THE GRAND PHYSICS SEMINAR HELD AT HOLY CROSS LAKE VIEW ON S.S.S 28TH SEPTEMBER 2024

Item 1

Two holidaymakers secured permission to go and check on their grandmother who stays two villages away from their homes. After a while, it started drizzling and their mother called the grandmother to find out if the visitors had reached safely. The holidaymakers were surprised to see a rainbow but the grandmother could not explain the origin or cause of the rainbow. They also remembered that their P.7 teachers had told them that it has seven colors which they failed to prove by counting physically. In the evening an old man in the village entertained them with music produced by a one-stringed instrument called a tube fiddle. They wondered how one string could produce different sound notes by pressing his fingers at different points on the vibrating string.

Task

As a learner of physics

a) Explain how a rainbow is formed
b) What makes it difficult to differentiate the colors in a rainbow
c) Explain how the mother was able to communicate to their grandmother
d) Explain how one string can produce different sound notes.

Item 2

During a tour, young men were found making heavy concrete blocks for construction. It was noted that some blocks were solid but others were hollow. A simple machine was used to lift 200N of blocks using an effort of 62.5N. During the working of the machine, the effort covers a distance of 2.0, for the load to move through a distance of 0.5m. The wheels of the simple machine rotate around an axle of mass 15kg made of copper and work done to overcome friction is 18000J after a day's work.

Task

As a learner of physics

a) Explain the difference between the blocks made as construction materials
b) Explain the advantages of using concrete as a construction material
c) Clear the doubts of the workers whether the machine is perfect.
d) Help the workers to determine the temperature rise of the axle
e) What are the likely effects of friction on the axle?

Hint

Specific heat capacity of copper is 400J/Kg/K

Item 3

As a school administration of certain school plans to install an electric bell, a big rim of a vehicle has been improvised. To the surprise of the head teacher, the string used to hold the rim broke just after fixing it. He has been advised to use a string of Young's modulus $1.7 \times 10^{4} Nm^{-2}$

The available strings are 1m long with a cross-section area of $0.02m^2$ and it stretches by 0.3m for every 100N

By midday, it was discovered that the temperature of the aluminum had changed by 20K

Hint

The specific heat capacity of aluminum is $900Jkg^{-1}k^{-1}$

The weight 0f rim is 300N

Task

As a learner of physics

a) Explain to the headteacher if the available string will work
b) Help the head teacher understand how the temperature of the rim changed and how much heat was absorbed.

Item 4

A Local government decided to contract a company to construct a road through newly acquired land. During the excavation, a tractor removed a hard bone that appeared to be an animal but everyone wondered for how long it had stayed in the soil. The bone was later taken Laboratory for close analysis. Another section of the road has unusual soil particles. Some of these particles were picked and wrapped in a piece of paper and then placed in an aluminum container and then kept in a thin-walled Lead box. After 20 days, it was discovered that its mass had reduced by 3/4 of its original mass and all fluorescent materials kept in the same store were found glowing. This surprised everyone.

Hint

The mass of carbon-14 in the bone is 5g

Mass of carbon 14 in the bone of living animal =20g

Half-life of carbon-14 is 5600years

Task

As a learner of physics

a) Explain to the people to understand the age of the bone
b) Explain to the people what these soil particles are likely to be
c) With reasons, advise the people in that place

Item 5.

Recently, your female friend enrolled in an Astrophysics course in one of the outside countries. After a few days of settling in, she called her parents in Uganda by 9 am local time in that country. However, in Uganda, it was 8 pm. Her parents had just received the news that the full moon had been sighted using satellite communication, indicating the start of fasting for the holy month. During the phone conversation, she mentioned that her first lecture was about the life cycle of a star. This interested the parents who wondered how a star could have a life cycle and they were also curious about the significant time difference between the two countries.

Task:
As a physics learner, help the parents to understand;
(a) What causes the differences in time between the two countries.

(b) The different phases of the moon.
(c) The life cycle of a star.
(d) How it is possible to talk to her parents

Item 6

On the eve of a party, family members kept outside preparing, and some enjoying the music until the following morning.
Some young people became critical of some changes they observed without valid scientific reasons.
They included the following:
- A bright full moon but with some dark spots

- Some groups of stars formed specific patterns.
- Some stars were brighter than others.
- Some stars were of different Colors.

