PHYSICS MODEL QUESTION PAPER (3rd SET SOLUTION)

SSC-II

SECTION A

1. A
2. C
3. A
4. D
5. B
6. B
7. A
8. B
9. C
10. C
11. B
12. B

SECTION B

i. Electroscope can also be used to distinguish between insulators and conductors. Touch the disk of a charged electroscope with material under test. If the leaves collapse from their diverged position, the body would be a good conductor. If there is no change in the divergence of the leaves, it will show that the body under test is an insulator.

ii. i. Capacitors are used for tuning transmitters, receivers and transistor radios.
ii. They are also used for fans, fan motors in air conditioners, coolers, motors washing machines, air conditioners and many other appliances for their smooth working.
iii. Capacitors are also used in electronic circuits of computers etc.

iii. **Alpha ray**

Alpha particle is a helium nucleus comprising of two protons and two neutrons with a charge of 2e.

In alpha decay, the proton number or atomic number Z of the parent nuclide reduces by 2 and its mass number or nucleon number A decreases by 4.

Beta ray

Beta radiation is a stream of high-energy electrons

In beta -decay, the parent nuclide has its proton number Z increased by 1 but its mass number or nucleon number A remains unchanged

Gamma ray

Gamma radiations are fast moving light photons.

Gamma rays are usually emitted with no change in atomic or mass number.

iv. The main services used on the internet include:

Web browsing

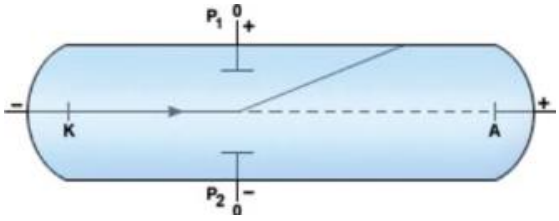
A browser is an application which provides a window to the Web. All browsers are designed to display the pages of information located at web sites around the world. The most popular browsers on the market today include Internet Explorer, The World, Opera, Safari, Mozilla Firefox, Chrome, etc.

Electronic Mail

One of the most widely used application of internet is electronic mail (or e-mail), which provides very fast delivery of messages to any enabled site on the Internet. Communication through e-mail is more quick and reliable. Through our e-mail, we can communicate with our friends and institution with more ease and pace.

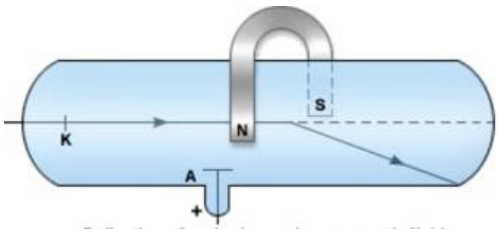
v. **Deflection of electrons by electric field**

When an electron beam passes through electric field between the two plates, the electrons are deflected towards the positive plate (Fig). The reason for this is that electrons are attracted by the positive charges and are repelled by the negative charges due to force $F=qE$



Deflection of electrons by magnetic field

Now we apply magnetic field at right angle to the beam of electrons by using a horseshoe magnet as shown in Fig. We will notice that the spot of the electrons beam on the screen is getting deflected from its original direction. Now change the direction of the horseshoe magnet. We will see that spot on the fluorescent screen is getting deflected in the opposite direction.

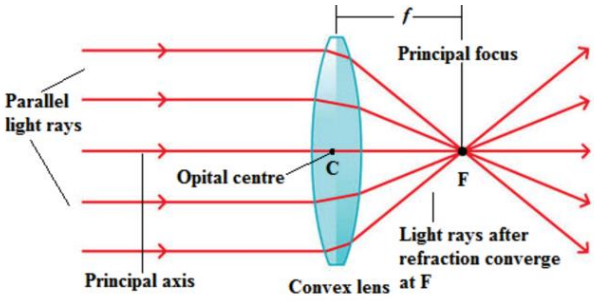


vi. *Convex lens will be used.*

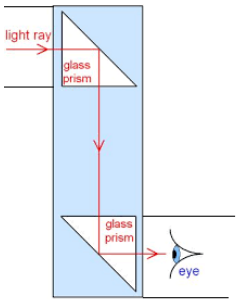
The lens which causes incident parallel rays to converge at a point is known as *Convex lens* or *converging* lens.

