

DATE: ___/___/___

CSA Mark June 2023

Good for math portion
Write complete logic and steps

Q 1 a) Average of 7 consecutive numbers is 20. Find the largest of these numbers.

Sufficient length for theory portion
Enough headings
Manage time properly

Solution:-

Formula:

$$\text{Average} = \frac{\text{Sum of all observations}}{\text{No of all observations}}$$

$$20 = \frac{n + n+1 + n+2 + n+3 + n+4 + n+5 + n+6}{7}$$

$$20 = \frac{n + 21}{7}$$

$$20 = \frac{7(n + 3)}{7}$$

$$20 = n + 3$$

$$20 - 3 = n$$

$$n = 17$$

The largest of these numbers is $x+6$

$$\text{So } 17 + 6 = 23$$

The largest number is 23

b) A told B that C is his father's nephew.

D is A's cousin but not the brother of C.

What relationship is there between D and C.

Solution:

C is son of A

D is son of A

D & C are not brothers

so D is sister of C

DATE: ___/___/___

c) Find the next number in the sequence
7, 12, 19, 28, 39

Solution:

$$\begin{array}{cccccc} 7 & , & 12 & , & 19 & , & 28 & , & 39 & , & 52 \\ \underbrace{\quad} & & \underbrace{\quad} & & \underbrace{\quad} & & \underbrace{\quad} & & \underbrace{\quad} & & \underbrace{\quad} \\ +5 & & +7 & & +9 & & +11 & & +13 & & \end{array}$$

In this numeric series, it is addition of odd numbers

d) Sum of money is to be distributed among A, B, C, and D in ratio 5:2:4:3. If C gets Rs. 1000 more than D, what is B's share.

Soln:-

$$= 5 : 2 : 4 : 3$$

$$= 5 + 2 + 4 + 3 = 14$$

$$A's \text{ share} = \frac{5}{14} (x)$$

$$B's \text{ share} = \frac{2}{14} (x)$$

$$C's \text{ share} = \frac{4}{14} (x)$$

$$D's \text{ share} = \frac{3}{14} (x)$$

To find B's share, we must know value of x . To find x we have to make mathematical equality

$$C = D + 1000$$

$$\frac{4x}{14} = \frac{3x}{14} + 1000$$

DATE: / /

$$4u - 3n = 1000$$

14

$$n = 1000$$

14

$$n = 14,000$$

$$\text{B's share} = \frac{2}{14} (14,000)$$

$$= 2000$$

Q6 c) What will be volume of a football with diameter 12 cm?

$$\therefore \text{Volume of sphere} = \frac{4}{3} \pi r^3$$

$$\text{Volume of football} = \frac{4}{3} (3.14) \left(\frac{12}{2}\right)^3$$

$$= \frac{4}{3} (3.14) (6)^3$$

$$\text{Volume of football} = 100.48 \text{ cm}^3$$

Q6 a) The value of a washing machine depreciates at the rate of 10 percent every year. If its present value is Rs. 8748 then what was the price of washing machine three years ago.

Soln:-

$$\text{Given Final price} = \text{Rs. } 8748$$

$$\text{Time} = 3 \text{ years}$$

$$\text{Depreciated at rate} = 10\%$$

$$\therefore \text{Final price} = \text{initial price} \left(\frac{100 - \text{rate}}{100} \right)^{\text{time}}$$

DATE: ___/___/___

Let initial value be x

$$8748 = x \left(1 - \frac{10}{100}\right)^3$$

$$8748 = x \left(\frac{90}{100}\right)^3$$

$$x = 8748 \times \left(\frac{100}{90}\right)^3$$

$$x = 12000$$

So, the initial price of washing machine was Rs 12000.

Q6b A father is four times the age of his daughter. In after 5-years, he would be 3 times of daughter's age, then further after 5 years, how many times he would be of his daughter's age?

Let the daughter's age = x

Let the father's age = $4x$

So according to given statement.

$$4x + 5 = 3(x + 5)$$

$$x = 10$$

Hence present age of daughter is 10 years and that of father is 40 years.

So after 10 years -

Daughter's age would be 20 years and father's age would be 50 years.

Hence father would be $\frac{50}{20} = 2.5$ times

of daughter's age.

Q7d The pentagon building in Washington DC is a regular pentagon with each side of 281 m. Find perimeter of building -

Soln :

$$\therefore \text{Perimeter} = 5 \times \text{side}$$

$$= 5 \times 281$$

$$\text{Perimeter} = 1405 \text{ m}$$

Q5 Describe in short ceramics and semi conductors.

