off and the piston suddenly pulled out to full extension. If no escapes, find its temperature immediately after pulling the piston. (take Cp/Cv = 1.4 (3 marks)

(c) (i) Distinguish between unsaturated and saturated vapours (2 marks)

(ii) Draw graphs to show the relationship between pressure and temperature for an ideal gas and for saturated water vapour originally at 0^0C ***(3 marks)***

(d) In an experiment, the pressure of a fixed mass of air at constant temperature is 10.4 kPa . Discuss the applicability of the above result in verifying Boyle's law ***(4 marks)***

7. (a) Explain why temperature remains constant during change of phase (4 marks)

(b) Describe with the aid of a labeled diagram, an electrical method for determination of specific latent heat of vaporization of a liquid. (7 marks)

(c) Water vapour and liquid water are confined in an air-tight vessel. The temperature of the water is raised until all the water has evaporated.

Draw a sketch graph to show the pressure of the water vapour changes with temperature and account for its main features.

(6 marks)

(d) Calculate the work done against when

1kg of water turns into vapour at atmospheric pressure of 1.01×10^5 Ps

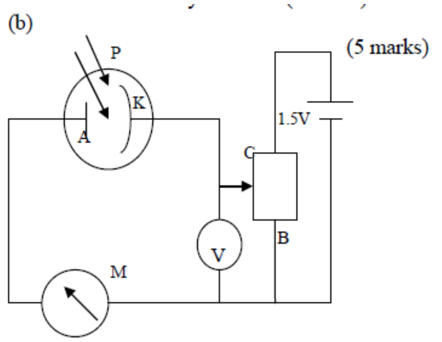
[Density of water vapour = $0.598\ kgm^{-3}$] (3marks)

SECTION C

8. (i) Write the Einstein photo-electric equation (1 mark)

(ii) Explain how the equation in (i) above accounts for the emission of electrons from metal surface illuminated by radiation ***(4 marks)***

(b)



P is a vacuum photocell with anode , A and cathode ,K ,made from the some metal of work function 2.0 eV. The cathode is illuminated by monochromatic light of constant intensity and of wavelength

4.4×10^{-7} m

(i) Describe and explain how the current show by the micro-ammeter, M will vary as the slider of the potential divider is moved from B to C (3marks)

(3 marks)

(ii) What will the reading of the high – resistance voltmeter, V be when photo-electric emission just ceases? (3marks) (3marks)

(c) With the slider mid-way between

B and C describe and explain how the reading of M would change if

(i) the intensity of the light was increased

(3 marks)

(ii) the wavelength of the light was changed to 5.5×10^{-7} m . ***(6 marks)***

9. (a) What is meant by the following

(i) An alpha particle (1 mark)

(ii) Radioactivity? (1 mark)

(b) Show that when an alpha particle collides head – on with an atom of atomic number Z, the closest distance of approach to the nucleus, b_0 , is given by

$b_o = \dfrac{Ze^2}{\pi\varepsilon_0 mV^2}$ = where e, is the electronic charge , ε_o is the permittivity of free space , m mass of the alpha particle and V is the velocity of the particle (6 marks)

(c) Describe the structure and action of a chamber (6 marks)

(d) State four uses of radio-active isotopes (2 marks)

(e) One kilogram of wood from a ship wreck has an activity of 1.2×10^2 counts per second due to ^{14}C, whereas the same amount of wood has an activity of 2.0×10^2 counts per second . Find the age of the shipwreck (Half-life of $^{14}C = 5.7 \times 10^3$ years) ***(4 marks)***

10. (a) (i) What is meant by emission line spectra? (3 marks).

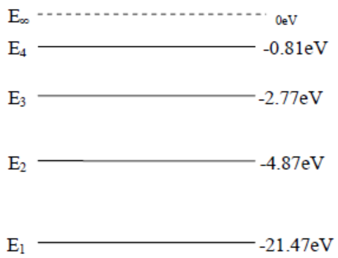


Figure 3

(ii)Figure 3 shows some of the energy levels of neon. Determine the wavelength of the radiation emitted in an electron transition from E_4 to E_3. in what region of the electro-magnetic spectrum does the radiation lie? (4 marks)

(b) Outline the principles of generation of continuous line spectra of X-rays in an X-ray tube

(5 marks)

(c) State Bragg's law of X-ray diffraction (1 mark)

(d) a beam of X-rays wavelength 1.0×10^{-10}m is incident on a set of cubic planes in a sodium chloride crystal. the first order diffracted beam is obtained for a grazing angle of 10.2^0

Find

(i) the spacing between consecutive planes (3 marks)

(ii) The density of the sodium chloride

4 marks)

P510/2
PHYSICS
Paper 2
Nov/Dec. 2001
SECTION A

1. (a) State the law of refraction of light (2marks)

(b) (i) Derive an expression for the refractive index of a prism in terms of the refracting angle, A and the angle of minimum deviation, D (5 marks)

(ii) Monochromatic light is incident on one refracting face of a prism of refracting angle 60^0, made of a glass of refractive index 1.50

Calculate the least angle of incidence for the ray to emerge through the second refracting face (5 marks)

(c) (i) State three differences between compound microscopes and telescopes (3marks)

(ii) Describe, with the aid of a ray diagram , how a compound microscope forms a final image at the near point (5marks)

2 (a) Define the terms radius of curvature and focal length of a converging mirror. (2 marks)

(b) (i) Draw a ray diagram to show the formation of a real image of a real object by converging mirror (2 marks)

(ii) Use the ray diagram in (b) (i) to derive the expression:

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$, where u, v and f are the object distance,

Image distance and focal length respectively (5 marks)

(c) (i) With the aid of a ray diagram describe the structure and action of a reflecting telescope in normal adjustment (5 marks)

(ii) State two advantage of a reflecting telescope over an astronomical telescope

(d) An astronomical telescope has an object of focal length 100cm and an eyepiece of focal length 10cm.

Calculate the separation of the objective and eyepiece if the lenses are arranged in such a way that final image is formed at 25 cm from the eye (4 marks)

3 (a) (i) Distinguish between free and damped oscillation (2marks)

(ii) Describe how the amplitude of a forced oscillation builds up to a constant value (3 marks)

(b) The displacement in meters of a a plane progressive wave is given by the equation

$$y = 0.2 \text{ Sin}\left[\pi\left(200t - \frac{20x}{17}\right)\right]$$

(i) wavelength and *(2 marks)*

(ii) speed, of the wave *(2 marks)*

(c)(i) Explain the occurrence of the beats in sound *(3 marks)*

(ii) Two turning forks X and Y are sounded together to produce beats of frequency 8 H z . Fork X has a known frequency of 512 Hz. When Y is loaded with a small plasticine , beast at a frequency of 2 Hz are heard when the two tuning forks are sounded together . Calculate the frequency of Y when unloaded. *(3 marks)*

(d) (i) What is meant by Doppler effect? *(1 mark)*

(ii) A car sounds its horn as it travels as a steady speed 15 ms^{-1} along a straight road between two stationary observers A and B . The observer A hears a frequency of 538 Hz while B hears a lower frequency.

Calculate the frequency heard by B assuming the speed of sound in air is 340 ms^{-1} *(4 marks)*

4 (a) (i) What is meant by interference and diffraction of light wave? *(2 marks)*

(ii) State the condition necessary for observing diffraction *(1 mark)*

(b) (i)Derive the expression for the fringe separation in young's interference pattern in term of the slit –separation , d , the distance , D of the screen from double slits and the wavelength λ of the light. ***(5 marks)***

(c) Two slit 0.50mm apart are placed at a distance of 1.0m from the screen .the slits are illuminate with light of wavelength 550nm. Calculate the distance between the fourth and second bright fringes of the interference pattern ***(5 marks)***

(d) A transmission diffraction grating of spacing d is illuminated normally with light of wavelength λ

on a screen placed beyond the grating. ***(2 marks)***

(iii) What is the effect on the diffraction pattern of using a grating with a larger number of lines ***(2 marks)***

SECTION B

5 (a) (i) Define the ampere ***(2 marks)***

(ii) Write down the expression for the force on a conductor carrying current which is inclined at an angle θ to a uniform magnetic field. ***(2 marks)***

(b) Figure 1 represents a current balance. when switch, K is open the force required to balance the magnet is 0.2N. When switch K is closed and a current of 0.5 A flows, a force of 0.22N is required for balance.

(i) Determine the polarity at the end of the magnet closed to the coil.

(ii) Calculate the weight required for balance when a current of 2A flows through the coil.

