CSS-2023 Physics Paper I

(Part-II)

Q No2 (Part-a)

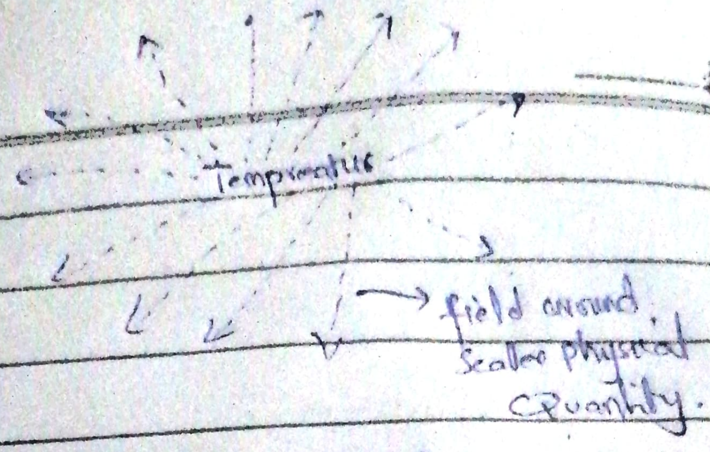
What is Gradient of a scaller function? Give its physical significance and show the Gradient Grad $\phi = \nabla \cdot \phi$

"When we measure the change in a scaller field with a particular direction. In orther words the rate of change of the scaller field at is known as gradient"

For Example: Temperature is a scaller quantity. But when we measure the change in the temprature in a particular direction. This became gradient.

$\nabla\phi$

Mathmatical Expression of the gradient of temprature:



Measuring ~~it~~ the field of temperature with different angle

Give the derivation as well

$$\nabla T = \frac{\partial T}{\partial x} + \frac{\partial T}{\partial y} + \frac{\partial T}{\partial z}$$

Physical Significance of the Gradient:

it is a primary concept in physics. because through gradient we can measure change and ~~the~~ and rate of change in a ~~f~~ Scaller field.

attempt in detail by giving subheadings

(a) The field of temprature
(b) The electric potential $\Delta V = E$
(c) The Heat flow $\Delta T = H$

these are significant phenomeno that can be deal with the help help of gradient

[Q2, Part -b]

Q Acceleration and its cartesian Components:

" The rate of change in velocity is known as acceleration."

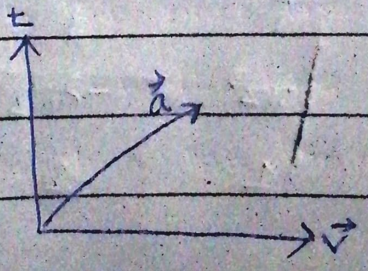
~~Math~~ mathmatical Representation:

$$\vec{a} = \frac{\Delta \vec{V}}{\Delta t}$$

Vector quantity because the division of vector with a Scaller is again a Vector quantity.

Cartesian components of Acceleration

xy-plane



~~As~~ Here in xy-plane the Cartensian Component the acceleration or $\vec{a} = a_x\hat{i} + a_y\hat{j}$

Detailed derivation?

while $a_x = a\cos\omega$.

$a_y = a\sin\omega$.

while in the cartesian components of acceleration are:

$$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$$

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Q No 2 (Part - c)

$$\vec{A} = xz^3\hat{i} - 2x^2z\hat{j} + 2yz^4\hat{k}.$$

So find curl at the point (1, -1, 1)

Ans: curl $\vec{\nabla} \times \vec{A} =$

Q No 2 [Part – c]

$\vec{A} = xz^3\hat{i} - 2x^2z\hat{j} + 2yz^4\hat{k}$

then find Curl of A at the point (1, −1, 1)

$$\nabla \times A = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ xz^3 & -2x^2z & 2yz^4 \end{vmatrix}$$

Now operating the formula.

$\hat{i}\left[\frac{\partial}{\partial y}(2yz^4) + \frac{\partial}{\partial z}(2x^2z)\right]$

$-\hat{j}\left[\frac{\partial}{\partial x}(2yz^4) - \frac{\partial}{\partial z}(xz^3)\right]$

$\hat{k}\left[\frac{\partial}{\partial x}(-2x^2z) - \frac{\partial}{\partial y}(xz^3)\right]$

By calculating:

$[2z^4 + 2x^2]\hat{i} + 3xz^2\hat{j} + -4xz\hat{k}$

Now to put the value (1, −1, 1)

$4\hat{i} + 3\hat{j} - 4\hat{k} = \nabla \times A$ at a point (1, −1, 1)

3/4

Write the final answer in the form of statement

Attempt and upload a single qs at a time for evaluation

Q NO 34:

Part a):

what was physics like before relativity and how did Enstein came up with his theory? mathmatically explain how mass and energy is interchangeable?

