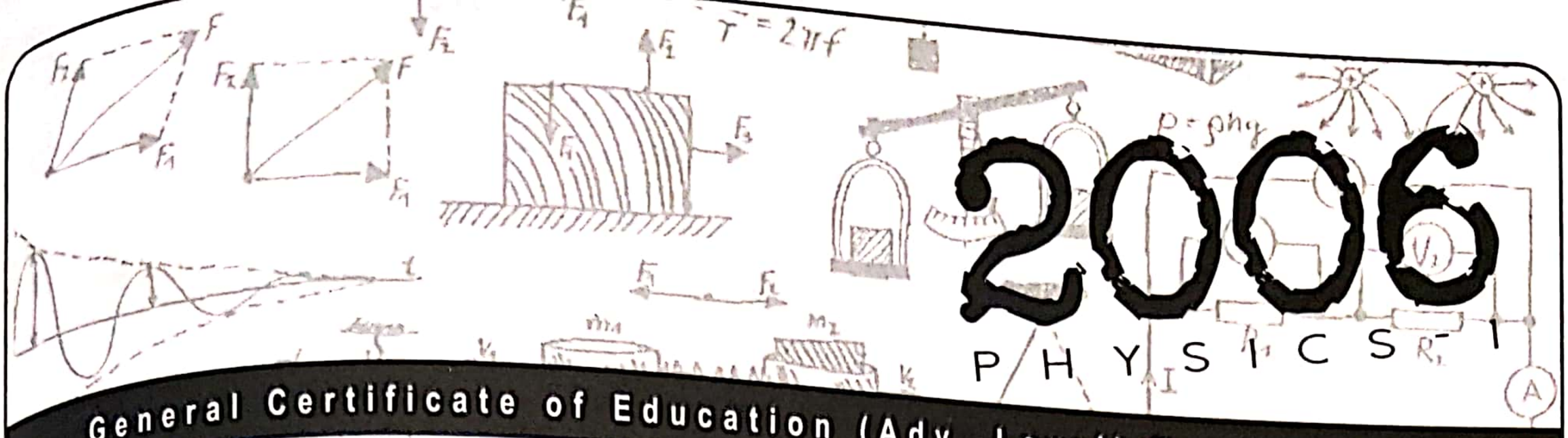


2006

PHYSICS I

General Certificate of Education (Adv. Level) Examination

1 Which of the following is not an SI unit?

(1) kg (2) m (3) s (4) A (5) k

Unit and Dimensions **01**

As soon as the question was seen, it is clear that the answer is simple k. There is no such SI unit called k. Only K is there. It is Kelvin that is used to measure temperature. According to SI unit convention, if a unit starts with a name of a scientist, it should be a capital (some examples are K, A, C, Pa). There is no connection of scientists in kg, m, s etc. The other important thing is when writing K, never write as K^0.

2 If (n-1) number of main scale divisions of a certain measuring instrument is divided into n venire scale divisions, then the least count of the instrument in main scale division is

(1) 1 (2) $\frac{1}{n}$ (3) $\frac{n}{n-1}$ (4) $\frac{n-1}{n}$ (5) $\frac{1}{n-1}$

Measuring Instruments **01**

As initially mentioned, even though it is not given in symbols, such questions are given in many occasions using numbers. If I did this question, I would have remembered two numbers of 9 and 10. The reason is that in most of the vernier calipers, 9 parts of the main scale is corresponding to 10 parts of vernier scale. If there are 9 and 10, I instantly remember 0.1 (1/10) as the least count. That is because I am a good student who had taken measurements in the school laboratory. If so, 10 will be in my memory for n instantly. Then the answer which is 1/n can be obtained by me without a calculation inside my brain. If you do a calculation, then you need to get as need to get as $1 - \frac{(n-1)}{n} = \frac{1}{n}$

like $1 - \frac{9}{10} = \frac{1}{10}$.

3 The refractive indices of water and glass are 4 /3 and 3 /2 respectively.

The refractive index of water relative to glass is

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{8}{9}$ (4) $\frac{9}{8}$ (5) 2

Refraction **03**

If you do it on the rough paper, then $m_{wg} = n_{wa}n_{ag} = \frac{4}{3} \times \frac{2}{3} = \frac{8}{9}$

You can get this answer without wasting a little bit of graphite. How is that? Any student knows that the answer is either 8/9 or 9/8 (if you are not a weak student). The other answers are useless choices. The question has being asked about the refractive index of water with respective to glass. Compared to glass, water is the rarer medium. Therefore, the refractive index of water should be less than 1 with respective to glass. For example, the refractive index of glass which is 3/2 (1.5) means the refractive index of glass with respect to the air. The

refractive index of the air with respective to glass is 2/3 (<1). Therefore, you should select 8/9. Look how much time can you save by arguing like this.

4 For an object undergoing simple harmonic motion

(1) the magnitude of the acceleration is maximum when the displacement is maximum.

(2) the displacement is maximum when the speed is maximum.

(3) the magnitude of the acceleration is maximum when the speed is maximum.

(4) the maximum potential energy is greater than the maximum kinetic energy.

(5) the acceleration is always constant.

03 **Simple Harmonic Motion**

It is a question that has been checked many times recently. The correct choice can be found as (1) as soon as you read it. The acceleration of a simple harmonic motion is proportional to its displacement numerically ($a = \omega^2 x$). The magnitude of the acceleration is mentioned here because the displacement can be positive or negative. Look at the 12th question of paper 1997 and the 5th question of paper 2004.

In questions with sentences, if the first choice is the correct answer, then there can be many benefits. Once it is realized that the answer is (1), why do you need to check on other answers? Many children even after picking up the correct choice, tend to read other choices one by one and try to find their mistakes. It consumes an extra time. That is all. By doing so, they are checking the examiners. There will be no harm to the candidates if there is a mistake by the examiners or a printing error. My advice is that, once you select the correct choice, it is a foolish act to look at the others. This is like you compare good and bad of others after choosing your partner in life. Speed is maximum at the mid equilibrium point. At that point, the displacement and the acceleration both get zero.

5 A black body of temperature T K radiates energy at a rate of 10 mW. At temperature 2T K it will radiate energy at a rate of

10 mW (2) 20 mW (3) 40 mW (4) 80 mW (5) 160 mW

11 **Radiation**

I do not like to do rough work for this question. It is your limitation if you cannot do it from the memory. I agree that, only a clever child can do it even though I advise to do it from the memory. But this question could have been done from the memory of anyone. The rate of energy radiation from a black body is proportional to the fourth power of its absolute temperature. Therefore, cannot you think that 2^4 is 16 by memory? So, cannot you get the answer as 160 mW in an instant? You should be able to solve such questions in less than 2 minutes.

6 A radioactive nucleus ${}^{A}_{Z}X$ decays to a nucleus ${}^{A-4}_{Z-1}Y$ in two stages. The radiations emitted in the two stages would most likely be

	First stage	Second stage
(1)	α	β^-
(2)	β^-	γ
(3)	β+	α
(4)	α	γ
(5)	β+	γ

Radioactivity 11

Such common questions are given recently. Look at the 36th question of paper 2000 and the 27th question of paper 2001. As the value of A has become A-4, definitely an alpha particle has been emitted. Therefore, in the next stage it should emit a β or a γ (as A is remained in A-4). In an α decay, Z becomes Z-2. So, the second stage cannot be aγ, as Z-2 has become Z-1. Then only the first choice it left. If Z-2 becomes Z-1, then it is a β- emission. This is because in a β- emission, n in a nucleus becomes p. Then Z is increased by 1.(Z-2+1 = Z-1)

An α emission occurs in a nucleus with high mass with more neutrons (that is rich in neutrons). Therefore, after an α emission, there is a tendency for another α emission or β- emission but not β+ emission. Always n is more likely to become a p as it is rich in neutrons. The above-mentioned facts are not needed to solve the question. I wrote it for your consideration.

7 Light of wavelength 5000 Å is incident on a sodium surface whose work function is 2.28 eV. The maximum kinetic energy of the emitted photoelectrons is (hc=12.4 x 10^3 eV Å)

(1) 0.03 eV (2) 0.20 eV (3) 0.60 eV

(4) 1.30 eV (5) 2.00 eV

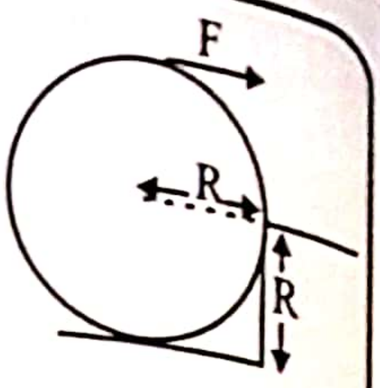
Photoelectric Effect 11

This is the first question that I do in rough work. Any child who has mathematical simplification skills than me can do it from his/her memory. Here we have the only equation in photo electric effect ($\frac{hc}{\lambda} - \varphi = K_{max}$). But I will not write the equation. Directly I will substitute to the symbols and write.

$$\frac{12.4 \times 10^3}{5000} - 2.28 = 2.48 - 2.28 = 0.2$$

Final 0.2, I will not write in the paper. I can do the subtraction of 2.48 and 2.28 from my memory. Here you need to understand the multiplication of hc is given in eV Å. This task will be a lengthy process if you substitute the known values for h and c. I do not know whether there were such children who had done that. The unit of hc is given ineV Å to get the energy of the photon directly in eV when the wavelength is substituted in Å. Then the it is easy to subtract 2.28 from it.