(c) A rectangular coil of N turns each of dimension l x b is inclined at an angle θ to a uniform magnetic field of flex density, B. derive an expression for the torque on the coil if a current I is passed through it

(5 marks)

(d) A ballistic galvanometer of sensitivity 2 division per μC is connected across a coil of 10 turns wound tightly round the middle of a solenoid of 10^3 turns per metre and diameter 5.0cm. When the current in the solenoid is reversed, the ballistic galvanometer deflects through 8 divisions. If the total resistance of the coil and galvanometer is 20Ω , find the current in the coil.

(5 marks)

6 (a) State the law of electro-magnetic induction (2 marks)

(b) A circular coil of 100 turns and across –sectional area $0.2m^2$ is placed with its plane perpendicular to a horizontal magnetic field of flux density

$1.0 x 10^{-2}$ T

The coil is rotated about a vertical axis so that it turns through 60^0 in 2s

Calculate the

(i) The initial flux linkage through the coil ***(2marks)***

(ii) The e.m.f induced in the coil (3 marks)

(c) (i) Explain the origin of the back e.m.f in an electric motor ***(2marks)***

(ii) A motor whose armature resistance is

2Ω is operated on 240V mains supply. If the back e. m.f in the motor is 220V, calculate the armature current. ***(3 marks)***

(d) (i)Describe with the aid of a diagram the mode of action of a simple d.c generator

(6 mark)

(ii) sketch the output of a d.c generator (1 mark)

(iii) what is the major difference between a d.c motor and a d.c generator. (1 mark)

7 (a) Define root mean value (rms) of an alternating current (1 mark)

(b) a sinusoidal alternating voltage

$V = 170\sin 120\pi t$, volts, is applied across a resistor of resistance 100Ω.

Determine:

(i) The r.m.s value of the current which flows ***(3 marks)***

(ii) The frequency of the current through the resistor ***(2 marks)***

(c) With the aid of a labeled diagram describe the structure and action of a hot wire ammeter ***(6 marks)***

(d) Explain the terms self-induction and mutual induction. (3 marks)

(e) a coil of self–inductance L and negligible resistance is connected across a source of alternating voltage $V = V_o \cos \omega t$.

(i) find the expression for the current which flows in the coil ***(3 marks)***

(ii) sketch , using the same axes, the time variation of the applied voltage and the current which flows in the coil ***(2 marks)***

SECTION C

8 (a) Derive the condition for a Wheatstone bridge to be balanced ***(4 marks)***

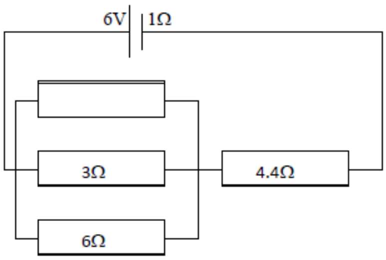
(b) (i) define temperature coefficient of resistance (1mark)

(ii) when a coil x connected across the left- hand gap of a meter bridge is heated to a temperature of 30^oC, the balance point is found to be 51.5cm from the left-hand end of the slide wire . when the temperature is raised to 100^oC, the balance point is 54.6cm from the left end. Find the temperature coeffience of resistance of X ***(6 marks)***

(c) (i) a battery of e.m.,f ε and internal resistance , r is connected to a resistor of available resistance, R. obtain the expression for maximum power dissipated in the resistor. (5 marks)

(ii) a battery of e.m.f 6V and internal resistance 1 Ω is connected across a network of resistors as shown in figure 2.

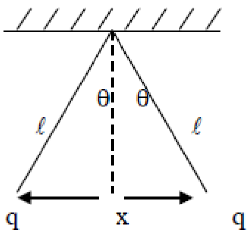
Find the current supplied by the battery. ***(4 marks)***



9(a) State coulomb's law of electrostatics. (1mark)

(b) (i) define electric field intensity and electric potential (2 marks)

(b) (ii) two identical conducting balls of mass , m are each suspended in air from a silk thread of length, λ. when the two balls are each given identical charge, q, they move apart as shown in figure 3



If at equilibrium each thread makes a small angle θ with the vertical, show that the separation , x is given by

$$x = \left[\frac{q^2\lambda}{2\pi\varepsilon mg}\right]^{1/3}$$; where ε is permittivity of air

(c) (i) Define the term capacitance of a capacitor ***(1 mark)***

(ii) State the factors that affect the capacitance of a capacitor ***(3 marks)***

(iii) Show that the energy stored in a capacitor of capacitance, C charged to p.d V is equal to ½ CV^2 ***(3 marks)***

(d) The plates of a parallel plate capacitor each of area $2.0cm^2$ are 5mm apart. The plates are in vacuum and a potential difference of 10000V is applied across the capacitor.

Find the magnitude of the change on the capacitor

10. (a) Define temperature coeffient of resistance and electrical resistivity (2 marks)

(b) A nichrome wire of length 1.0m and diameter 0.72mm at 25^0C , is made into a coil . The coil immersed in $200cm^3$ of water at the same temperature and a current of 5.0A is passed through the coil for 8 minutes until when the water starts to boil at 100^0C

Find

(i) the resistance of the coil at 25^0C

(ii)the electrical energy extended assuming all of it goes into heating the water

(2 marks)

(iii) The mean temperature coefficient of resistance of nichrome between 0^0C and 100^0C

(c) Describe , with the aid of a circuit diagram how a slide wire potentiometer can be used to measure e.m.f of a cell. ***(4 marks)***

(d) An accumulator of e.m.f 2.0 V is connected across a uniform wire of length 1.0m and resistance 8.0Ω. A cell of e.m.f 1.50V is connected across a length, l of the slide wire. The galvanometer shows no deflection when l is 90.0 cm.

Find the internal resistance of the accumulator

P510/1

PHYSICS

Paper 1

Nov/Dec. 2002

SECTION A

1.(a). (i)What is meant by the dimensions of physical quantity?

(1mark)

(ii)For stream line flow of a non-viscous, incompressible fluid, the pressure, p at a point is related to the height h and the velocity, v by the equation

$(p-a) = pg(h - b) + 1/2p(v^2 - d)$, where a, b and d ………and p is the density of the fluid and g is the acceleration due to gravity. Given that the equation is dimensionally consistent, find the dimensions of a, b and d.

(3marks)

b.Define simple harmonic motion. (1mark)

c.Sketch the following graphs for a body performing simple harmonic motion.

i) Velocity against displacement, (1 mark)

ii) Displacement against time. (1mark)

d. the period oscillation of a conical pendulum is 2.0s. If the string makes an angle of 600 to the vertical at the point of suspension, calculate the:

i) Vertical height of the suspension above the circle, (3mark)

ii) Length of the string, (1 mark)

iii) Velocity of the mass attached to the string. (3mark)

(e). I) give one example of an oscillatory motion which approximates Simple harmonic motion. (1 mark)

Ii)what approximation is made in e) i)? (1 mark) (f). Explain the acceleration of a ball bearing falling through a liquid decreases continuously with it becomes zero.

2.(a). I) state Newton's law of universal gravitation. (1 mark)

(ii)Show that this law is constitent with kepler's third law. ***(3 marks***

Iii)two alternative units for gravitational field strength are Nkg^{-1} and ms^{-1}. Use the method of dimensions to show that the two units are equivalent. ***(3marks)***

(b). (i) Derive an expression for the speed of a body moving uniformly in a circular path. ***(3 marks)***

(ii)Explain why a force is necessary to maintain a body moving with constant speed in a circular path. ***(2 marks)***

(c).A small mass attached to a spring suspended from a fixed point moves in a circular path at constant speed in a horizontal plane.

i)draw a diagram showing the forces acting on the mass. ***(1mark)***

ii)derive an equation showing how the angle of inclination of the string depends on the speed of the mass and the radius of the circular path. (1 mark)

(d). I) Define moment of a force. (1mark)

ii) a wheel of radius 0.60 m is pivoted at its centre. A tangential force of 4.0 n acts on the wheel so that the wheel rotates with uniform velocity.

find the work done by the force to turn the wheel through 10 revolutions (3 marks)

3.(a). (i) Show that the weight of fluid displaced by an object is equal to the up thrust on the object. (5 marks)

ii) A piece of metal of mass 2.60×10^3 kg and density 8.4×10^3 kg m^{-3} is attached to a block of wax of mass 1.0×10^{-2} kg and density 9.2×10^2 kg m^{-3}. When the system is placed in a liquid, it floats with wax just submerged.