Ceramics:

Outline:

- Definition of ceramics
- Characteristics of ceramics
- How ceramics are produced
- Applications
- Application based classification of ceramics
- Types of Ceramics

Definition:

"A ceramic is an inorganic non-metallic solid made up of clay that have been shaped and then hardened by heating to high temperatures."

Characteristics of ceramics:

- Hard
- wear resistant
- brittle
- Refractory
- thermal insulators
- electrical insulators
- non magnetic
- oxidation resistant
- chemically stable.

How ceramics are produced?

Firing is the process by which ceramics have traditionally been made; indeed, the word 'ceramic' can be traced back to a Sanskrit word meaning 'to burn.'

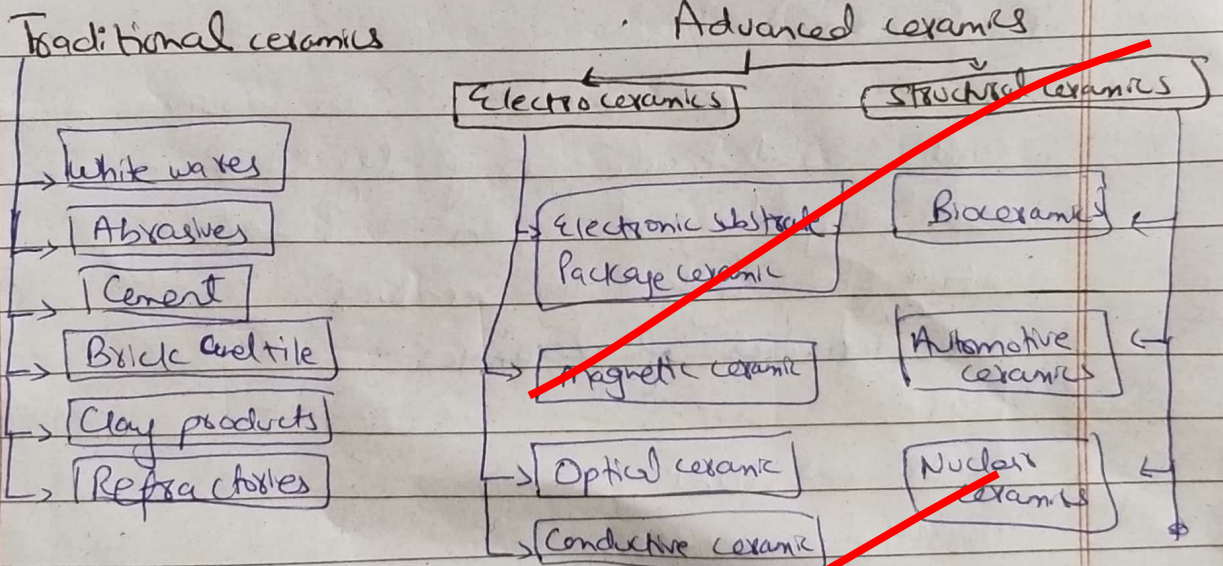
Applications:

Ceramics have application in the following areas:

- a) Aerospace
- b) Consumer usage
- c) Automobile industry
- d) Coatings
- e) Military equipments
- f) Building and construction

Classification of Ceramics based on Application

Ceramics can be classified into traditional and advanced ceramics on the basis of application.



Types of ceramics.

There are two types of ceramics

Crystalline

Non crystalline

Semiconductors :

Outline

Definition

Types of semiconductor

Semiconductor : A material having electrical properties in between the conductors & insulators.

E.g silicon, germanium, in electronic appliances

Types of Semiconductor

Intrinsic Semiconductor

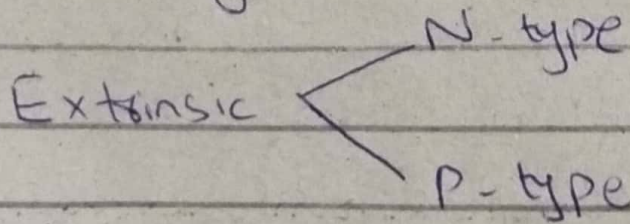
Extrinsic Semiconductor

Intrinsic : A semiconductor in its pure form

E.g silicon, germanium in pure form

Extrinsic : When impurity is added (doping) to a pure semiconductor form, it becomes extrinsic semiconductor.

Doping : It is process of addition of impurity. Any doped semiconductor is called extrinsic.