The light rays travelling parallel to the principal axis of a convex lens after refraction meet at a point on the principal axis, called principal *focus* or focal point F. At this point, concentration of light becomes so high that heating effect can be produced and

if a paper is placed here it can catch fire.



vii. a.



b. Periscope

viii. If we apply the law of conservation of energy to electromagnetic induction, we realize that the electrical energy induced in a conductor comes from the kinetic energy of the moving magnet. We do some work on the magnet to bring it close to the solenoid. This work consequently appears as electrical energy in the conductor. Thus, mechanical energy of our hand used to push the magnet towards or away from the coil results into electrical energy. Hence, Lenz's law is a manifestation of the law of conservation of energy.

ix. a. Arrange them in series,
Using formula
$R = R_1 + R_2$
$= 10 + 10$
$= 20\Omega$

b. Arrange them in parallel,
Using formula
$1/R = 1/R_1 + 1/R_2$
$= 1/10 + 1/10$
$R = 5\ \Omega$

x. The resistance of conductors increases with increase in temperature. This is due to increase in the number of collisions of electrons with themselves and with the atoms of the metals. In the same way, if we decrease the temperature, resistance of the conductor decreases because rate of collision of electrons decreases.

xi. i. DC motor converts electric energy into mechanical energy. A.C generator converts mechanical energy into electrical energy.

ii. Two slip rings are used in generator, while in motor a ring is split into two halves, known as split rings.

iii. In generator, slip rings attached with coil, slides along with their own carbon brushes. In motor, split rings continuously interchange their carbon brushes during rotation of coil.

xii. a. The speed of a wave in water depends on the depth of water. So in shallow water, speed of water wave decreases.

b. The frequency of the water waves remains the same in both parts of water because it is equal to the frequency of the vibrator.

c. When water waves enter the region of shallow water their wavelength decreases, because speed of waves decreases as $V=f\lambda$

xiii. The technique or method used to absorb undesirable sounds by soft and porous surfaces is called acoustic protection.

Reflection of sound

Reflection of sound is more prominent if the surface is rigid and smooth, and less if the surface is soft. Thus, by using soft, porous materials, such as draperies and rugs in noisy places we can reduce the level of noise pollution. However, if the surface of classrooms or public halls is too absorbent, the sound level may be low for the audience.

Reverberations

Sometimes, when sound reflects from the walls, ceiling, and floor of a room, the reflecting surfaces are too reflective and the sound becomes garbled. This is due to multiple reflections called reverberations.

In the design of lecture halls, auditorium, or theater halls, a balance must be achieved between reverberation and absorption. It is often advantageous to place reflective surfaces such as curved sound boards behind the stage to direct sound to the audience. Generally, the ceilings of lecture halls, conference halls and theatre halls are curved so that sound after reflection may reach all the corners of the hall.

xiv. a **. Grid**

The grid is connected to a negative potential. The more negative this potential, the more electrons will be repelled from the grid and hence fewer electrons will reach the anode and the screen. Hence, the negative potential of the grid can be used as a brightness control.

b. **Filament**

Filament contains large number of free electrons. At room temperature electrons cannot escape the metal surface due to attractive forces of the atomic nucleus. If the

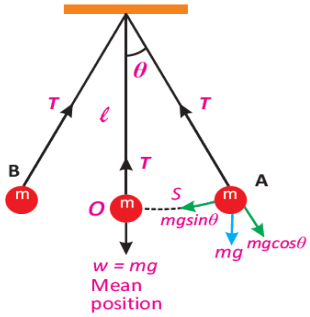
metal is heated to a high temperature, some of the free electrons may gain sufficient energy to escape the metal surface.

c. **Anode**

The anode is connected to positive potential and hence is used to accelerate the electrons.

xv.

a.



b.mgsinθ is providing restoring force

c. Velocity will be zero at extreme point A.

SECTION C

Ans.3 a

COMPOUND MICROSCOPE

Compound microscope is used to investigate structure of small objects. It gives greater magnification than a single lens. (1)

Parts

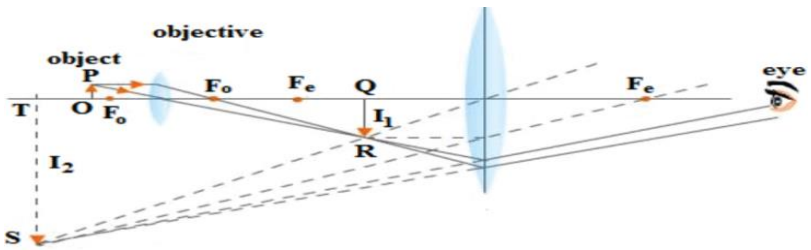
It has two converging lenses, the objective and the eyepiece.