Find the density of the liquid. (4 marks)

b.Explain the

i) Terms laminar flow and turbulent flow, (4marks)

ii) Effects of temperature on the viscosity of liquids and gases (3 marks.(

c.(I)distinguish between static pressure and dynamic pressure.

i) A pivot-static tube with a pressure gauge is used to measure the speed of a boat at sea. Given that the speed of the boat does not exceed 10 ms^{-1} and the density of sea water is 1050 kgm^{-3}, calculate the maximum pressure on the gauge.

4.(a). Define the term surface tension in terms of surface energy.

(b)(i) Calculate the work done against surface tension forces in blowing a soap bubble of diameter 15 mm, if the surface tension of the soap solution is

3.0×10^{-2} Nm^{-1}.

(ii)A soap bubble of radius r_1 is attached to another bubble of radius r_2. If r_1 is less than r_2, show that the radius of curvature of the common interface is

$$\frac{r_1 r_2}{r_2 - r_1}$$ (5 marks)

(c.)(i) Define coefficient of viscosity of a liquid.

(ii)Describe a simple experiment to demonstrate stream line and turbulent flow in a liquid.

(d).(i) Sketch a graph of potential energy against separation of two molecules in a substance.

(ii)Explain the main features of the graph in d) (i).

SECTION B

5.(a). State the assumptions made in the derivations of the expression

$P = \frac{1}{3}\rho\overline{c^2}$ for the pressure of an ideal gas. (2 marks)

(b) Use the expression in (a) above to deduce Dalton's law of partial pressures.
(3 marks)

(c)Describe an experiment to determine the saturation vapour pressure of a liquid.
(6 marks)

(d).(i) What is meant by a reversible isothermal change? (2 marks)

(ii)State the conditions for achieving a reversible isothermal change. (2 marks)

(e)An ideal gas at 27^0C and at a pressure of 1.01×10^5 Pa is compressed reversibly and isothermally until its volume is halved. It is then expanded reversibly and adiabatically to twice its original volume.

Calculate the final pressure and temperature of the gas if $\gamma = 1.4$. (5 marks)

6.(a). Explain the mechanism of heat conduction in solids.

b.Describe a method of determining the thermal conductivity of cork in the form of a tin sheet.

c.A window of height 1.0 m and width 1.5 m contains a double glazed unit consisting of two single glass panes, each of thickness 4.0 mm separated by air gap of 2.0 mm. Calculate the rate at which heat is conducted through the window if the temperatures of the external surfaces of glass are 20^0C and 30^0C respectively.

(thermal conductivities of glass and air are 0.72 $Wm^{-1}k^{-1}$and 0.025 $Wm^{-1}k^{-1}$ respectively).

(d). (i) State Stefan's law.

(ii) The element of 1.0kW electric fire is 30.0 cm long and 1.0cm in diameter. If the temperature of the surroundings is 20^0C, estimate the working temperature of the element.

(Stefan's constant, $\sigma = 5.7 \times 10^{-18}$ $Wm^{-1}k^{-1}$)

7.(a). (i) Define specific heat capacity of a substance.

(ii) State how heat losses are minimised in calorimetry.

(b). (i)What is meant by a cooling correction?

(ii) Explain how the cooling may be estimated in the determination of the heat capacity off a poor conductor of heat by the method of mixtures.

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

(c)Describe how you would determine the specific heat capacity of a liquid by the continuous flow method.

SECTION C

8. (a). What is meant by

(i) Bohr atom, (1mark)

(ii) Binding energy of a nucleus? (2marks)

b.The total energy, E, of an electron in an atom may be expressed as

$$E = \frac{-mq4}{8\varepsilon_0^2 n^2 h^2}.$$

(i) Identify the quantities m, q, n and h in this expression. (2marks)

(ii) Explain the physical implication of the fact that E is always negative.

(iii) Draw an energy level diagram for hydrogen. explain the physical implication of the fa to indicate emission of ultraviolet, visible and infra-red spectral lines.

c.i)explain briefly the sources and absorption of infra-red radiation.

ii)describe briefly, the method of detecting infra-red radiation.

d.The atomic nucleus may be considered to be a sphere of positive charge with a diameter very much less that of the atom. Discuss the experimental evidence which supports this view.

9.a. I) what are cathode rays?

Ii) an electron gun operating at 3 x 10^3v is used to project electrons into the space between two oppositely charged parallel plates of length 10 cm and separation 5 cm.

Calculate the deflection of the electrons as they emerge from the region between the charged plates when the potential difference is

1 x 10^3V.

b.(i) Describe a simple experiment to demonstrate photoelectric emission.

(ii) Explain why the wave theory of light fail to account for the photoelectric effect.

(iii) Describe an experiment to verify Einstein's equation for the photoelectric effect and explain how Planck's constant may be obtained from the experiment.

10.(a). What is meant by

(i) half-life of a radioactive element, (1mark)

(ii) nuclear fission, (1mark)

(iii) nuclear fusion? (1mark)

(b) An atom of ^{222}Ra emits an α particle of energy 5.3 MeV. Given that the half-life of ^{222} Ra is 3.8 days, use the decay law,

$N = N_0e^{-\lambda t}$

to calculate the:

(i) decay constant,

(ii) amount of energy released by 3.0 x 10^{-9} kg of ^{222}Ra after 3.8 days

(5marks)

(c).Describe a simple form of a mass spectrometer and explain how it is used to distinguish between isotopes. (7marks)

(d). The nucleus of $^{37}_{17}$Cl emits an α – particle followed by two β-particles.

Show that the final nucleus is an isotope of chlorine. (2marks)

P510/2

PHYSICS

Paper 2

Nov/Dec. 2002

SECTION A

1(a) (i) State the law of reflection of light (02 marks)

(ii) Show, with the aid of a ray diagram, that the radius of curvature of a concave mirror is twice the focal length of the mirror. (05 marks)

(b) An object is placed 20cm in front of a diverging lens coaxially with a concave mirror of focal length 15cm. When the concave mirror is 20cm from the lens the final image coincided with the object .

(1)Draw the ray diagram to show how the final image is formed (02 marks)

(ii) Determine the focal length of the diverging lens (04 marks)

(c) (i) Define angular magnification of an optical instrument (01 mark)

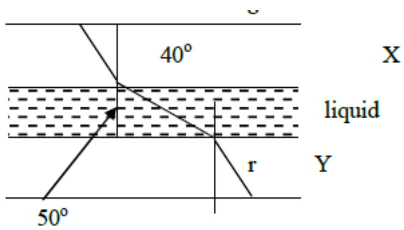
(ii) What is meant by an exit pupil of a compound microscope? (02 marks)

(iii) Describe with the aid of ray diagram , the structure and action of a compound microscope in normal adjustment

2.(a) (i) What is meant by the refractive index of a material? (01 mark)

(ii) Monochromatic light incident on a block of material placed in a vacuum is refracted the rough an angle θ . If the block has a refractive index n and is of thickness t , show that the light takes a time nt secθ to emerge from the block where c is the speed of light in a vacuum.

(03 marks)



(b) Figure 1shows a layer of liquid confined between two transparent plates x and y of refractive indices 1.54 and 1.44, respectively.

A ray of mono-chromatic light making an angle of 40^0 with the normal to the interface between medium x and the liquid is refracted through an angle of 50^0 by the liquid . Find the

(i) refractive index of the liquid (03 marks)

(ii) angle of refraction, r in the medium y. (02 marks)

(iii) minimum angle of incidence in medium x for which the light will not emery from medium y. (03 marks)

(c) (i) A ray of monochromatic light is incident at a small angle of incidence on a small angle prism in air. Obtain the expression d = (n – 1)A for the deviation of the light by the prism (05 marks)

(ii) Light of two wavelengths is incident at a small angle on a thin prism of refracting angle 5^0 and refractive indices 1.52 and 1.50 for the two wavelengths. Find the angular separation of the two wavelengths after refraction by the

Prism. (03 marks)

3. (a) Why is light referred to as transverse wave? (01 marks)

(b) (i) State Huygen's principle ***(02 marks)***

(ii) Use Huygen's principle to show that the refractive index of medium 2 relative to medium 1 is given by ${}_1n_2 = v_1$ where v_1 and v_2 are the velocities of light in v_2

Mediums 1 and 2 respectively . (07 marks)

(c) (i) What is meant by division of wave fronts as applied to interference of waves ? (02 marks)

(ii) Two slits A and B are separated by a distance d and illuminated with light of wavelength λ .