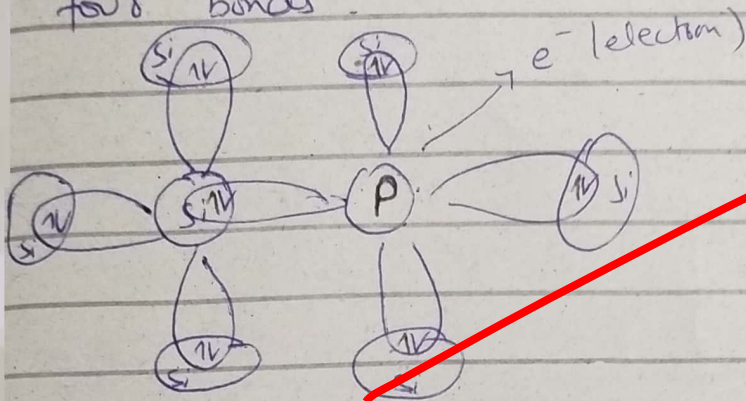
N-type extrinsic semiconductor

When impurity is added to a pure semiconductor from V-group of the periodic table, N-type.

extrinsic semiconductor is formed -

Explanation

As silicon, germanium (pure semiconductor) belong to IV group of periodic table, they can form four bonds.



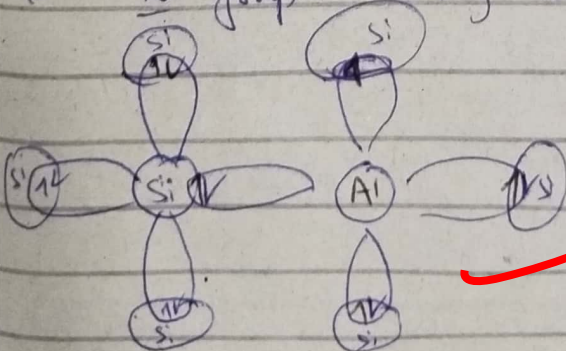
Phosphorus belonging to V group is doped. As phosphorus can form five bonds, one electron of phosphorus will remain free. It will conduct electricity. It is N-type semiconductor (N-type negative).

P-type extrinsic semiconductor.

When impurity is added to a pure semiconductor from III-group of the periodic table, P-type extrinsic semiconductor is formed -

Explanation:-

Let consider pure semiconductor (silicon, germanium) belong to IV group. Doping is done from third group.



As aluminium can form 3 bonds, so hole will be created.

Hole is deficiency of electron. Deficiency of electron brings positive charge. Hole behaves like a proton.

Q5b) Explain LED

Outline:

- What is LED?
- Construction and working
- Advantages of LED

What is LED?

The light-emitting diode (LED) is one of today's most energy efficient and rapidly-developing lighting technologies.

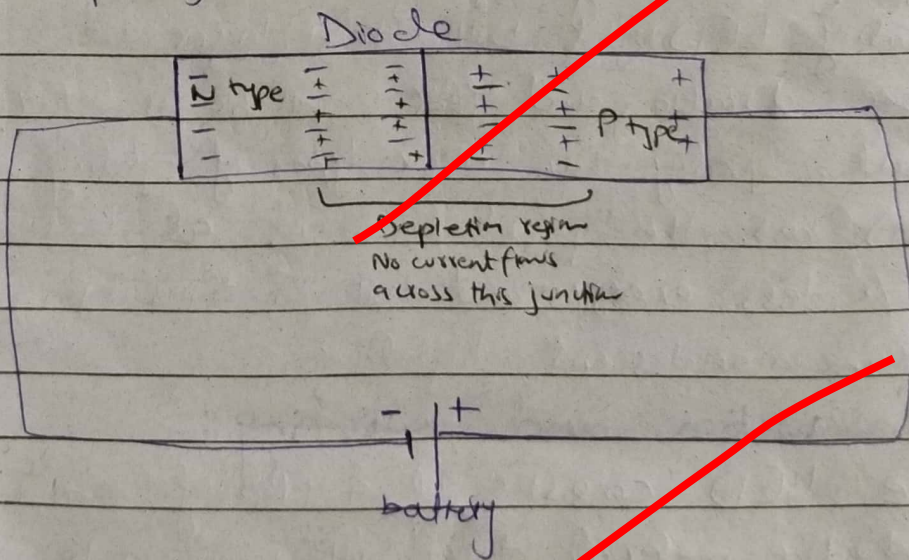
Quality LED light bulbs last longer, are more durable, and offer comparable or better light quality than other types of lighting. LED has the potential to use at least 75% less energy, and last 25 times longer, than incandescent lighting.

Construction and working:

The LED consists of a chip of semi-conducting material doped with impurities to create a p-n junctions - Single piece of Silicon is taken in which doping is done in a sense that half of the silicon is p and other half is N type.