The objective lens has a short focal length, f_o < 1 cm.

The eyepiece has a long focal length, f_e of a few cm.

RAY DIAGRAM

Magnification can be determined through the ray diagram as shown in Fig. Objective forms a small image I_1 inside the focal point of eyepiece. This image acts as an object for the eyepiece and the final larger image I_2 is formed outside the focal point of the objective.



(4)

Magnification

The magnification of a compound microscope is given by

$M = L/f_o\,(1+d/f_e)$ (1)

b. Data

frequency = f = 2kHz = 2 x 10^3 Hz

Wavelength = λ = 35cm= 35 x 10^{-2} m

Distance= S = 1.5km =1.5 x 10^3 m

Time = ?

Solution

V=f λ

V = (2 x 10^3)(35 x 10^{-2})

V = 700ms^{-1} (2)

S=vt

1.5 x 10^3 =700 t

t = 2.14 s (2)

Ans.4 a RADIOISOTOPES

Nuclei which do not emit radiations naturally are called stable nuclei. In general, most of the nuclei with atomic number 1 to 82 are stable nuclei. While the elements whose atomic number is greater than 82 are naturally unstable.

The stable and non-radioactive elements can also be changed into radioactive elements by bombarding them with protons, neutrons or alpha particles. Such artificially produced radioactive elements are called radioactive isotopes or radioisotopes.

$n^1 + Na^{23} = Na^{24}$ + gamma -rays (sodium radioisotope)

$He^4 + Al^{27} = P^{30} + n^1$ (phosphorous radioisotope) (2)

Uses of Radioisotopes

1. Tracers

In industry tracers can be used to locate the wear and tear of the moving parts of the machinery. They can be used for the location of leaks in underground pipes. By introducing a suitable radioactive tracer into the pipe, the leak can be conveniently traced from higher activity in the region of crack in the pipe. (2)

2. Medical Treatment

Radioisotopes are also used in nuclear medicines for curing various diseases. For example, radioactive cobalt-60 is used for curing cancerous tumors and cells. The radiations kill the cells of the malignant tumor in the patient. (2)

Ans. 4 b

Given that, Power = p = 100 W

Voltage = V = 220V

time = t = 5 hours for 30days

Resistance = R =?

The amount of energy in kilowatt-hour=?

Solution:

The amount of energy in kilowatt-hour = watt x time of use in hours / 1000

= 100 x 5 x30/1000

= 15KWh (2)

$P = V^2/R$

$R = V^2/P$

$= 220^2/10$

$=484\Omega$ (2)

Ans.5 a Energy can be transferred from one place to another through waves. For example, when we shake the stretched string up and down, we provide our muscular energy to the string. As a result, a set of waves can be seen travelling along the string.

Factors:

1. Amplitude

The amount of energy carried by the wave depends on distance of the stretched string from its rest position. That is, the energy in a wave depends on the amplitude of the wave.

2. Frequency

If we shake the string faster, we give more energy per second to produce wave of higher frequency, and the wave delivers more energy per second to the particles of the string as it moves forward.

Water waves also transfer energy from one place to another (2)

Experiment:

Drop a stone into a pond of water. Water waves will be produced on the surface of water and will travel outwards. Place a cork at some distance from the falling stone. When waves reach the cork, it will move up and down along with the motion of the water particles by getting energy from the waves.

This activity shows that water waves like other waves transfer energy from one place to another without transferring matter, i.e., water. (3)

Ans.5 b

Data :

Series Connecion

$C_1 = 100\ \mu F$

$C_2 = 100\ \mu F$

Voltage = 20V

Charge Q_1 = ?

Charge Q_2 = ?

Solution:

Equivalent capacitance= C =?

$1/C = 1/C_1 + 1/C_2$

$= 1/100 + 1/100$ (2)

$C = 50\ \mu F$

Charge on each capacitor will remain same in series combination (1)

$Q_1 = Q_2 = Q$

$Q = CV$

$= 50 \times 10^{-6} \times 20$

$=1000\ \mu C$ (2)