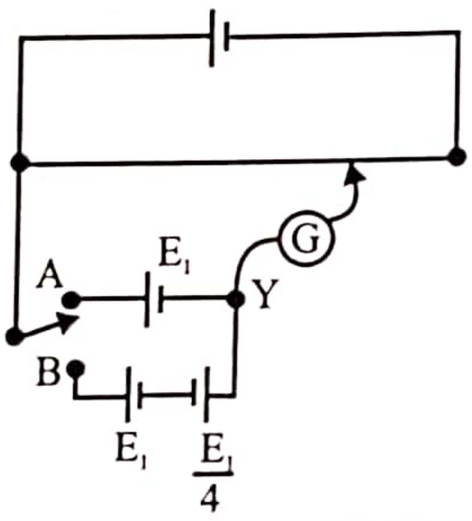
8 A circular coin of radius R and mass M is placed so that it touches a step of height R as shown in the figure. The minimum value of the horizontal force F required to pull the coin over the step is



(1) $\frac{Mg}{2}$ (2) $\frac{Mg}{\sqrt{2}}$ (3) Mg (4) $\sqrt{2}\,Mg$ (5) $2\,Mg$

02 Equilibrium of forces

I will do this from the memory. At the minimum amount of F, the coin should be barely lifted off from the earth. Then the reactive force from the earth will be zero. If we take the moments around the end of the edge, it can be clearly seen that F will be Mg (FR = MgR). The answer can be obtained directly as the end of the edge is in the horizontal line with the centre of the coin.

9 

In the potentiometer circuit shown when switch S is connected to A the balance length is l. When S is connected to B the balance length will be

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{3l}{4}$ (4) $\frac{4l}{3}$ (5) $\frac{5l}{4}$

08 Potentiometer

I will do this question also from the memory. There is no doubt that you might have done many of such questions. The ends of the cells are being connected in an opposite way to each other in the lower section. Therefore, the net e. m. f is ¾ E_1. So, if l is for E_1, then 3/4l for 3/4E_1. What else? You should do this question in 15 s. Otherwise you cannot do correct questions beyond 50.

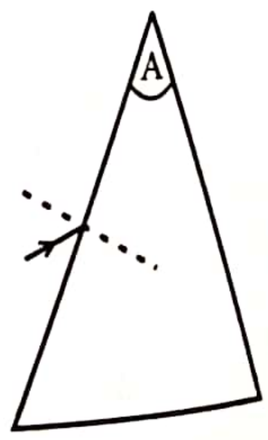
10 An astronomical telescope consists of two convex lenses of focal lengths 50 mm and 650 mm. The moon subtends an angle of 0.5° on an unaided eye. If the telescope is used in normal adjustment to view the moon, the angle subtended by the final image of the moon on the eye is

(1) 6.5° (2) 5.5° (3) 4.5° (4) 3.5° (5) 2.5°

03 Optical Instruments

There are many such questions in the previous past papers. Look at the 11th question of paper 1999 and the 29th question of paper 2001. You must solve it from the memory. The angular magnification is 13 (650/50). 650 and 50 are given to simplify properly. However, a magnification cannot be 1/13. Once 13 is multiplied by 0.5, is not it 6.5? Do you really need rough work for this?

11 A ray of light incident on a glass prism is shown in the figure.



Consider the following statements.

(A) Irrespective of the value of angle A the incident ray always emerges from the opposite face.

(B) For a certain value of the angle of incidence the deviation of the emergent ray is minimum.

(C) There is an angle of incidence for the ray for which the angle of emergence is equal to the angle of incidence.

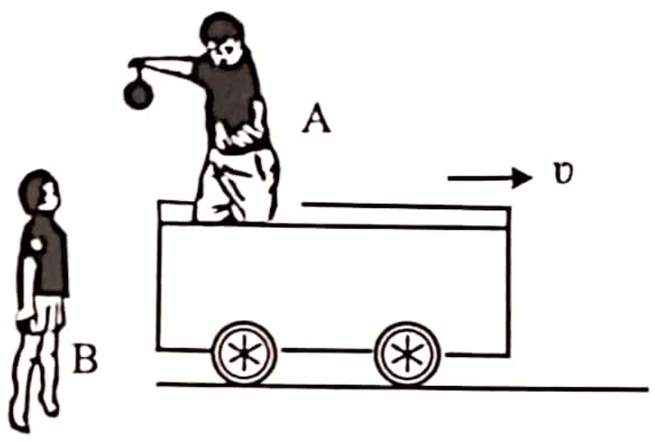
Of the above statements,

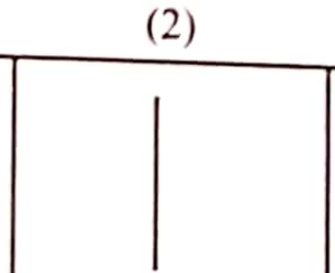
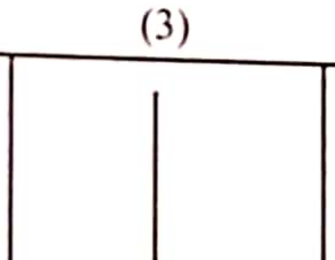
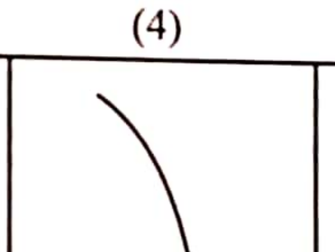
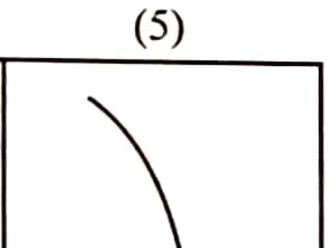
(1) only (B) is true.
(2) only (A) and (B) are true.
(3) only (B) and (C) are true.
(4) only (A) and (C) are true.
(5) all (A), (B) and (C) are true.

Refraction through Prisms 03

There are such sentences related to prism in the previous past papers. When a ray is incident on the second surface, if its incident angle gets greater than the critical angle, it will not emerge from the opposite face. The occurrence or non-occurrence of this is dependent on the angle of A. If the value of A is greater, the incident angle on the opposite face gets increased. Therefore, (A) is wrong. You can directly see that (B) and (C) are correct. Even those two sentences are inter connected with each other. Every child knows the fact that there is a minimum deviation. At that instance, the angle of emergence is equal to the angle of incidence.

12 A person A standing on a trolley moving with a constant speed v on a straight horizontal track drops an object as shown in the figure. B is an observer standing on the ground. If the air resistance is negligible, the paths of the object as observed by A and B are represented by



	(1)	(2)	(3)	(4)	(5)
A					
B					

Linear Motion 02

It is an easy question. The path of the object is seen as a projectile by the person on the earth. Once it is released, the object also has the horizontal speed of the trolley. So, A sees as the object is falling vertically downwards. If a bomb is dropped from a plane which travels with a uniform constant speed, then a person inside the plane views as the bomb is falling vertically downwards. For a person who is still on the earth can view the fall of the bomb as a projectile.

13 Refractive indices for red light and blue light in crown glass are 1.51 and 1.53 respectively.

Consider the following statements.

(A) The speeds of red light and blue light in vacuum are the same.

(B) The speed of red light is greater than that of blue light in crown glass.

(C) Critical angle of red light is greater than that of blue light for crown glass.