Derive the expression for the separation between successive fringes on a screen placed a distance d from the slits. (05 marks)

(iiiIn young's double-slits experiment, the 8^{th} bright fringe is formed 5mm away from the centre of the fringe system when the wavelength of light used is 6.2×10^{-7}m. Calculate the separation of the two slits is the distance from the slits to the screen is 80cm. (03 marks)

4. (a) Explain the term interference as applied to light. (04 marks)

(b)

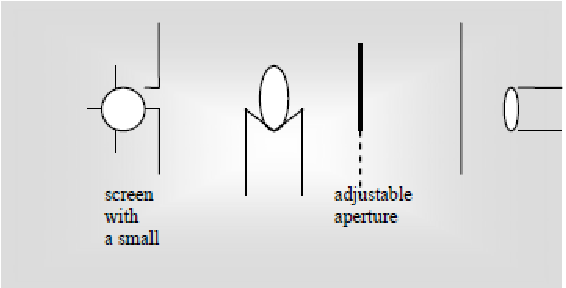


Fig.2

In an experiment to observe diffraction of light , the set up in figure 2 is used.

(i) describe what you would see at e if the aperture is gradually reduced

(04 marks)

(ii) Explain your observations in (b) (i) above (04 marks)

(c) A diffraction grating has 550 lines per mm. When it is illuminated normally by monochromatic light , the angle between the central maximum and first maximum is 19.1^0. Find the

(i) Wavelength of the light ***(04 marks)***

(ii) Number of diffraction maxima obtainable ***(02 marks)***

(d) State two uses of diffraction of light ***(02 marks)***

SECTION B

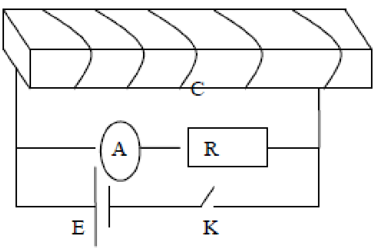
5 (a) Distinguish between self induction and mutual induction ***(03 marks)***

(b) (i) Explain the factors which affect the efficiency of a transformer. ***(04 marks)***

(ii) Power of 6000W produced at 100V is to be remitted over to distance of 2km through cables of resistance $0.2\Omega m^{-1}$. Determine the voltage at the output of a transformer need to transmit the power so that only 5% of it is lost.

(assume the transformer is 100% efficient)

(05 marks)



(c) In the diagram in the figure 3 , C is a coil of a large number of turns connected in series with a centre zero meter A , and a resistor R across cell E . The switch K is closed for some time and then opened.

(i) Sketch a graph to show the variation of current with time observed on the ammeter from the moment K was first closed . (01 marks)

(ii) Explain the variation of current observation in (c) (i)   (05 marks)

(iii) Describe the effect of placing abunch of soft iron wires inside the coil , on the observations in (c) (i) . ***(02 marks)***

6 (i) Write the expression for the force on a charge, Q coulombs moving with velocity, v at an angle θ   to a uniform magnetic field of flux density, B. (01 mark)

(ii) Use the expression in (a) (i) above to deduce the force on a conductor carrying a current in a magnetic field. ***(03 marks)***

(iii) Two thin, long parallel wires A and B carry currents of 5A and 2A respectively in opposite directions. If the wires are separated by a distance of 2.5 cm in a vacuum. Calculate the force exerted by wire b on 1 m of wire A .

(03 marks)

(b) With the aid of a diagram, explain the terms **angle of dip** and **magnetic meridian,** as applied to the earth's magnetic field. ***(04 marks)***

(c) (i) Describe , using an appropriate circuit diagram ,an experiment to investigate the dependence of magnetic flux density at the centre of a circular coil, on the current through the coil. ***(07 marks)***

(ii) State two other factors on which the magnetic flux density in (c) (i) depends. ***(02 marks)***

7(a) (i) Define *magnetic flux* ***(01 mark)***

(ii) Describe an experiment to investigate the relationship between the force on a current conductor situated in a uniform magnetic field and the current , using the ampere/current balance. (06 marks)

(b)

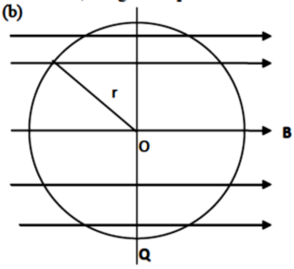


Fig. 4

A circular loop of wire radius r is placed in a uniform magnetic field of flux density **B** , with the axis to the field as shown in figure 4. Explain what happens to the loop when current starts to flow in it in a clockwise direction if the loop is pivoted

About the axis POQ ***(04 marks)***

(c) A vertical square coil of side 5cm has 100 turns and carries a current of 1 a

. Calculate the torque on the coil when it is placed in a horizontal magnetic field of flux density o.2T with its plane making an angle of 30^0 to the field

(03 marks)

(d) Explain why a moving coil galvanometer have a radial magnetic field , fine hair springs and many turns. ***(06 marks)***

Section c

8 (a) State ohm's law *(01marks)*

(b) Describe with the aid of circuit diagram , an experiment to determine the relationship between the resistance and the length of a wire. (6 marks)

(c) Adry cell gives a balance length of 84.8cm on a potentiometer wire when a resistor of resistance 15Ω is connected across the terminals of the cell, a balance length of 75.0cm is obtained.

Find the internal resistance of the cell *(4 marks)*

(d) A battery of e.m.f.18.0V and internal resistance 3.0Ω is connected to a resistor of resistance 8Ω. Calculate the:

(i) power generated, *(2marks)*

(ii) efficiency *(2 marks)*

(e) If the 8 Ω resistor in (d) is replaced by a variable resistor , sketcth graphs to show the variation of power and efficiency with the load *(3 marks)*

(f) explain why a metal wire gets hot when current is passed through it. *(2 marks)*

9 (a) Define electric potential *(1 mark)*

(b) Obtain an expression for the electric potential at a point a distance , r from a point charge, q situated in a vacuum. *(4 marks)*

(c)

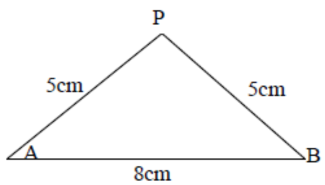


Fig.5

Two point charges A and B of charges +0.10μC and +0.05μC are separated by a distance of 8.0cm along the horizontal as shown in figure 5. Find the electric field intensity at P. *(9 marks)*

(d) Sketch the electric field pattern due to the charge distribution in (c) above. *(2 marks)*

(e) Explain how a lightening conductor works. *(4 marks)*

10. (a) Sketch the electric field lines between two large parallel metal plate across which a p.d. is applied. *(1 mark)*

(b) Describe with the aid of a diagram, how you would investigate the factors which affect the capacitance of a parallel plate capacitor. *(7 marks)* (ii)Calculate the capacitance of a parallel capacitor whose plates are 10cm by 10cmseparated by an air gap of 5mm *(2 marks)*

(c) A hollow spherical conductor of diameter 21.4cm carrying a charge of 6.9x10^{-10}cis raised to a potential of 50v. Find the permitting of the surrounding medium.

(3 marks)

(d) (i) Show that the effective capacitance, C of two capacitances, C_1 and C_2, connected in series

is given by $C = \dfrac{C_1C_2}{C_1+C_2}$ *(4 marks)*

(ii) A 20μf capacitor. Is charged to 40V and then connected across an uncharged 60 μF Capacitor. Calculate the potential difference across the μF

P510/1
PHYSICS
Paper 1
Nov/Dec. 2003
SECTION A

1 (a) Distinguish between fundamental and derived physical quantities. Give two examples of each (4 marks)

(b) (i) What is meant by scalar and vector quantities? (2 marks)

(ii) A ball is thrown vertically upwards a velocity of 10ms^{-1} from a point 5.0m above the ground. Describe, with the aid of a velocity- time sketch graph, the subsequent motion of the ball

(10 marks)

(c) A boat cross a river 3 km wide flowing at4ms-1 to reach a point on the opposite bank 5km upstream. The boat speed is still water is 12ms^{-1}. Find the direction in which the boat must be headed. (04 marks)

2 (a) Define the following terms :

(i)angular velocity (1 mark)

(ii) Centripetal acceleration. (1 mark)

(b) (i) Explain why a racing car can travel faster on a banked track than on a flat track of the radius of curvature. (4 marks)

(ii) Derive an expression for the speed with which a car can negotiate a bend on a banked track without skidding (03 marks)

(c) Show how to estimate the mass of the sun if the period and orbital radius of one of its planets are known (3 marks)

(d) The gravitational potential, U at the surface of a planet of mass M and radius R is given by

$U = \frac{GM}{-R}$ where G is the gravitational constant

Derive an expression for the velocity, which an object of mass, M must have at the surface of the planet if it is to escape from the planet. (4 marks)

(e) Communication satellites orbit the earth in synchronous orbits. Calculate the height of communication satellite above the earth (4 marks)

3 (a) State the laws of floatation ***(01 mark)***

(b) With the aid of a diagram, describe how to measure the relative density of liquid using Archimedes' principle and the principle moments. ***(6 marks)***

(c) Across-sectional area of a ferry at its water-line is $720m^2$. If sixteen cars of average mass 1100kg are place on board, to what exact depth will the boat sink in the water?