As the sun was appearing from the horizon, the color of the sky kept changing from red, orange, yellow, and later blue.

- The sky seemed to be touching the ground
some villages away.
The chief guest is from the city and has never been to this home in the village.

Task.
As a learner of physics
a) Explain to the young people to understand the observations.
b) Explain to the chief guest to understand the method to use to locate the home accurately with ease.

Item 7.
It is established that a dairy company produces pasteurized milk that contains harmful bacteria. To ensure the effectiveness of the pasteurization process and monitor bacterial growth, the company adds a radioactive isotope tracer, Phosphorus-32 (P-32) to the milk. The tracer helps in tracking and ensuring that the bacteria are destroyed during the pasteurization process. However, P-32 is harmful for human consumption until its activity is reduced to a safe level. To monitor the activity of P-32 in the milk to safe levels, the company uses a Geiger-Muller (GM) tube to measure the activity over time. The results obtained from the GM tube measurements are given in Table 1.

Table 1: GM tube measurements.

Activity/counts per minute	22000	16000	11400	8200	5800	4000	3000	2400
Time (days)	0	2	4	6	8	10	12	14

Hint:

(i) Phosphorus becomes inactive after its activity goes below ***6000*** counts per minute

Task:

As a learner of physics,

(a) Help the company to understand when the milk will be safe for human consumption.
(b) Advise the company to understand the dangers that may be involved and how safe to guard themselves.
(c) without the presence of the pasteurized milk, the GM-tube could still indicate some reading. Help the company owners to understand this.
(d) The GM tube has failed to detect X-rays which has puzzled everyone. Help the company owners to understand this.

Item 8

An investor seeking to establish a ceramics company requires guidance on using a hydraulic press to manufacture concrete pavers, blocks, and bricks. The hydraulic press supplier contacted, provided a manual booklet with a sketch drawing to help the investor understand the technical aspects. The manual has instructions for the hydraulic press to be operated effectively. One of the instructions given is that the temperature of the hydraulic fluid in it should not rise beyond 20°C. This is crucial to ensure the press's efficiency and longevity.

Hint:

(i) The specific heat capacity of the hydraulic fluid is 1750 $\boldsymbol{Jkg^{-1}K^{-1}}$
(ii) The minimum energy input for the press to start working is $\boldsymbol{1600\ J}$
(iii) 1 liter = $\boldsymbol{0.001\ m^3}$
(iv) Density of hydraulic fluid = $\boldsymbol{800\ kgm^{-3}}$

Task:

As a learner of physics;
(a) Explain to the investor the principle of working of the machine.
(b) Explain why oil is the most suitable to be used.
(c) If 340000 J of heat in the fluid is generated. explain whether the system will remain efficient when 10 liters of oil is put in the machine.

(d) If the hydraulic press has an efficiency of 80% and needs to press concrete requiring output work of 2000 J. Advise whether it will be in position to start operating.

Item 9

In a certain village, electricity is normally supplied at 240V and 5A, electricity normally blacks out on weekends. On working days, a businessman normally uses electricity to charge community batteries and also listens to radio programs. Later his radio failed to work and he noticed it had specifications 100V, 5A, and 50Hz,

which he couldn't interpret, he checked the empty box of the radio and found two devices labeled 20Ω and 8Ω which he couldn't use either. He wishes to work throughout the week and was advised to purchase a suitable generator of required specifications for weekend purpose. The businessman does not know what a generator is, how it works and is bothered by the type of generator that should be purchased.

Task:

As a learner of physics,

(a) Explain to the businessman to understand the specifications of the radio

(b) Explain to the business to understand the connections for his radio to work normally.

(c) Explain to the businessman to understand what a generator is and how it works.

Item 10 (scientific investigation)

One of the items that boy children like playing with is a toy gun. To please his child, a father bought a toy gun as birthday gift. In the evening, while the child was playing with his friends, the toy gun stopped working and the child started crying. When the father saw his child crying, he picked up the toy gun and took it to a mechanic for repair. On opening the toy gun, the mechanic found out that the spring in the toy gun, of force constant $20Nm^{-1}$ was damaged. The father asked the mechanic to replace the damaged spring with another suitable spring, but the only available spring, had no specifications

Task

As a learner of physics carry out a scientific investigation to determine whether the available spring is suitable.

END

For more information

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