Of the above statements,

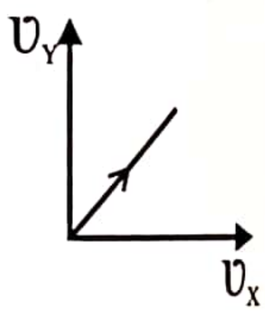
(1) only (A) is true.
(2) only (B) is true.
(3) only (A) and (B) are true.
(4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

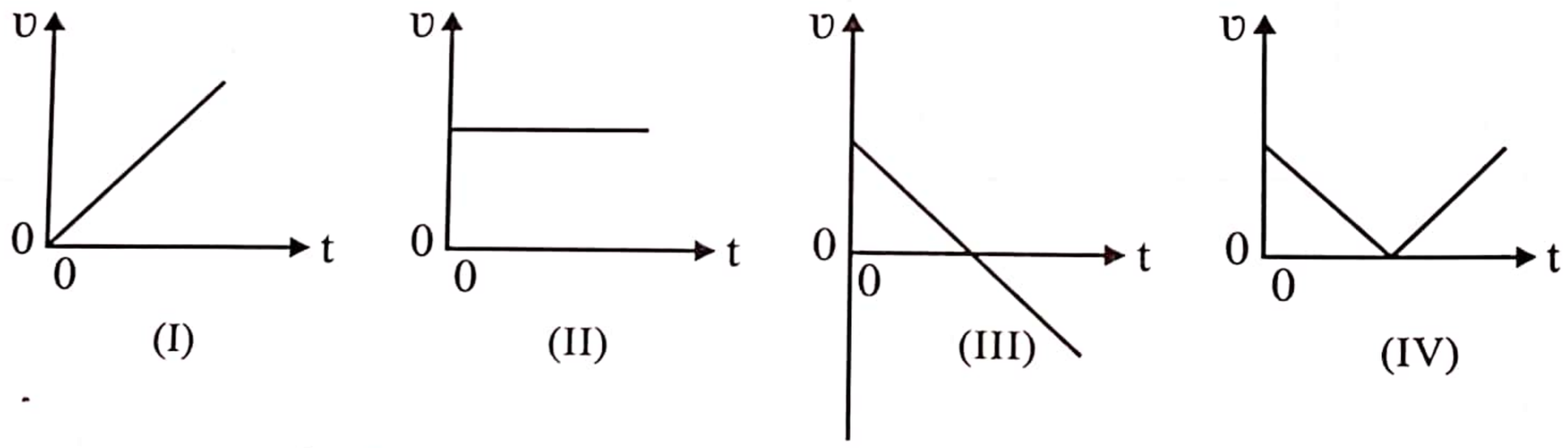
03 **Refraction**

There are also questions with such statements in previous past papers. Look at the 11th question of paper 1990. According to the questions made from the old syllabus, you need to know that, the refractive index of blue light is greater than the red light. The values are given here. Then it is easy. It can be directly seen that statement (A) is correct. In a vacuum, any electromagnetic wave has the same speed irrespective of the value of its frequency/wavelength (speed of light, c). Therefore, the speed of light in the vacuum is the same irrespective of the colour. But in a medium it changes. The refractive index is the ratio of (the speed of light in the vacuum/ the speed of light in the medium).Therefore, if the refractive index is low, then the speed of the particular colour in that medium is high. So, (B) is correct. Next, if the refractive index is low, then the critical angle is high. Because n =1/Sin C. If the refractive index is high, then the critical angle is low. The critical angle of diamond is less due this. Therefore, (C) is correct.

Even though I expressed everything to describe, there is no need to write equations or expressions to check the correct/wrong nature of the sentences by wasting the time. You should be able to form these facts instantly on your mind. If the refractive index is less, then the speed is high. If needed you can think of glass and water. As the refractive index of glass is greater than water, the speed of light in glass is less. In the same way, the critical angle is high in a material with less refractive index.

14 A stone is thrown at a certain angle with the horizontal in the direction shown by the arrow. If air resistance is ignored, which of the following velocity (v) – time (t) graphs best represent the variations of v_X with t, and v_Y with t?





	υ_X with t	υ_Y with t
(1)	II	III
(2)	II	I
(3)	I	IV
(4)	II	IV
(5)	II	II

02 **Linear motion**

Very simple. You should not waste not more than (5-10) s. There is no point in doing Physics if you do not know that in a projectile, the horizontal component of the velocity is constant whereas the vertical component of the velocity gradually gets zero, change its direction and then gets increased. At a glance you need to select (1). The graph of (iv) is wrong for Vy. It has not represented the change of direction. The (iii) graph shows the motion of an object that is vertically thrown upwards and its motion towards the ground. This also has been checked by many times.

15 Consider the following statements made regarding a transformer.

(A) The core of a transformer is usually made of soft iron in order to maintain a better flux linkage.

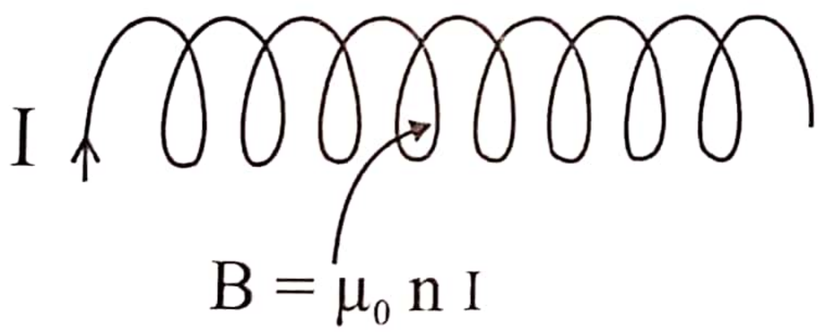
(B) The wire diameter of the secondary coil of a step-down transformer is usually larger than that of the primary coil.

(C) When winding transformer, wires without insulated coating must be used.

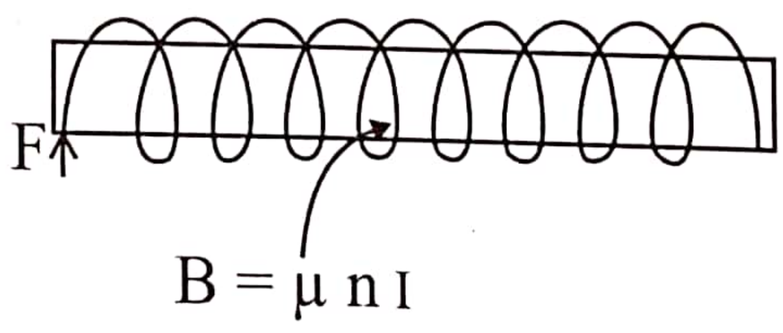
Of the above statements,

(1) only (A) is true.
(2) only (B) is true.
(3) only (A) and (B) are true.
(4) only (A) and (C) are true.
(5) all (A), (B) and (C) are true.

Plenty of (A) and (B) statements are given about transformers. In a transformer, magnetic flux leakages should be minimized. If not, all magnetic force lines will not go across the secondary. If wires are coiled around a soft iron core and send a current across it, then the value of the magnetic flux density inside the transformer is 5000 times more if it had air in the middle without the core. You do not have to know these values. But for your information, I will show the following rough sketch.



Solenoid in the air



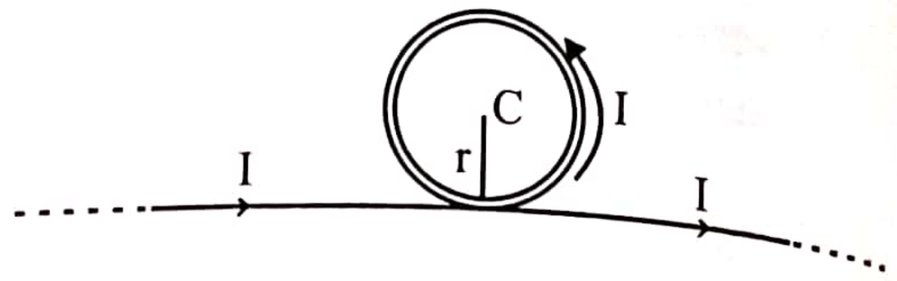
Solenoid coiled in an iron core

You know that B is equal to $\mu_0 nI$ if there are n number of turns in a nearly coiled solenoid which has a flowing current of I.If the same was wound around a magnetic core, then the B inside of it is μnI. Here μis the permeability of the medium (μ_0 and μare same as ε_0 and ε in electric fields). For soft iron $\mu = 5000\mu_0$. Honestly the value of B gets increased when there is iron because iron also get magnetized from the created B by flowing current of the wire. Then the net value of B gets increased by 5000 times.

In a step-down tranformer, the voltage of the secondary is lesser than the primary. That means the current in the secondary is higher than the primary (as multiplication of VI need to be a constant). Therefore, the resistance of the turns in the secondary should be lessened. Otherwise

the geneated heat gets higher. To reduce the resistance, the wire should be thicker. That means its diameter should be increased. Therefore, (B) is true. There should be an insulating coat in the wounded wires of the tranformer. Otherwise the wires will touch each other and can get short-circuited. Therefore, statement (C) is wrong.