(d) (i) Define the terms longitudinal stress and young's modulus of elasticity (2 marks

(ii) Describe how to determine Young's modulus for a steel wire (7 marks)

4 (a) Amass of 0.1 kg is suspended from a light spring of force constant 24.5 Nm^{-1} . Calculate the potential energy of the mass ***(4 marks)***

(b) (i) State four characteristics of simple harmonic motion (4 marks)

(ii) Show that the speed of a body moving with simple harmonic motion of angular frequency ω is given by:

$V = \omega(A^2 - x^2)^{1/2}$, where A is the amplitude and x is the displacement from equilibrium position. (4 marks)

(iii) Sketch graphs to show the variation with displacement n, of the kinetic and potential energies of a body moving with simple harmonic motion (2 marks)

(c) A mass of 0.1 kg suspended from a spring of force constant 24.5 Nm^{-1} is pulled vertically downwards through a distance of 5.0 cm and released . Find the:

(i) period of oscillation, (2 marks)

(ii) position of the mass 0.3 second after release. (4 marks)

SECTION B

5(a) (i) Define molar heart capacity of a gas constant volume

(ii) The specific heat capacity of oxygen at constant volume is $719 Jkg^{-1}K^{-1}$. If the density of oxygen at S.T.P is 1.429 kg m^{-3}, calculate the specific heat capacity of oxygen at constant pressure. (4 marks)

(b) Indicate the different states of a real gas at different temperature on a pressure versus volume sketch graph ***(3 marks)***

(c) (i) In deriving the expression $P = \frac{1}{3}\rho\overline{c^2}$ for the pressure of an ideal gas, two of the assumptions made are not valid for a real gas . State these assumptions (2 marks)

(ii) the equation of state of one mole of a real gas is:

$$\left[p + \frac{a}{v^2}\right](v - b) = RT.$$

Account for the terms $\frac{a}{v^2}$ and b

(2marks)

(d) Use the expression $P = \frac{1}{3}\ pc^2$; for the pressure of an ideal gas to derive Dalton's law of partial pressures. (4 marks)

(e) Explain, with the aid of a volume versus temperature sketch graph, what happens to a gas cooled at constant pressure from room temperature to zero Kelvin. ***(4 marks)***

6 (a) What is meant by a black body? (2 marks)

(b) Describe how an approximate black body can be realized in practice

(2 marks)

(c) (i) Draw sketch graphs to show variation of relative intensity of black body radiation with wavelength for the three different temperatures (2 marks)

(ii) Describe the features of the sketch graphs in (c) (i) above ***(3 marks)***

(d) (i) State Stefan's law. (1 mark)

(ii) A solid copper sphere of diameter 10mm and temperature of 150K is placed in an enclosure maintained at a temperature of 290K. Calculate, stating any assumption made, the initial rate of rise of temperature of the sphere.

(Density of copper= 8.93x 10^3 kg m^{-3} specific heat capacity of copper = 3.7 x 10^2 J kg k^{-1}
(7 marks)

(e) With the aid of a diagram, describe how a thermopile can be used to detect infra-red radiation

7 (a) (i) What is meant by kinetic theory of gases? (3 marks)

(ii) Define an ideal gas . ***(4 marks)***

(b) (i) Describe an experiment to show that a liquid boils only when it's saturated vapour pressure is equal to the external pressure. (5 marks)

(ii) Explain how cooking at a pressure of 76cm of mercury and a temperature of 100^0C, may be achieved on top of high mountains. (3 marks)

(c) (i) Define root-mean-square speed of molecules of a gas. (1 mark)

(ii) The masses of hydrogen and oxygen atoms are 1.66×10^{-27}kg and 2.66×10^{-26}kg respectively. What is the ratio of the root-mean-square speed of hydrogen to that of oxygen molecules at the same temperature (3 marks)

SECTION C

8 (a) (i) State Rutherford's model of the atom ***(2 marks)***

(ii) Explain two main failure of Rutherford's model of the atom. ***(3 marks)***

(b) (i) Explain how Millikan's experiment for measuring the charge of the electron proves that charge is quantized. ***(4 marks)***

(ii) Oil droplets are introduced into the space between two flat horizontal plates, set 5.0 mm apart. . The plate voltage is then adjusted to exactly 780V so that one of the droplets is held stationary. Then the plate voltage is switched off and the selected droplet is observed of fall a measured distance of 1.5mm in 11.2s.

Given the density of the oil used is 900kg m^{-3} and the viscosity of air is 1.8 x 10^{-5} Nsm^{-2}, calculate the charge of the droplet.

(6 marks)

(c) A beam of positive ions is accelerated through a potential difference of 1×10^3 V into a region of uniform magnetic field of flux density 0.2T. While in the magnetic field it moves in a circle of radius 2.3cm. Derive an expression for the charge to mass ratio of the ions, and calculate its value

(5 marks)

9. (a) (i) What is meant by the thermionic emission? ***(1 mark)***

(ii) Sketch the current –potential difference characteristics of a thermionic diode for two different operating temperatures and explain their main features

(iii) Describe one application if a diode ***(2 marks)***

(b) (i) What features of an X-ray tube make it suitable for continuous production of X-rays. ***(3 marks)***

(ii) Sketch a graph of intensity versus frequency of a radiation produced in an X-ray tube and explain its features ***(5 marks)***

(c) A mono chromatic X-ray beam of wavelength 1.0×10^{-10}cm is incident on a set of planes in a crystal of spacing 2.8×10^{-10}m . what is the maximum order possible with these X-rays? ***(4 marks)***

10. (a) What is meant by the following terms

(i) nuclear number? (1 mark)

(ii) binding energy? (1mark)

(b) Calculate the energy released during the decay of ${}^{220}_{86}Rn$ nucleus into ${}^{216}_{84}Po$ and an α- particle

$$\left\{\begin{array}{l} \text{Mass of } {}^{220}_{86}Rn = 219.964176u \\ \text{Mass of } {}^{216}_{84}Po = 215.955794u \\ \text{Mass of } {}^{4}_{2}He = 4.001566u \\ (1u = 931MeV) \end{array}\right.$$

(c) Describe the Bainbridge mass spectrometer and explain how it can be used to distinguish between isotopes ***(7 marks)***

(d) (i) Explain how you would use a decay curve for a radioactive material to determine its half-life (2 marks)

(ii) A radioactive source contains 1.0μg of plutonium of mass number 239. If the source emits 2300 α –particles per second, calculate the half –life of plutonium.

[Assume the decay law $N = N_o e^{-\lambda t}$] (5 marks)

P510/2
PHYSICS
Paper 2
Nov/Dec. 2003
SECTION A

1(a) (i) State the laws of reflection of light (2 marks)

(ii) Show that an incident ray of light reflected successively from two mirrors inclined at an angle θ to each other, is rotated through an angle 2θ (4 marks)

(b) Describe how a sextant is used to determine the angle of elevation of a star (5 marks) (c) (i) Describe an experiment to measure the focal length of a convex mirror (5 marks)

(ii) A concave lens of focal length 20 cm is placed 10cm front of a concave mirror of focal length 16cm. Calculate the distance from the lens at which an object would coincide with its image ***(4 marks)***

2 (a) Define the wavelength of a wave (1 mark)

(b) A source of sound moving with velocity U_0 in the same direction. Derive the expression for the frequency of sound heard by the observer. (5 marks)

(c) Explain what happens to the pitch of the sound heard by the observer in (b) above when the

(i) Observer moves faster than the source ***(2 marks)***

(ii) Observer's velocity is equal to that of the sound ***(2 marks)***

(d) State and explain one application of the Doppler effect ***(5 marks)***

(e) The wire of a guitar of length 50cm and mass per metre 1.5×10^{-3} kg, is under tension of 173.4N. If it is plucked at its mid-point ,find the

(i) Frequency, ***(3 marks)***

(ii) Wavelength, of the fundamental note***(2 marks)***

3 (a) Explain, with the aid of a diagram, why a thick plane mirror forms multiple images ***(4 marks)***

(b) Derive the expression for the focal length of a combination of two thin converging lenses in contact, in terms of their focal length. ***(5 marks)***

(c)

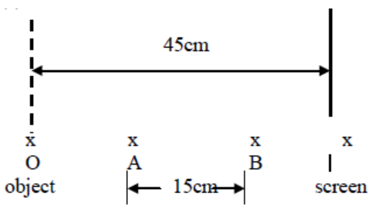


Fig. 1

In the diagram in figure 1 , the image of the object is formed on the screen when a convex lens is placed either at A or B . If A and B are 15cm apart, find the

(i) Focal length of the lens ***(3 marks)***

(ii) Magnification of the image formed when the lens is at B ***(3 marks)***

(d) Draw a ray diagram of a Galilean telescope and derive the expression for its magnifying power when in normal adjustment ***(5 marks)***

4 (a) (i) What is meant by interference of wave? ***(2 marks)***

(ii) State the conditions necessary for the observation of an interference pattern ***(2 marks)***

(iii) Describe how interference can be used to test the flatness of surface ***(3 marks)***

(b) Describe with the aid of a labeled diagram , how the wavelength of monochromatic light is measured using Young's double – slit method ***(5 marks)***

(c) Two microscope slides are in contact at one end and are separated by a thin piece of paper at the end. Monochromatic light is deiced normally on the wedge.