Charge carriers - electrons and holes flow into the junction from electrodes with different voltages. Negative charge will

move towards positive charge due to attractive potential barrier will be created. This barrier will prevent charge to move across junction. External source (battery) is attached to break the barrier - Negative of battery will repel negative of N type and positive of battery will repel positive of P-type. They start moving and width of depletion region start decreasing. At last this depletion region will be eroded and current start to flow and light will be emitted. The wavelength of the light emitted, and thus its colour, depends on the band gap energy of the materials forming the p-n junction.



Advantages of LED:

- a) Long life time 50,000 hours or more.
- b) Energy efficient
- c) No warm-up period
- d) Light is Directional
- e) Not effected by cold temperature

Q2a) Polio

Outline:

- What is Polio?
- Symptoms
- Cause of spreading
- Prevention
- Polio vaccine.

Polio:

Polio (poliomyelitis) is a highly infectious viral disease, which mainly affects young children. The term poliomyelitis derives from Greek words referring to inflammation (itis) of the gray (polio) matter of the spinal cord (myelos).

Symptoms:

Polio is a highly infectious disease caused by a virus. It invades the nervous system, and can cause total paralysis in a matter of hours. Initial symptoms are fever, fatigue, headache, vomiting and stiffness in the neck and pain in the limbs. One in 200 infections leads to irreversible paralysis (usually in legs).

Cause of spreading:

The poliovirus spreads in human faeces. People become infected with the virus through contaminated food and water, especially in the areas where sanitation and hygiene are poor. Improper sewage disposal, for example, can contaminate a water supply. Polio virus typically enters the body through the mouth and proceeds through the digestive tract to the intestines.

DATE: ___/___/___

After multiplying in the body, the virus is shed in the faeces - from which it can spread and cause further infections.

Prevention:

There is no cure for polio, it can only be prevented. Immunization with polio vaccine is the best way to prevent polio.

Polio vaccine:

There are two types of vaccine that protect against polio:

- a) Inactivated polio vaccine (IPV)
- b) Oral Polio Vaccine (OPV)

IPV is given as an injection in the leg or arm, depending on age - OPV is taken by mouth. Polio vaccine may be given at the same time as other vaccines.

Children should be vaccinated with four doses of inactivated polio vaccine (IPV) at the following ages -

A dose at 2 months

A dose at 4 months

A dose at 6-18 months

A dose at 4-6 years

Qs'a write uses of any five electromagnetic radiations.

Uses of Electromagnetic radiations.

Outline:

- Uses of Radiowaves
- Uses of Microwaves
- Uses of Infrared
- Uses of Ultraviolet
- Uses of Gamma rays

Uses of Radiowaves:

Radiowaves are primarily used for communication including voice, data and entertainment media i.e TV and radio etc. Radiowaves are used to transmit data and have been used for all sorts of applications including satellites, radios and computer networks.

Uses of Microwaves:

- a) Microwaves are used for cooking and heating of food.
- b) Microwaves are used to transmit information and in radar that helps to predict weather.

Uses of Infrared.

- a) Infra-red radiations are used to treat strained muscles and tissues.
- b) Infrared radiation is also used to diagnose tumors.
- c) IR is also used to send signals from one place to another including remote controls.
- d) Used in night vision and astronomy.

Uses of ultraviolet radiation

- a) UV rays are used to detect forged bank notes: they fluoresce in UV light; real bank notes don't.
- b) UV light is used by powerful telescopes like the Hubble Space Telescope to see far away stars.
- c) Used by the doctors to treat Vit-D deficiency as ~~suitable~~ ~~dose~~ suitable dose of UV rays cause the body to produce vitamin D.
- d) UV light controls the endocrine system and is a painkiller.

Uses of Gamma rays.

- a) Gamma rays are used to kill cancer cells.
- b) Used to sterilize foods, medical equipments and research equipments.
- c) Gamma rays are used in radioactive tracers.

Q3 b Cyclone

It is a system of rotating winds around a low pressure core due to pressure gradient and Coriolis effect of spin motion of the Earth.

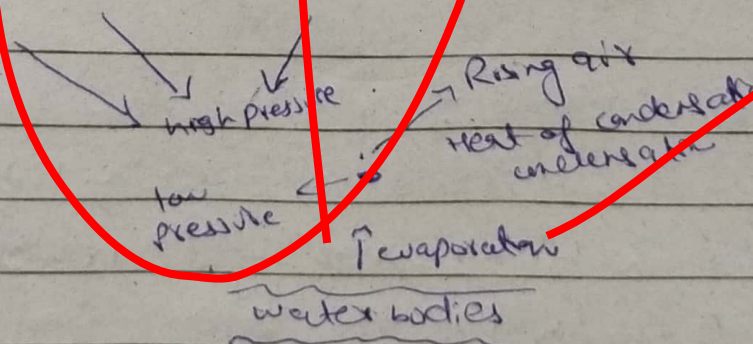
~~Formation~~ formation of cyclone

Two major factors play role in formation of cyclone

- i) Pressure Gradient ii) Coriolis effect

Pressure Gradient

Water is evaporating from water body all the time. The gas at certain height ~~highly~~ which is called as condensation. Heat released during condensation is called as heat of condensation. Air surrounding this heat rise. The place from where air rises has less pressure. Air surrounding this having high pressure moves towards that low pressure.