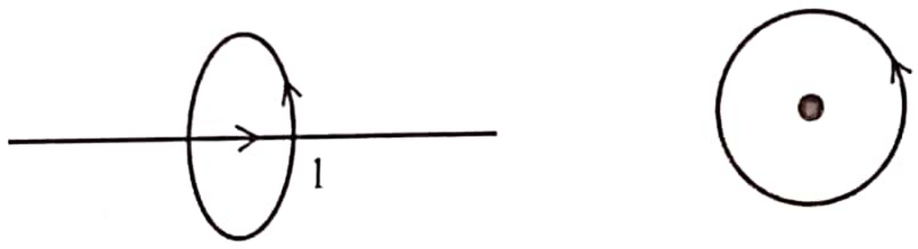
16 A long insulated wire carrying a current I is bent to form a flat circular coil of N turns and radius r.The two straight ends of the wire extend to a large distance as shown. The magnitude of the magnetic flux density at the centre C of the coil is



(1) 0 (2) $\frac{N\mu_0 I}{2\pi r} + \frac{\mu_0 I}{2r}$ (3) $\frac{N\mu_0 I}{2r} - \frac{\mu_0 I}{2\pi r}$ (4) $\frac{N\mu_0 I}{2r} + \frac{\mu_0 I}{2\pi r}$ (5) $\frac{N\mu_0 I}{2r} - \frac{\mu_0 I}{2r}$

09 **Magnetic Effect of Electric Currents**

This is exactly the 48th question of paper 1991. The only difference is that there are N turns in the circular coil. The B in C due to the straight part is ($\mu_0 I/ 2\pi r$). The B in the centre of a circular coil with N turns is($N\mu_0 I/ 2r$). For the resulatnt field, you need to add these two fields together.



Both fields are perpendicular to the paper and situated away from the paper at C. Think why it has been mentioned that the wire is insulated. Do you need to write expressions in the rough paper?

17 As a mechanical wave propagates in a medium, the energy of the wave dissipates gradually. This will gradually

(1) decrease the speed of the wave. (2) decrease the amplitude of the wave.

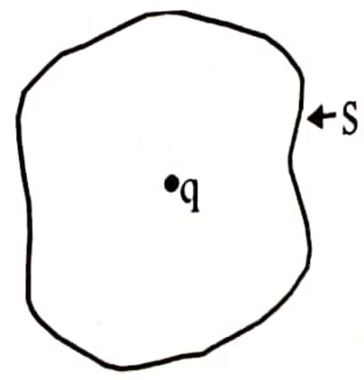
(3) decrease the frequency of the wave. (4) decrease the wavelength of the wave.

(5) increase the wavelength of the wave.

03 **Wave Properties**

This is a very simple problem. When the energy is dissipated, then the amplitude gets reduced. Think of a transverse wave travelling in a string. If the medium is not changed, then the speed is not changed. If the medium is changed, then the speed is changed. At that instant, the wavelength is changed.

18 Sis a Gaussian surface and q is a charge inside it. Consider the following statements made about the net electric flux Φ through the surface S.



(A) If the volume enclosed by the surface S increases, then Φ increases.

(B) If the charge q is moved close to the surface S increases, then Φ increases.

(C) Even if the shape of the surface S is changed, Φ remain the same.

Of the above statements,

(1) only (A) is true.

(2) only (B) is true.

(3) only (C) is true.

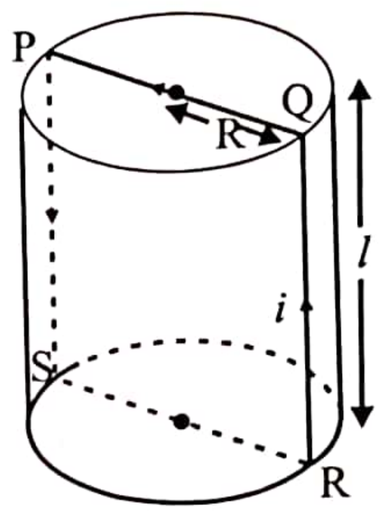
(4) only (A) and (B) are true.

(5) only (B) and (C) are true.

Gauss Theorem 06

These sentences are also very simple. There have been many questions related to flux in the recent past. The net flux is unchanged if the net charge in the Gauss surface is not changed. How can φ change when the volume of the surface of S is increased? Think charge q as a pipe which injects water. As the amount of water that is injected from the pipe is unchanged, if the pipe is covered from a plate, then does the total amount of water incident on the plate change if there is a change in the shape of the plate or the pipe is brought near to the plate? (A) and (B) are false whereas only (C) is true.

19 The figure shows a cylindrical satellite with radius R and length l and a wire PQRS wrapped around it in a rectangular shape. If a current i is made to flow through PQRS at an instant when the direction of the earth's magnetic field of flux density B is along PQ,



(1) a net force of 2RiB and a torque of 2RliB will act on the satellite.

(2) a net force of 2liB and a torque of 2RliB will act on the satellite.

(3) there will be no net force but a torque of RliB will act on the satellite.

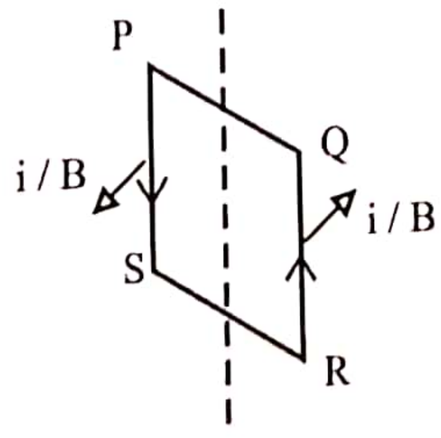
(4) there will be no net force but a torque of 2RliB will act on the satellite.

(5) neither a net force nor a net torque will act on the satellite.

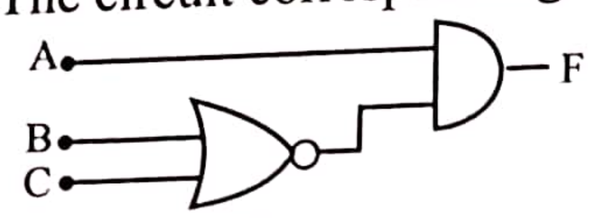
Magnetic Fields / Force having on a current Carrying Conductor 07

Here it mentions about a satellite to make the problem beautiful. The answer of the question is not changed for Physics even if it mentions a rectangular wire without talking about a satellite. Actually, this is one of the methods that rotate the satelliteto different directions. If you send a current in the wire coil to the required direction, then by using the earth's magnetic field, you can create a torque around the satellite. I have talked regarding this in the first essay question of paper 2005. Please have a look on the review of 2005.

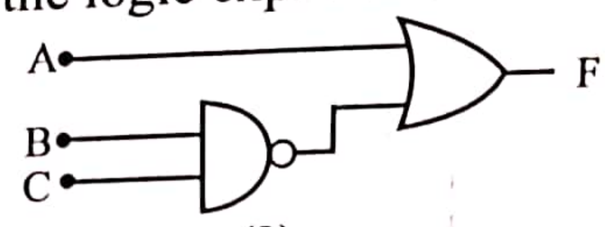
This is a set up that you know. You learn this set up when you learn about moving coil galvanometer. There are no forces generated on PQ and RS sides. As the field and the current is on the same direction, there will be a couple of force on the other sides. The resultant force of a couple is zero. There is only a net torque. It is ilB2R (the magnitude of a force X the perpendicular distance of the two forces). The answer is (4).



20 The circuit corresponding to the logic expression $F=A \cdot \overline{B+C}$ is



(1)



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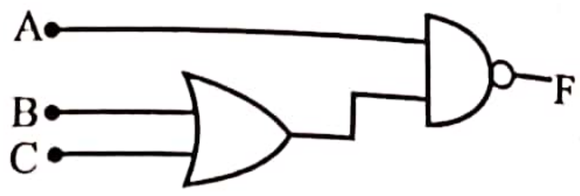
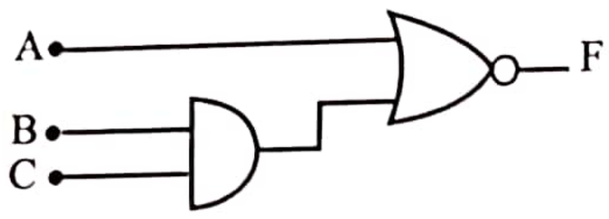
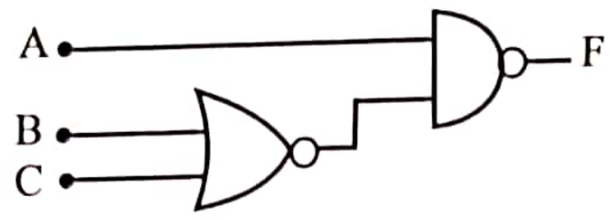


(3)



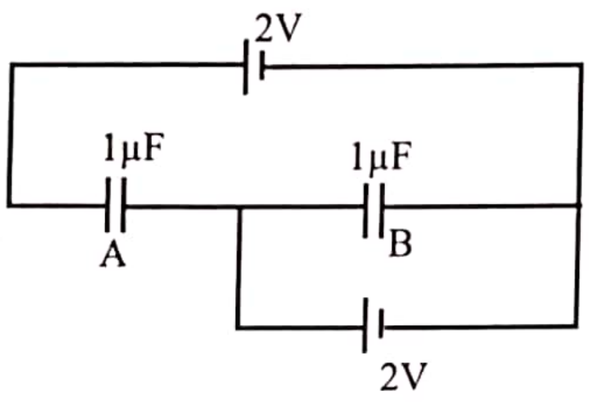
(4)



(5)

09 **Logic Gates**

This is also very simple. Such questions are being discussed many times. As soon as you saw $\overline{B+C}$ you need to think of a NOR gate. Then because of A, you need to think of an AND gate. The answer is (1).