(i) What type of fringes will be observed?

(ii) Explain what will be observed if a liquid is introduced between the slide ***(2 marks)***

(d) When monochromatic light of wavelength 5.8×10^{-7} m is incident normally on a transmission grating, the second order diffraction line is observed at an angle of 27^0 . How many lines per centimeter does the grating have? ***(4 marks)***

SECTION B

5. (a) (i) Write down the expression for the force exerted on a straight wire of length, l metres carrying a current , I amperes at right angle to the magnetic field of flux density B teslas. ***(1 mark)***

(ii) A rectangular coil of N turns and area A m^2 is suspended in a uniform magnetic field of flux density B teslas. Initially the plane of the coil is at right angles to the magnetic field. Derive the expression for the initial couple on the coil when a current of, I amperes flows through the coil ***(5 marks)***

(b) draw a labeled diagram of a moving –coil galvanometer and explain how it works ***(6 marks)***

(c) A small circular coil of 10 turns and mean radius 2.5 cm is mounted at the centre of a long solenoid of 750 turns per metre with its axis at right angles to the axis of the solenoid . if the current in the solenoid is 2.0A, calculate the torque on the circular coil when a current of 1.0A is passed through it. ***(5 marks)***

(d) Explain why a current-carrying conductor placed in a magnetic field experiences a force. ***(3 marks)***

6. (a) (i) What is meant by the root mean square value of an alternating current? ***(1 mark)***

(ii) Describe with the aid of a labeled diagram, the structure and action of a moving iron ammeter ***(5 marks)***

(iii) What is meant by the term reactance? ***(1 mark)***

(b) In the diagram in figure 2 V_L is the voltage drop across inductor

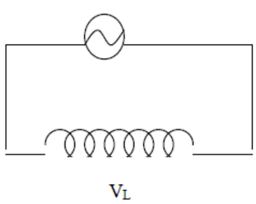


Fig. 2

(i) Draw a vector diagram to show the orientation of V_L with respect to current I

(ii) Using the same axes, sketch graphs to show the variations of V_L and I with time ***(2 marks)***

(c)

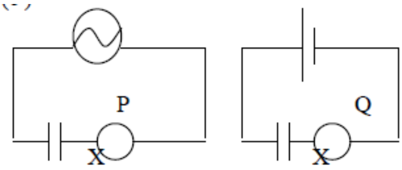


Fig.3

The bulbs P and Q have the same rating. P is connected in series with a capacitor across an a.c . Source while Q is connected in series with an identical capacitor across a d.c source of e.m.f equal to the root mean square voltage of the a.c. as shown in figure 3

Explain why bulb P lights continuously while bulb Q does not ***(5 marks)***

(d) A 240V, 60Hz alternating voltage is applied across a capacitor of capacitance 10μF. calculate the

(i) root mean square value of the current which flows ***(4 marks)***

(ii) Power expended ***(1 mark***

7 (a) (i) Define the ampere ***(1mark)***

(ii)

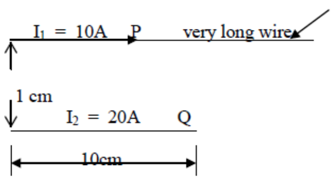


Fig.4

The diagram in figure 4 shows two parallel wires P and Q placed 1 cm apart and carrying currents of 10A and 20A respectively in the direction. If wire Q is 10 cm long find the magnetic force acting on it. ***(4 marks)***

(b) A stream of electrons enters normally , a uniform magnetic field which is perpendicular to and directed into the plane of the page as shown in figure 5

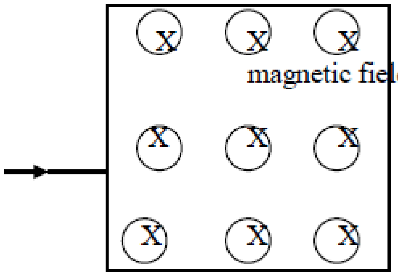


Fig.5

Explain, with the aid of a diagram, the path of the electrons while inside the field and after leaving it. ***(6 marks)***

(c) Explain why , when a current is switched off in some circuits , a spark is seen across the gap of the switch ***(3 marks)***

(d) Show that the total charge which passes through a coil depends only on the resistance of the coil and the total flux linked. ***(6 marks)***

SECTION C

8. (a) (i) Define electrical resistivity and the ohm ***(2 marks)***

(ii) Describe an experiment to determine the electrical resistivity of a material in the form of a wire using a metre bridge. ***(7 marks)***

(b)

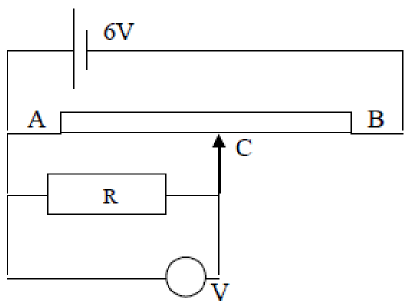


Fig. 6

In figure 6 the wire AB of length 1.00 m has a resistance of 10 Ω . if point C is the mid-point of Ab , and the voltmeter reading is 2.0 V, find the value of R. (6marks)

(c) describe the current versus voltage characteristics of a

(i) Semi-conductor diode (2 marks)

(ii) Filament lamp (2 marks)

Why does ohm's law hold at constant temperatures only (1 mark)

9 (a) Define the term dielectric constant and capacitance (2 marks)

(b) An air capacitor of capacitance 400μF is charged to 180V and then connected across an uncharged capacitor of capacitance 500 μF

(i) Find the energy stored in the 500μF capacitor ***(4 marks)***

(ii) With the two capacitors still connected, a dielectric of dielectric constant 1.5 is inserted between the plates of the 400μF capacitor.

if the separation between the plates remains the same, find the new p.d across the two capacitors. ***(3 marks)***

(c) (i) State the characteristic of an equipotential surface ***(2 marks)***

(ii) Describe how a conductor can be charged at zero potential ***(3marks)***

(d) Describe, with the aid of a diagram ,how high voltage can be generated using a Vande Graaf generator (6 marks)

10 (a) (i) State coulomb's law (1mark)

(ii) Show that the electric flux through a spherical surface enclosing a charge in vacuum is Q/ε_0 (2 marks)

(b) Define the terms electric field intensity and electric potential; (2 marks)

(c)

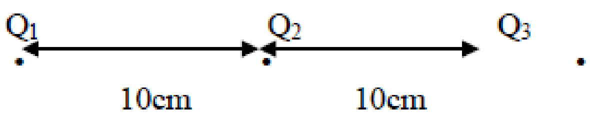


Fig.7

Three pointcharges Q_1 , Q_2 and Q_3 of magnitude +5μC, + 6μC and -20μC respectively are situated along a straight line as shown in figure 7

calculate the

(i) Intensity mid-way between Q_1 and Q_2 (3 marks)

(ii) Potential mid-way between Q_1 and Q_2 3 marks)

(d) (i) Explain why two insulating bosied rubbed together acquire equal and opposite charges (3 marks)

(ii) Describe how a gold leaf electroscope can be used to verify the observation in (d) (i) (6 marks)

P510/1
PHYSICS
Paper 1
Nov/Dec. 2004
SECTION A

1. (a) State the **laws of friction** ***(4 marks)***

(b) A block of mass 5.0kg resting on the floor is given a horizontal velocity of 5.0 ms^{-1} and comes to rest in a distance of 7.0m . Find the coefficient of kinetic friction between the block and the floor. ***(4 marks)***

(c) (i) State the **law of conservation of linear momentum** (1mark)

)ii) What are perfectly inelastic collision? (1 mark)