Ans: This statment can be answered in three different segment. The first will answered the classical physics era / Newtonian era. while the second one, Physics ~~transi~~ era of transition ~~bet~~ from classical to modern physics. and the third one is the mass-energy conversion assumption of theory of relativity.

(i) Physics before the theory of Relativity:

Before the era of theory Relativity. There were mainly three area of physics that was:

ⓐ Classical Mechanics

ⓑ Optics

ⓒ Classical thermodynamic

Scientist used to consider these three fields as paraliameter for the rest of natural phenomenon. On the basis of these assumption The whole physics centeral ideas:

(i) Time is an absolute quantity
(ii) Length is not changed
(iii) The presence of either that Propagaite light waves.

(ii) How did Enstein come up his theory?

~~Enstein~~

In thet time, physics faced several natural phenomeno, which it unable to response. for example, the newtonian physics, studying it with difference reference frame, and maxeplankes equation and the most impoctant one was the Michelson - inferometer experment. Then, enstein came up with the thoory of relativity to response these question. So that it laid

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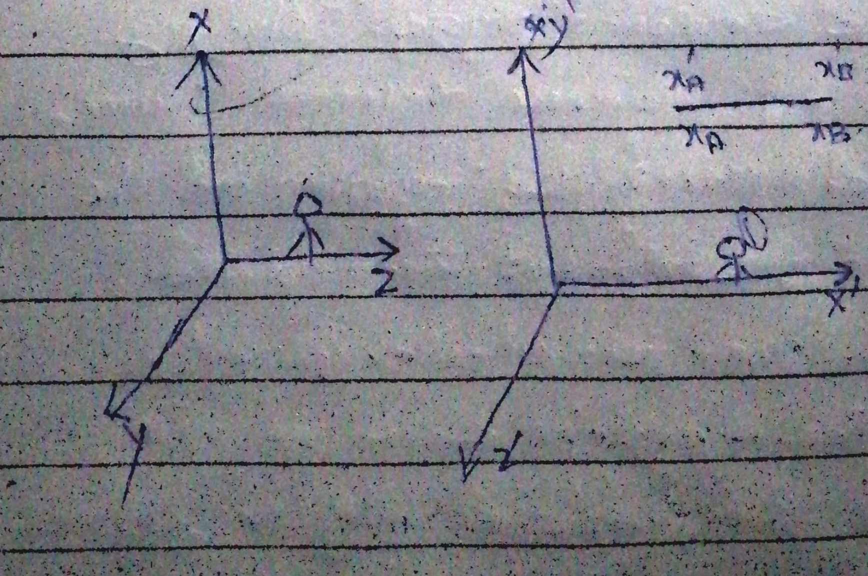
down ~~a new era~~ base of a new era in physics.

Q.No4 part-b:

"Enstein Assumption of Relative length"

Enstein rejected the Newton assumption of length. According to him, length is absolut physical quantity.

~~But Enston~~ According to the enstein theory of Relativity, ~~motion~~ in ~~differe~~ length observing from different reference fram is vary according to observer. In a nutshell, motion impacts the length of a body while observing from different reference frame. for Example,



According to observer 1, the length of the rode is $\Delta l_o = x'_B - x'_A$ while the observer "2" it is different. let to elaborate:

$$x'_A = \gamma(x_A - V_A t)$$

$$x'_B = \gamma(x_B - V_B t)$$

puting in the above equation

$$\Delta L_o = \gamma(x_B - V_A t) - \gamma(x_A - V_B t)$$

$$\Delta l_o = \gamma x_B - V_A t - \gamma x_A + \gamma V_B t$$

$$\Delta L_o = \gamma x_B - \gamma x_A - \gamma(V_B t - V_A t) \rightarrow 0$$

$$\Delta L_o = \gamma(x_B - x_A)$$

$$\Delta l_o = \Delta L \gamma \qquad \therefore \gamma = \sqrt{1 - \frac{v^2}{c^2}}$$

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Q No 4 (Part-c)

Calculate the mass Equivalent of Energy from an antenna radiating 10 KW for 24 hours.

Given Data in the statment:

⇒ Energy Rediated by antenna 10 KW

⇒ During 24 hours

whats the required data according to the statment:

To determine, how much energy is being radiated during 24 hours.

and the emission

The Equilence of mass of that energy which has been radiated during 24 hours.

Understanding the state:

According to Mass energy Equilence

$$E = mc^2 \quad -(i)$$

But, the Given statment mentioned Power; So:

$$P = \frac{E}{t}$$

$$P.t = E \quad -(ii)$$

10K. 24hours

10K. 24×60×60×~~60~~ = E

10Kw ~~43,000~~ 43,200s = E

432,000KJ = E -(iii)

put the value of (iii) in equation 1, to get "m" so calculating

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$m = 1.441\ kg$

$m = 0.001\ kg$

If antena emit that amount of Energy.