21 

In the circuit shown, charges of the capacitors A and B respectively are

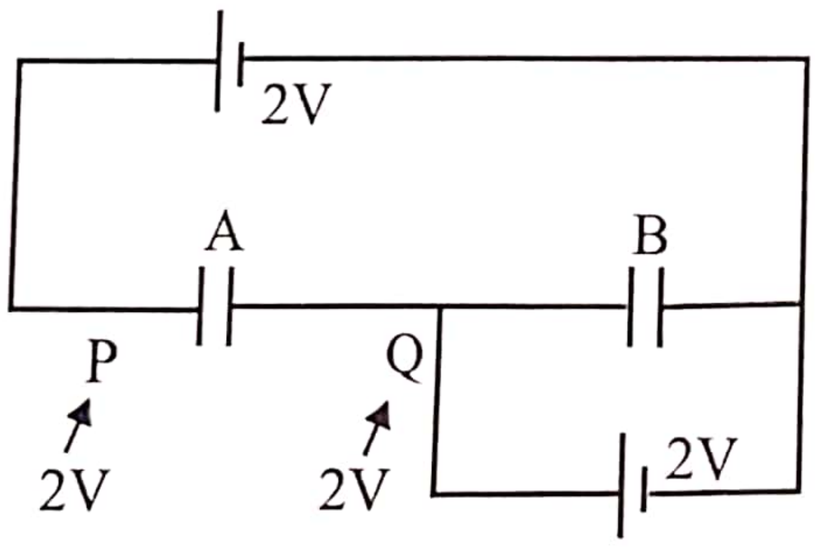
(1) 2 μC,2 μC (2) 1 μC,2 μC

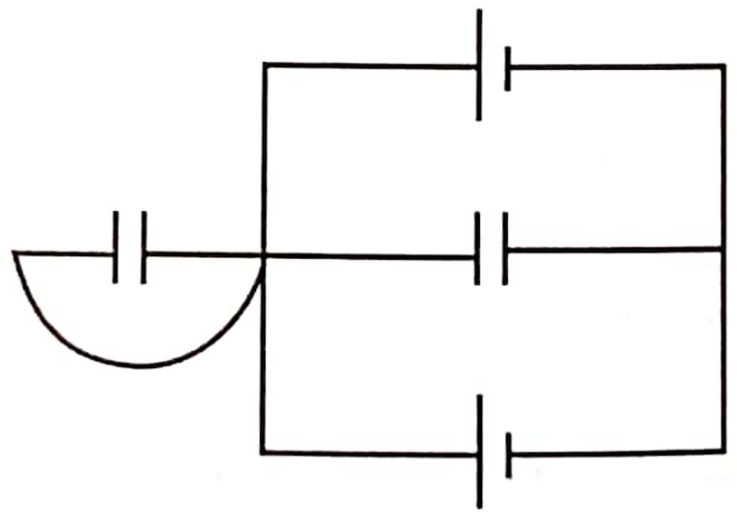
(3) 1 μC,3 μC (4) 0,2 μC

(5) 0,4 μC

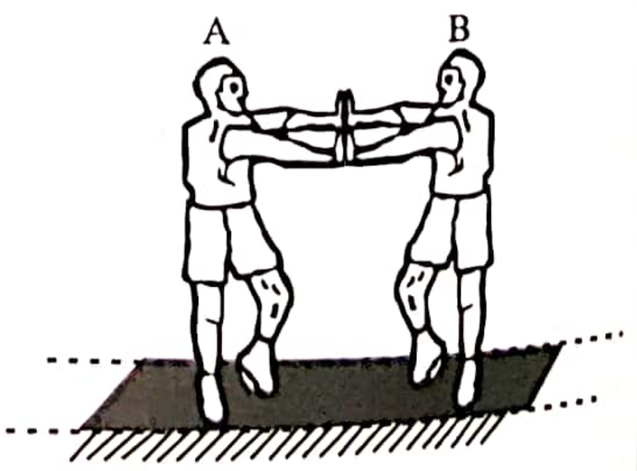
06 **Electrostatic Potential**

This is also simple. But it is little bit tricky. The work will be serious if you do not see that the voltage difference across capacitor A as zero. There is no problem with B. There is a 2 V voltage difference between its plates. Therefore, according to Q=CV the charge is 2 μC. No need to write any equation. The voltage difference across both A and B is 2 V. But the voltage difference only across B is also 2 V. Therefore, there is no way that A can have a voltage difference. Look at the following figure for more details.





22 Two boys, Aand B, standing on a horizontal ice surface move apart by pushing each other. The weight of A is twice that of B.By the time A has moved 4 m the distance moved by B is



(1) 0 (2) 2 m (3) 4 m

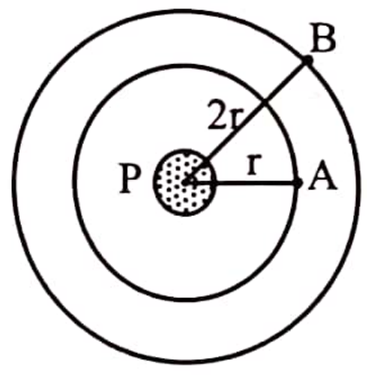
(4) 8 m (5) 12 m

02 **Newton's Law and Momentum**

It has been asked many times in different ways. There is no need for a calculation. As the

weight of A is double the weight of B, when child A goes 4 m, B should go a distance of 8 m. What is there to solve? There is conservation of momentum here. (2 m X 4/t = m X S/t). This expression is written for a joke. Do not do questions like that and get caught. I do not understand that why the examiners have given two boys!

23 As shown in the figure, two satellites A and B of masses m_A and m_B move around a planet P in circular orbits with speeds V_A and V_B respectively. The radii of the orbits are r and 2r respectively. The ratio $\frac{V_A}{V_B}$ is



(1) $2\frac{m_A}{m_B}$ (2) $\frac{m_A}{m_B}$ (3) $\sqrt{2}$ (4) $\frac{1}{\sqrt{2}}$ (1)2

You can use the proportionality method and do it quickly. $V^2 \propto \frac{1}{r}$ ($\frac{mV^2}{r} = \frac{GMm}{r^2}$)

There is no need from m to the question. $\frac{V_A}{V_B} = \sqrt{\frac{2r}{r}} = \sqrt{2}$ Always for questions of satellites or planets, $V^2 \propto \frac{1}{r}$ is true. Therefore, such questions must be practiced to be solved with the proportionality method.

24 Suppose the times taken for a large airplane to accelerate uniformly from 500 km hr^{-1} to 505 km hr^{-1}, a car from 50 km hr^{-1} to 55 km hr^{-1} and a bicycle from 5 km hr^{-1} to 10 km hr^{-1} are the same.

Consider the following statements.

(A) All have the same acceleration.

(B) All travel the same distance during the above time period.

(C) The accelerating force on each is the same.

Of the above statements,

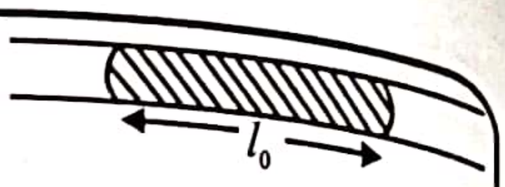
(1) only (A) is true. (2) only (B) is true.

(3) only (A) and (B) are true. (4) only (A) and (C) are true.

(5) all (A), (B) and (C) are true.

This also does not need any calculations. The speed increment of all three can be seen as 5 km/h. It has been given that it takes the same time for the speed increments. Therefore, the acceleration is same in all three. To find the acceleration you need the difference of velocities not the speed of each one. If the velocity difference is the same, and the time taken for that is the same, then the acceleration will also be the same. Therefore (A) is true. Even though the accelerations are the same, the distances are not the same as the speeds are different. You can say this from the general knowledge. You can decide easily that the plane should go more distance than the motor vehicle and the motor vehicle should go more than the bicycle. As the weights of them are different, there cannot be the same force even the accelerations are equal. This is also general knowledge. This can be given to the Common General Paper as well. (Except A) It has been mentioned as a big airplane may be to emphasize its massive weight because light airplanes can be found in the weight of a motor vehicle.