(d) A car of mass 1500kg rolls from rest down a road inclined to the horizontal at an angle of 35^0 , through 50m. the car collides with another car of identical mass at the bottom of the incline. If the two vehicles interlock on collision ,and the coefficient of kinetic friction is 0.20,find the common velocity of the vehicles. ***(8 marks)***

(e) Discuss briefly the energy transformations which occur in (d) above (2 marks)

2 (a) Define the term **angular velocity** (1 mark)

(b) A car of mass m, travels round a circular track of radius ,r with a velocity V

(i) Sketch a diagram to show the forces acting on the car (2 marks)

(ii) Show that the car does not overturn if $V^2 < \frac{arg}{2h}$, where a is the distance between the wheels , h is the height of the centre of gravity above the ground and g is the acceleration due to gravity (5 marks)

(c) A pendulum bob of mass 0.2kg is attached to one end of inelastic string of length 1.2m the bob moves in horizontal circle with the string inclined at 30^0 to the vertical . Calculate

(i) the tension in the string ***(2 marks)***

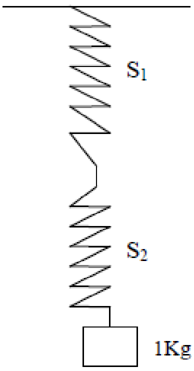
(ii) the period of the motion ***(4 marks)***

(d) Explain and sketch the variation of acceleration due to gravity with distance from the centre of the earth ***(6marks)***

3 (a) (i) What is meant by **simple harmonic motion** ***(2 marks)***

(ii) Show with the aid of a suitable sketch graph how the kinetic energy of amass attached at the end of as oscillating light spring changes with distance from the equibrium position ***(4 marks)***

(b)



A mass of 1.0kg is hung from two springs S_1 and S_2 connected in series as shown in figure 1 . The force constants of the springs are $100Nm^{-1}$ and $200Nm^{-1}$ respectively .Find

(i) the extension produced in the combination (4 marks)

(ii) The frequency of oscillation of the mass if it is pulled downwards through a small distance and released ***(6 marks)***

(c) Explain with the aid of a sketch graph ,what would happen to the oscillation in (b) (ii) if the mass immersed in a liquid such as water (4 marks)

4 (a) (i) Define the term **gravitational field strength** (1 mark)

(ii) Draw a sketch graph to show how the gravitational field strength varies with height , h, above the earth's surface (2 marks)

(b) The period of a simple pendulum is measured at different locations along a given longitude . explain what is observed ***(3marks)***

(c) Derive the expression for the escape velocity of a rocket fired from earth.
(3 marks)

(d) The rings of the planet Saturn consist of a vast number of small particles, each in a circular orbit about the planet. Calculate the speed of the particles nearest to Saturn if its mass is 6.0×10^{26} kg ***(4 marks)***

(e) The moon moves in circular orbit of radius 3.84×10^{8} m around the earth with a period of 2.36×10^{6} s . Calculate the gravitational fields of the earth at the moon ***(4 marks)***

SECTION B

5 (a) What is meant by

(i**) thermometric property** (1 mark)

(ii) **triple point of water** ? ***(1 mark)***

(b(i) Describe the steps taken to establish a temperature scale ***(5 marks)***

(ii) Explain why two thermometers may give different values for the same unknown temperature ***(2marks)***

(c (i) Describe , with the aid of a diagram , how a constant – volume gas thermometer may be used to measure temperature ***(6 marks)***

(ii)State **three** corrections that need to be made when using the thermometer in (c) above (3 marks)

(iii) State and explain the sources of inaccuracies in using mercury –in –glass thermometer ***(2 marks)***

6. (a) Define **thermal conductivity** of a material and state its unit(2 marks)

(b) Describe with the aid of a diagram how the thermal conductivity of a poor conductor can be determined ***(7marks)***

(c) A cooking saucepan made of iron has a base area of $0.05m^2$ and thickness of 2.5 mm. it has a thin layer of soot of average thickness boils at bottom surface. Water in the saucepan is heated until it boils at 100^oC. The water boils away at a rate of 0.60kg per minute and the side of the soot nearest to the heat source is at 150^oC . Find the thermal conductivity of the soot. (thermal conductivity of iron = 66 $Wm^{-1} K^{-1}$ and specific latent heat of vaporization = 2200kj/kg ***(6 marks)***

(d) (i) What is **a black body** ***(1 mark)***

(ii) Sketch the spheral distribution of black body radiation for three different temperatures and describe their main feature ***(4 marks)***

7 (a)Derive the expression $P = \frac{1}{3}\rho\overline{c^2}$ for the pressure , P of an ideal gas of density ρ and mean square speed c^2 . State any assumption made

(b) A gas is confined in a container of volume 0.1 m 3 at pressure of 1.0 x 10^5 Nm-2 and a temperature of 300K. If the gas is assumed to be ideal, calculate the density of the gas. (The relative molecular mass of the gas is 32.) ***(5 marks)***

(c) What is meant by

(i) **Isothermal change**

(ii) **adiabatic change** (2 marks)

(d) A gas at a pressure of 1.0x 10^6 Pa is compressed adiabatically to half its volume and then allowed to expand isothermally to outs original volume . Calculate the final pressure of the gas (assume the ratio of the principle specific heat capacities

$\frac{Cp}{Cv}, \gamma = 1.4$) ***(6 marks)***

SECTION C

8 (a)(i) Describe with the aid of a labeled diagram the main features of a cathode ray oscilloscope (C.R.0.) ***(8marks)***

(ii) State two uses of a C.R.O

(1 mark)

(iii) The gain control of a C.R.O is set on 0.5 V cm^{-1} and an alternating voltage produces a vertical trace of 2.0 cm with the time base off. Find the root mean square value of the applied voltage. ***(2 marks)***

(b) A beam of electrons is accelerated through a potential difference of 2000 V and directed midway between two horizontal plates of length 5.0cm and a separation of 2.0 cm . the potential difference across plates is 80 V

(i) Calculate the speed of the electrons as they enter the region between the plates ***(3 marks)***

(ii) Explain the motion of the electrons between the plates ***(2 marks)***

(iii) Find the sped of the electrons as they emerge from the region between the plates ***(4 marks)***

9 (a) Explain the term **stopping potential** as applied to photo electric effect (2 marks)

(b) Explain how intensity and penetrating power of X-ray from an X-ray tube would be affected by changing

(i) the filament current ***(2 marks)***

(ii) the high tension potential difference across the tube ***(2 marks***

(c) When a.p.d of 60 kV is applied across an X-ray tube , a current of 30mA flows . The anode is cooled by water flowing at a rate of 0.060kgs^{-1}. If 99% of the [power supplied is converted into heat at the anode , calculate the rate at which the temperature of the water rises (specific heat capacity of water = 4.2 x 10^3 J kg $^{-1}$ k $^{-1}$ ***(5 arks)***

(d) (i) Derive **Bragg's law** of X-ray diffraction

(ii) Calculate the atomic spacing of sodium chloride if the relative atomic mass of sodium is 23.0 and that of chlorine is 35.5

(density of sodium chloride= 2.18 x 10^3 kgm $^{-3}$ ***(4 marks)***

10 (a) (i) Explain briefly the mechanism of thermionic emission ***(2 marks)***

(ii) Draw a labeled diagram of the circuit used to determine the anode current and anode voltage characteristics of a thermionic diode. ***(2 marks)***

(iii) Sketch the characteristic expected in (a) (ii) at constant filament current, and account for its special features. (6marks)

(c) (i) Define the terms radioactivity and half – life of a radioactive substance (2 marks)

(ii) a radioactive isotope of strontium of mass 5.0 μg has a half –life of 28 years. find the mass of the isotope left after 14 years

(Assume the decay law $N = N^0 e^{-\lambda t}$

P510/2
PHYSICS
Paper 2
Nov/Dec. 2004
SECTION A

1. (a) What is meant by the following terms as applied to a telescope?
   (i) Magnifying power (1mark)
   (ii) Eye ring. (1 mark)

(b) (i) Draw a ray diagram to show the information of the final image by an astronomical telescope in normal adjustment. (3 marks)

(ii) With the aid of the diagram in (b) (i) , derive an expression for the magnifying power of an astronomical telescope in normal adjustment. ***(3 marks)***

(iii) Give the disadvantage of the telescope in (b) (i) when used to view distant objects on earth. Describe how the telescope can be modified to overcome this disadvantage. ***(4 marks)***

(c) Find the separation of the eye piece and objective of an astronomical telescope of magnifying power 20 and in normal adjustment, if its eye piece has a focal length of 5cm. ***(4 marks)***

(d) State **three** advantages of reflecting a telescope over a refracting telescope. ***(3 marks)***

2. (a) Define the terms principal focus and power of a lens. ***(2 marks)***

(b) Derive the relation between the focal length, f, object distance, u, and image distance, v, for a thin lens. ***(7 marks)***

(c) A thin converging lens , P, of focal length 10 cm and a thin diverging lens , Q, of focal length 15 cm are placed coaxially 50cm apart. If an object , O, is placed 12 cm from P on the side remote from Q, (i)

(i) Find the position, nature and magnification of the final image. ***(7 marks)***

(ii) Sketch a ray diagram to show the formation of the finite image. ***(2marks)***

(d) Explain why lenses of narrow aperture are preferred to lenses of wide aperture in optical instruments. ***(2 marks)***

3. (a) (i) What is meant by **polarized light?** ***(1 mark)***

(ii) Describe how plane polarized light can be produced. ***(2 marks)***

(iii) Sketch the time variation of electric and magnetic vectors in a plane polarized light wave. ***(2 marks)***

(b) Two coherent sources a distance, s, apart produce light of wave length , which overlap at a point on a screen a distance, D, from the sources to form an interference pattern.