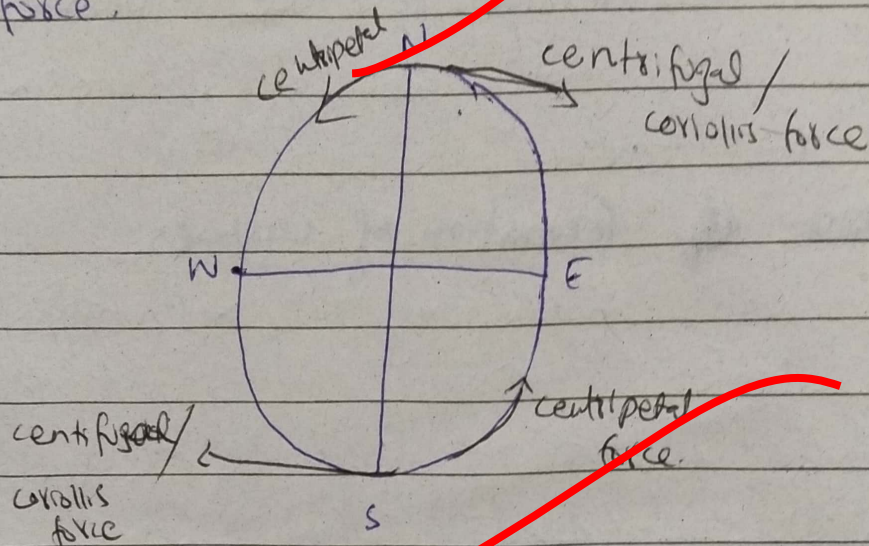
Coriolis force: A force which tends to move the objects to the right in northern hemisphere and to the left in southern hemisphere due to spin motion of the Earth.

Origin of Coriolis force

The force due to moving frame on moving object is called as Coriolis force.

Coriolis force is analogous to that of centrifugal force.

Centrifugal force is reaction of centripetal force.



When this Coriolis effect of spin motion of Earth is coupled with ~~pressure~~ pressure gradient then the resulting phenomenon is termed as **Cyclone**.

Regions of cyclone:

- i) Eye
- ii) eye wall
- iii) Ring shaped region

The eyewall consists of ring of tall thunderstorms that produce heavy rains and usually the strongest winds with a speed of around 74 mph (119 km/h)

Changes in the structure of the eye and eyewall can cause changes in the wind speed which is ~~the~~ an indicator of the storm's intensity.

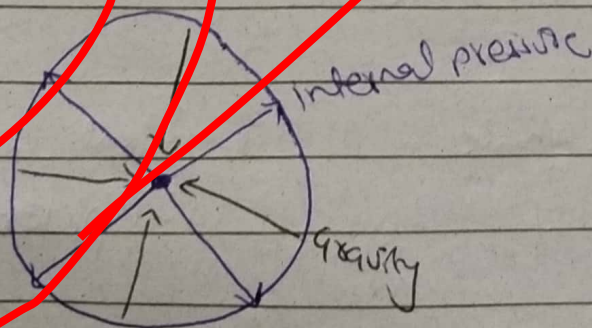
Q3 Black hole:

(9)

An object of extreme density and very strong gravitational pull. even light cannot escape from it.

Formation of Black hole:

Scientists think that the smallest black holes formed when the universe began - Stellar black holes are made when the centre of a very big star falls in upon itself, or collapses. When this happens, it causes a supernova. A supernova is an exploding star that blasts part of the star into space. Scientists think supermassive black holes were made at the same time as the galaxy they are in.



Star is maintained until there is a balance between internal pressure and gravity i.e. equal and opposite.

Star collapse when there is imbalance when hydrogen combine with hydrogen to form helium but helium is not most stable. - 4 will be more toward stable state. Iron is considered most stable.

Star - Fusion reaction slows down and internal pressure ^{is} decreased. But gravity ~~is~~ is not decreased so star will collapse toward centre because gravity is more than internal pressure. Star collapsed to small volume. Density increase and it result in Black hole.