25 A liquid of volume expansivity γ forms a liquid thread of length l_0 inside a tube made of a material of linear expansivity αas shown in the figure. If the temperature is increased by an amount θ, the length of the liquid thread will become



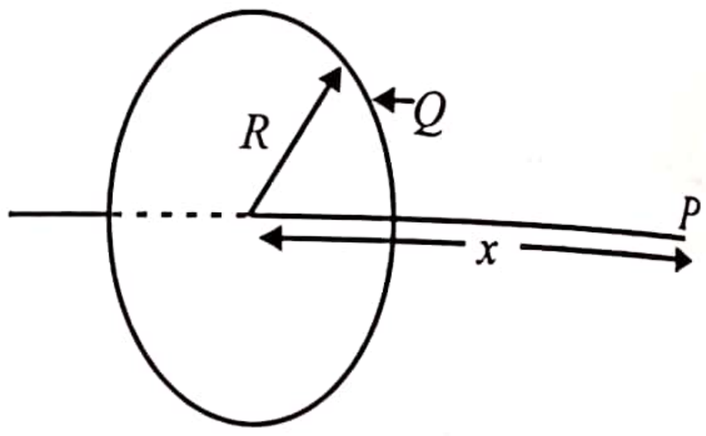
(1) l_0 (2) $l_0\frac{(1+\gamma\theta)}{(1+\alpha\theta)}$ (3) $l_0(1+\gamma\theta)(1+2\alpha\theta)$ (4) $\frac{l_0(1+\gamma\theta)}{(1+2\alpha\theta)}$ (5) $\frac{l_0(1+\gamma\theta)}{(1+3\alpha\theta)}$

04 Expansion of Liquids

This is the 38th question of paper 1994. There is no change. Unfortunate children write equations for this. Initial length of *l*o liquid line gets increased up to l_o (1+γθ). But by that time, the cross section of the tube is more the liquid length must be lessened by a particular amount. Why are you going to write equations for this? Everybody knows that l_o (1+γθ). The cross section goes with 2α. According to that, the correct answer can be (3) and (4). But as the tube is increased with the width the height of the liquid should be lessened by a certain amount. Then (3) cannot be the answer.

By looking at the answers, you can select the answer. It cannot be (1). 2α is in (3) and (4). Does the liquid length is increased in Sri Lanka or America, when the tube is widened?

26 A thin conducting ring of radius R has a charge Q uniformly distributed over it. P is a point on the axis passing perpendicular to the plane of the ring and through its centre. The electric potential at the point P is given by



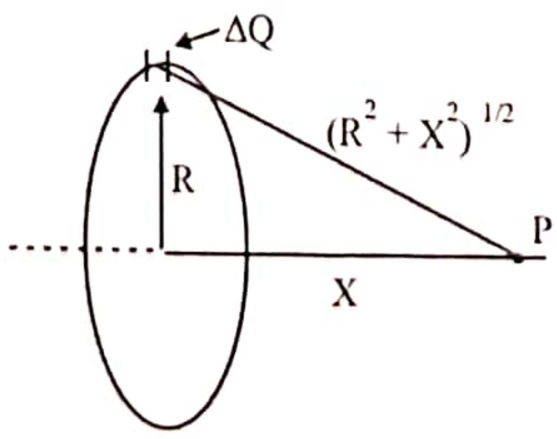
(1) $\frac{Q}{4\pi\varepsilon_0 x}$ (2) $\frac{Q}{4\pi\varepsilon_0(R^2+x^2)^{1/2}}$

(3) $\frac{Qx}{4\pi\varepsilon_0(R^2+x^2)}$ (4) $\frac{Qx}{4\pi\varepsilon_0(R^2+x^2)^{3/2}}$ (5) $\frac{QR}{4\pi\varepsilon_0(R^2+x^2)}$

06 Electrostatic Potential

To find the electric potential in appoint of an axis is not in the syllabus. It is true. But there is no Physics which cannot be renewed. Any child knows the potential of the centre. It is ($Q/4\pi\varepsilon_0 R$). When x=0 is substituted to the given expressions, you should get this. If you think like that only (2) and (5) are correct. As soon as you see (5), you can identify that it does not represent a potential. The denominator has an expression with square of distance. R has put to the numerator to get the dimensions of the potential. I invite the children to solve the question like this. There is no wrong if you can get the answer in a cunning way. For example, think if a child is lost in this question to find the answer. Then in such a situation, what is wrong if the answer can be found from the trick that I mentioned above? The method of finding the answer is not tested in MCQ. Even there is Physics and logic in the trick. That is also a skill you need to take into the life.

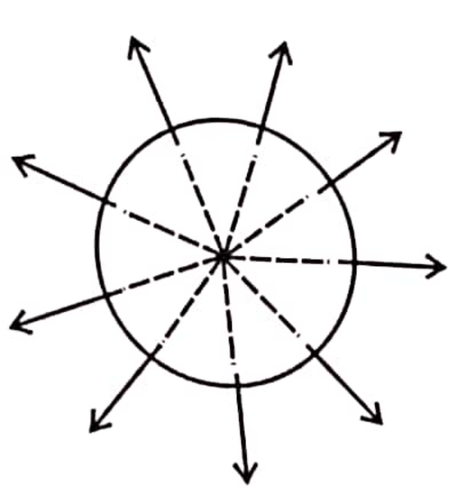
The normal method of getting the answer is by treating a small part of the ring, write the potential for that small charge and then add up the charge to find the total potential. According to the given figure, let us consider a small charge of ΔQ. The distance form that ΔQ charge part to P is $(r_2+x_2)^{1/2}$. Therefore, the potential of P due to ΔQ is $\frac{1}{4\pi\varepsilon_0}\frac{\Delta Q}{\sqrt{(R^2+x^2)}}$



Now the answer is already in the hand. To get the total potential, total ΔQ should be added to the above expression. According to the symmetry, the distance from any ΔQ part to P is the same. So, the total summation of ΔQ is Q.

The correct answer is (2). Actually, there is no need to sum up together. Once you saw the above expression, you can conclude that the answer is (2).

One can think that cannot we write the expression by taking the charge Q to the centre. It is wrong. There is a Q charge in a conducting sphere and you need to write expressions to find the field and the potential for an outside point. For that, it is not wrong to consider as if the charge Q is in the centre.



But why cannot we do like that in a ring? The reason is that in a conducting sphere, the charge is uniformly distributed on the surface and the force lines distribution is unchanged in a point outside the sphere even that charge is brought to the centre. Look at the figure. But it is not so in a ring.

According to the symmetry of the sphere, you can use Gauss Law to find the field intensity of an outer point. Even it proves the above result.

But to find the E of point P, there is no use from Gauss Law. There is no genius who can solve E of P using Gauss Law. There will be no one in the future. To find E of P, you need to find ΔE from a part of ΔQ and start from the first basics. If you want try that (especially mathematics children).

Even if Q is brought to the centre, then the potential of P is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{x}$. If this is correct, the potential should be infinity when $x = 0$. But the potential of the centre is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$.

27. If two cylinders one containing argon gas and the other containing neon gas are kept at the same temperature, then

(1) the pressures of the gases must be equal.

(2) the mean speeds of the gas atoms of the two gases must be equal.

(3) the gas atoms of the two gases must have the same root mean squre speed.

(4) the masses of the gases must be equal.

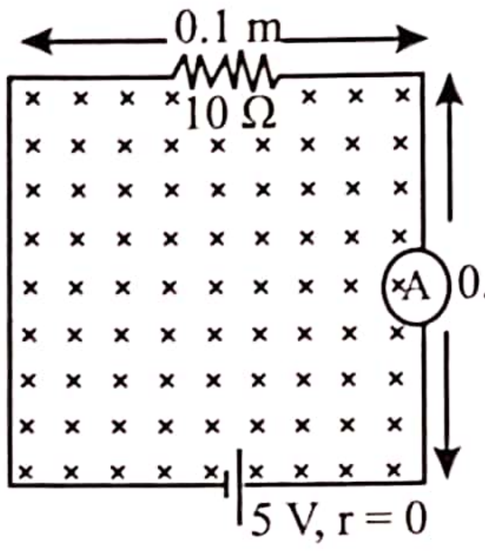
(5) the gas atoms of the two gases must have the same mean translational kinetic energy.

You do not have to think far. The temperature is dependent upon the mean kinetic energy of gas molecules/atoms. The temperature is a measure of the kinetic energy. There cannot be a

child in Physics who does not know about this. Here Argon and Neon have been given as they are mono atomic gases. So, mainly those atoms have the translational kinetic energy only. If the gases are bi atomic gases, then there are vibrational energies and rotational energies around the other atom. One needs to understand that the temperature is not equal even though the pressures and weight are equal.According to $\overline{C^2} = \frac{3RT}{M}$ expression, $\overline{C^2}$ is dependent on M. Therefore, (3) is wrong. It is a known fact that the mean translational kinetic energy of a molecule/atom is 3/2 KT. Here K is Boltzmann's constant.

$$\frac{1}{2} m\overline{C^2} = \frac{m}{2}\frac{3RT}{M} = \frac{3}{2}\frac{RmT}{m\,N_A} = \frac{3}{2}\frac{RT}{N_A} = \frac{3}{2}KT$$

28



The circuit shown is placed in a uniform magnetic field that is acting into the page. This magnetic field is decreasing in magnitude at a rate of 150 T s^{-1}. The reading of the ammeter is

(1) 0.15 A (2) 0.35 A (3) 0.50 A

(4) 0.65 A (5) 0.80 A

You need to think a bit. If you think properly you can do it from the memory. Even though if we neglect the magnetic field there is a current in the circuit. First, find the current which is 0.5 A (5/10). Why do you need mathematics? There is an induced e. m. f in the loop because of the change of magnetic field due to the time. According to Faraday's Law, it is equal to the rate of change magnetic flux. To find the rate of change of flux, 150 must be multiplied by the area. As 0.1 X 0.1 = 0.01, when 150 is multiplied by 0.01, you will get 1.5. You can do that from your memory. Next,we need to solve whether this induced e. m. f of 1.5 V should be added or subtracted with the cell of 5 V. It should be decided from the Lenz Law. If the field is decreasing into the paper, then the reduction should be prohibited to the inside by the magnetic field generated from the current of induced e. m. f. If it does not like to reduce to the inside what else can we do other than giving a support to the same side? Therefore, the induced current should flow in clock wise direction of the circuit. If it flows anti-clock wise the field from it is out of the paper (upwards). Then how can we stop the reduction of the inside? That induced current is 0.15 A (1.5/10). The current from the cell in the circuit 0.5 A goes anti- clock wise. The induced current 0.15 A goes clock wise. So, the net current is 0.35 A (0.5 - 0.15).