(i) What is meant by coherent sources? ***(2 marks)***

(ii) Show that the fringe width , , is given by $\omega = \frac{\lambda D}{S}$ *(4 marks)*

(iii) If $\lambda = 5.46 \times 10^{-7}$ m, $S = 5\text{x}10^{-5}$ m and D = 0.3m find the angular position b of the first dark fringe on the screen. (4 marks)

(c) (i) What is meant by diffraction of light? (2 marks)

(ii) Weight of a wave length $6\text{x}10^{-7}$ is incident on a diffraction grating with 500 lines per cm. Find the diffraction angle for the first older image. ***(3marks)***

4. (a)(i) Distinguish between **transverse** and **longitudinal** waves.(2 marks)

(ii) Define the wave length of a wave (1 mark)

(b) Describe , with the aid of a diagram, an experiment to show how the fundamental frequency varies with tension in a given wire. (6 marks)

(c) A sound wave propagating in the x- direction is given by the equation

$y = 2\text{x}10^{-7}$ sin ***(8000t – 25x)*** meters

Find :

(i) the amplitude (1marks)

(ii) the speed, of a wave. ***(5 marks)***

(d) Explain why the amplitude of a wave goes on decreasing as the distance from the source increases. ***(5 marks)***

SECTION B

5. (a) With the aid of a diagram, describe briefly an experiment to illustrate Lenz's Law of electromagnetic induction. ***(5marks)***

(b) Explain the main precautions taken in the construction of an a.c. transformer. ***(4 marks)***

(c) Explain the effect of the following on the voltage across the secondary coil of an a.c. transformer.

(i) A fall in the supply frequency of the current in the primary. ***(4 marks)***

(ii) A reduction in the primary turns. ***(2 marks)***

(d) A transformer whose secondary coil has 60turns and primary 1200 turns, has its secondary connected to a 3Ω resistor. If its primary is connected to a 240 a.c. supply, calculate the current flowing in the primary assuming that the transformer is 80 % efficient. ***(5 marks)***

6. (a) When can an alternating current be referred to as being sinusoidal? (1mark)

(b) Define (i) the root mean square value of an alternating current. ***(1mark)***

(ii) reactance ***(1 mark)***

(c) Describe the structure and action of a meter that makes use of a thermocouple in measuring the root mean – square value of an alternating current. Why does the meter have high sensitivity? ***(5 marks)***

(d) (i) Show that current leads voltage by 90^o when a sinusoidal voltage is applied across a capacitor. ***(5 marks)***

(ii) Sketch a phasor diagram to illustrate the orientation of the current vector with respect to the voltage vector in (d) (i)

(e)

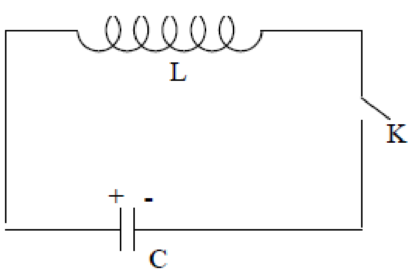


Fig. 1

An inductor , L, a capacitor, C, and switch, k, are connected as shown in Figure 1. Explain, briefly what happens when the switch is closed. ***(6 marks)***

7.(a) What is meant by **magnetic meridian?** (1 mark)

(b) (i) Describe the effect of eddy currents in a dynamo and state how they can be reduced? ***(3 marks)***

(ii) Explain why eddy currents are useful in a moving coil galvanometer.
(3 marks)

(iii) What is the difference between a motor and a dynamo ***(2 marks)***

(c) Describe how a search coil and a calibrated ballistic galvanometer can be used to measure magnetic flux density at a given point near a wire carrying direct current.
(6 marks)

(d) An air craft is flying horizontally at 800 km/ h at a point where the earth's magnetic flux density is 2.31×10^{-5} T and the angle of dip is 60^0. If the distance between the wing tips is 50 m, calculate the potential difference induced between its wing tips. (5 marks)

SECTIONC

8. (a) (i) Define **electrical resistivity** and state its units. (2 marks)

(ii) Describe, with the aid of a circuit diagram, an experiment to determine the electrical resistivity of a given wire using a metre bridge. (7 marks)

(iii) The resistivity of mild steel is
$15 \times 10^{-8} \Omega$ and its temperature coefficient is $50 \times 10^{-4} K^{-1}$. Calculate the resistivity at 60^o C. ***(5 marks)***

(b)

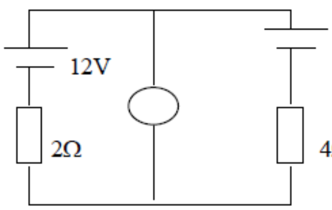


Fig.2

Resistors of 2 Ω and 4Ω are connected in series with power supplies of 12V and 8V as shown in Figure 2. Calculate:

(i) the reading of the voltmeter. (4 marks)

ii) the power dissipated in the 4Ω resistor. ***(2 marks)***

9. (a) Define the following terms:

(i) capacitance of a capacitor. (1 mark)

(ii) dielectric constant . ***(1 mark)***

(b) Explain the effect of a dielectric on the capacitance of a capacitor. ***(4 marks)***

(c) Derive an expression for the energy stored in a capacitor of capacitance, c, charged to a voltage, V. ***(5 marks)***

(d)

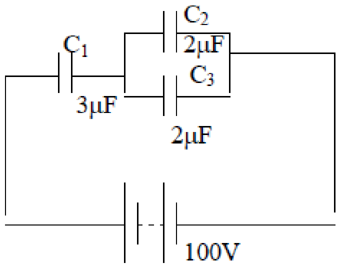


Fig. 3

In Figure 3, C_1,C_2 and C_3 are capacitors of capacitances3μF,2μFand2μF respectively, connected to a battery of e. m. f. 100V.

(i) Calculate the energy stored in the system of capacitors if the space between the plates of is filled with an insulator of dielectric constant 3, and the capacitors are fully charged. (6 marks)

(ii) Account for the change in the energy stored by an isolated parallel – plate capacitor when the plate separation is doubled. ***(3 marks)***

10.(a) (i) Define the terms **electromotive force** and **volt.** ***(2 marks)***

(ii) Why should the temperature of a conductor increase when the current passes through it? (2 marks)

(b) Describe how a potentiometer can be used to calibrate a voltmeter. (6 marks)

(c)

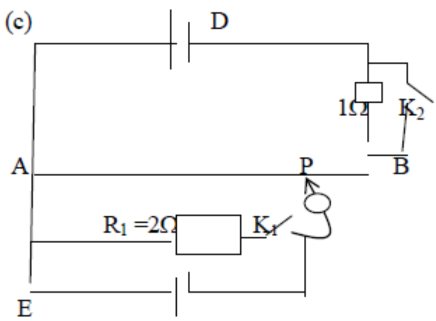


Fig.4

(c)In Figure 4, AB is a uniform resistance wire of resistance 4Ω and length 100cm. E is a cell of e.m.f. 1.5V; D is a driver cell of negligible internal resistance. When switch K_2 is closed and switch K_1 is open, the balance length AP is 60cm. When both K_1 and K_2 are closed, the balance length is 35cm. Find:

(i) the internal resistance of E. (3 marks)

(ii) the balance length when K_1 is closed and K_2 is open. ***(5 marks)***

(d) Explain what happens when the e, m.f. of cell E is greater than that of D and K_2 is closed while K_1 is open. ***(2marks)***