Here the main deciding factor is finding the direction of the induced current. It is very easy to find the value and the direction of the current from the cell. It is not hard to find the induced current value. The rate of change of flux gives the induced e. m. f. Once it is divided by the resistor, you can get the induced current. If the direction of the induced current is changed, then you get 0.65 A (0.5 + 0.15). It is also has been given as an answer.

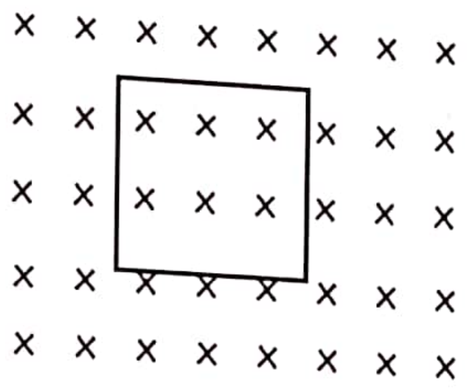
If you simply understand Lenz law, then solving such questions become easy. The nature always opposes to a change. If the flux is gradually reduced then the change is a reduction. Then the nature says "Please do not get reduced" and tries to stop that reduction. If you need to stop the reduction, you cannot do it by reducing more.

If you need to stop the reduction to the inside, then more should be pumped to the inside (to the same direction). If you need to stop the increment of the inside, then pumping should be done to the opposite direction (to the outside). Think simply on these issues.

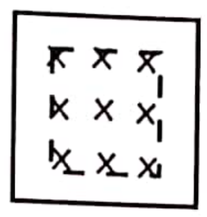
If love is getting reduced, then try to get it increased. But if the love is continuously getting

increased, try to increase more. But according to Lenz Law there can be a logic saying, if the love is continuously getting increased, try to decrease. There is a truth in that. It is troubling when the love is increased more sometimes.

Here I thought to write about a specific point. I felt that most of you all think that, to have an e. m. f, the circuit should cut the magnetic flux lines. Take these two instances.



(i)



(ii)

Do we have an induced e. m. f in the circuit loop in those two instances? It happens in both of them. Most of people think that the induced e. m. f is zero in the second instance. It is wrong. Faraday's law mentions that induced e. m. f of any closed path is equal to rate of change of magnetic flux which is surrounded by an area from the path. According to that, in the first instance, the change of field outside the circuit (situated away from it) is useless. For the second instance, what is needed for the area is the area that situates in the change of field. There it is wrong to take the area of the loop. Always you need to take the flux change that happens inside of the considered closed path. When trying to find the field intensity due to a charge distribution, you need to consider the inside charge distribution of the considered point.

We will solve the question of the paper with respect to (1) and (2) instances. In the first instance, there is no change in the answer. In the second instance, you need to know the area that situates the change of field. If the length and the width of the rectangular shape is 0.1/2 m, then the induced e. m. f in the circuit is (0.1/2 X 0.1/2 X 150) V.

Therefore, the concept of cutting flux lines is a one that we built. Especially when a bar magnet is going across a flux, we mention about this cutting. I do not see wrong in that. There is no wrong if we can get the work done from the cutting concept. But the cutting phenomena is powerless for a conducting loop that is kept still where the magnetic flux is changed with the time.

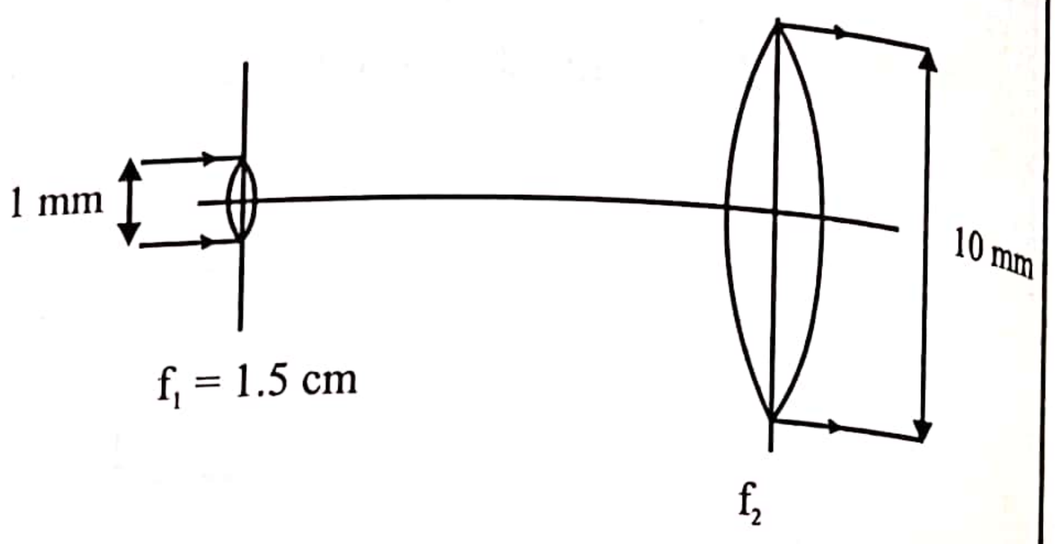
If I describe more, then think that there is no such conducting loop in the question. If there is a rate of change of flux, then this e. m. f will be induced even in the free space where the loop was kept. Then there is no such a thing to be cut. But if there is no conductor, we cannot get an induced current. There is no need of a conductor to generate an e. m. f.

If we go deep into the basics, what happens here is that the rate of change of magnetic flux is generating an electric field in the surrounding. There should be an electric field to have an e. m. f. An e. m. f is the work done by a unit charge when travelling across an electric field. In a change of magnetic fields, there is an electric field. This is the basic principle of electro-magnetism. These two are an interconnected beautiful couple like two sides of the coin.

There are so many couples in Physics (nature). You can write more like, mass-energy, space-time, matter-radiation, wave-particle, electricity-magnetism, matter-antimatter. There are many couples that you do not know (leptons-quarks, fermions-bosons ...). This is how

Physics is inter-related with nature. Do not you have beautiful attractive couples that you know? Male-female, mother-father, daughter-son, flowers-fruits …Where do you have many such beautiful couples? You should also love this beauty.

29 A laser beam of 1 mm diameter has to be converted into a beam of 10 mm diameter using two convex lenses as shown. What is the value of the focal length f_2 of the second lens and the distance d at which it should be placed from the first lens?



	f_2	d
(1)	4.5 cm	6.0 cm
(2)	10.0 cm	10.0 cm
(3)	10.0 cm	11.5 cm
(4)	15.0 cm	15.0 cm
(5)	15.0 cm	16.5 cm

03 Refraction through Lenses

Such questions are given by many times. Parallel rays are incident here. It emits as parallel rays from the second lens as well. Therefore, the distance between the lenses is equal to the total of focal lengths. There is nothing to do rough work. The ray is widened by 10 times. Therefore, f_2 should be 10 times of f_1. Look at the 33rd question of paper 2003. So, f_2 is 15 cm. Do you need rough work to find f_1+f_2? 15.0 +1.5 = 16.5 cm

This set up is equivalent to an astrological telescope that is in normal adjustment. There is no change actually. There are plenty of such questions in the previous papers too.

30 The near point of a defective eye is 50 cm. The lens that should be worn to correct the near point to 25 cm is

(1) a converging lens of focal length 50 cm.
(2) a diverging lens of focal length 50 cm.
(3) a converging lens of focal length 25 cm.
(4) a diverging lens of focal length 25 cm.
(5) a converging lens of focal length 75 cm.

03 Defects of Vision

This is also a famous question. This is the 18th question of 2001. There is no change in it.

1/50-1/25= 1/f Do you need to simplify it? Is not f = -50 cm? If you have done the problems, then you can find the answer even from your memory. It was not rare to find children who got -25 cm. The surprising fact is that the children in Mathematics are also doing the same mistake. I think that they subtract 50-25 and get 25. You should know that the focal length cannot be 25 cm. Can the focal length and least distance of distinct vision be the same?

31 An earthquake which occurred at a certain location generates a transverse wave (S-wave) and a longitudinal wave (P- wave). Both waves travel through the earth, and the p-wave arrives 3 minutes before the S-wave at a certain point on the earth. The average speeds of the S and P waves between the point and the location of the earthquake are 4 km s^{-1} and 8 km s^{-1} respectively. How far away from the point did the earthquake occur?

(1) 40 km (2) 540 km (3) 720 km (4) 1440 km (5) 2400 km

Once there is a lightning, we get the light and then hear the sound afterwards. If the time difference is measured, then the place where the lightning occurred can be found using the speed of light and sound. This is also such a question.

According to your skill, this can be solved from a simple calculation or from the memory. Let us first see how it can be done from the memory. The speed of the P waves is twice as S. Both waves are travelling the same distance. Therefore, the time taken for S should be double the amount for P. Now the answer is in the hand. If the time difference between the waves is 3 min, then for the quickest wave it takes 3 min. Or else it is 6 min for the slowest wave. Otherwise you cannot retain the double value. If you are writing form the equation, think t as the time for the quickest wave, then it is 2t for the slowest wave (as the ratio of speeds are double). Now 2t-t = 3 min t= 3 min

Now all you need to do is either multiply small time by 8 or long time by 4 only. Remember to change minutes into seconds.

Distance = 3 X 60 X 8 = 1440 km or 6 x 60 X 4

This multiplication has to be done. If you forgot to change min into seconds, you will et 24. It is not in the answers set. It is a relief or not a relief according to you.

According to the third method, take distance as d, then d = 8t = 4(t+3). From this you can get t = 3. By looking at 8t = 4(t+3) equation you can get t = 3. 8 is twice as 4. Therefore, t+3 should be double the value of t.

According to your smartness and commitment, the rough work amount can be changed as below.

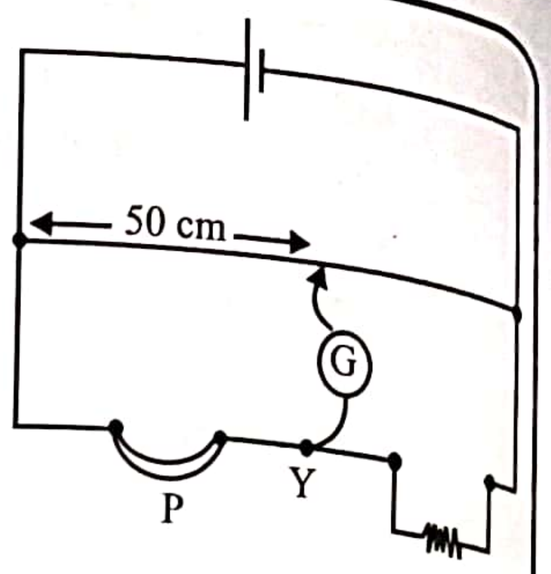
From logic 3 X 60 X 8 = 1440

Second method 2t-t = 3 t =3 3 X 60 X 8 = 1440

Third method 8t = 4(t+3) 2t =t+3 t=3 3 X 60 X 8 = 1440

This method is used to find the place where an earthquake has occurred. When there is an earthquake, longitudinal and transverse waves will be generated. Always the speed of the longitudinal wave is higher. The relevant equations for longitudinal wave speed in a medium are not in the syllabus. But in a medium like iron, you should know from the experience that the logitudinal wave speed high. Even if we take water, the sound speed inside the water is higher than the transverse wave speed on the water surface.

32 The diagram shows a balanced metre bridge. Pindicates a pair of identical resistive wires connected in parallel. When one resistive wire is removed, the new balance length is approximately equal to



(1) 22 cm (2) 44 cm

(3) 55 cm (4) 67 cm

(5) 92 cm

08 Wheatstone Bridge and Meter Bridge

Can you feel that this can be done from memory and logic? First, at 50 cm distance there is the balanced point. So the equivalent resistance of the two wires and the the resistor that is connected in the space of the meter's bridge is the same. Next, if one wire is removed, the resistor on left should be double the initial value. This has been checked by many times. When R and R becomes parallel the equivalent is R/2. When one is removed from the equivalent resistor, R/2 goes to R. Now the answer is in your hand. Now left side resistance is double the amount of the resistance of right side. So, to get the new balanced length 100 cm should be divided into 2;1. Cannot you divide 100 by 2:1 ratio?

These are problems of year 5. 100 X 2/3 =66.7

The near length is 67 cm. Once you see that near value in the question, you need to understand that it is not divided completely.

If the logic is correct, then you can remove the first two choices. When one wire is removed, by logic we get to know that left side resistance is getting increased. Right side resistance is not changed. Therefore, the balanced length should be more than 50 cm. First two answers are both less than 50 cm. Once it is 2 by 1, you should know that you should get 66 by your scent.

This can be solved from the long methods. If the new balanced length is l, then $\frac{l}{2R} = \frac{100-l}{R}$

Why do you work hard like this? When do you learn to divide Rs. 100 in 2:1 ratio?

There was a printing error in Tamil medium paper. So, it was given as 'all'. Instead of two wires with identical resistors, it was printed as two wires with identical resistivity. For many children, they are happy when they get an 'all' question. There is no use of it. Everyone gets the marks. Remember that Advanced Level is a relative exam.

33 Two small plastic spheres, A and B of which A is hollow and B is solid. made of the same material and having the same external radii are released from rest from a tall building. Both spheres reach their terminal velocities before hitting the ground. When the spheres reach the ground

(1) the speed of A is greater than the speed of B.

(2) the viscous force on A is less than that on B.

(3) the viscous force on B is less than that on A.

(4) A has taken a shorter time than B.

(5) both spheres gain the same speed.

10 Viscosity

This idea has been tested before. The speheres are same in size. They are falling in the same medium. As they are same in size, the acting upthrusts are the same. The terminal velocity of the heavy sphere is higher than the terminal velocity of the light sphere as the heavy sphere take much time to reach the terminal veolcity. These sentences are checking these facts. It has been mentioned that spheres acquire their terminal velocity when they reach the ground. A is the light sphere whereas B is the heavy sphere. So, the speed of A cannot be greater than B. The speed of A is less than B. Therefore, when it hits the ground, the viscous force ($6\pi\eta av$) is less than the value of B. (2) is correct. If (2) is correct then (3) is wrong. Anyhow as (2) is correct, there is no need to check others. But later on when you are studying, you can go back and learn lot of things.

Which sphere takes much time? The light sphere comes to terminal speed quickly. But as the heavy sphere is accelereated for a long time before coming to the terminal speed, it reaches the ground quickly. Therefore, the time taken by B is less. Choice (5) is automatically wrong.

All these points are mentioned in the 52nd question of paper 2000. There is no such a sin from A/L students to write equations for these type of questions.

34

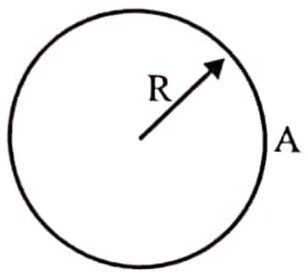


Figure I

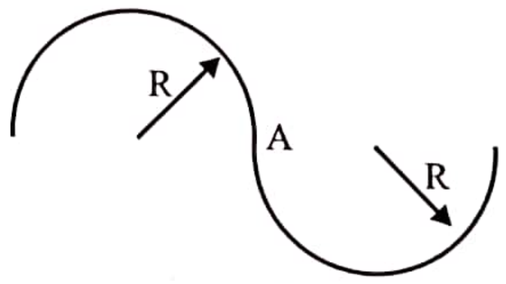
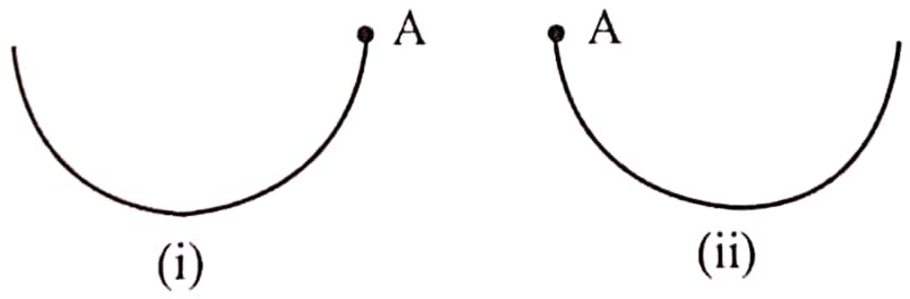


Figure II

The moment of inertia of a ring of mass M made of a uniform thin wire about an axis through the point A (figure I) perpendicular to the plane of the ring is $2MR^2$. When the ring is bent to a S shape as shown in figure II, the moment of inertia about the same axis is

(1) 0 (2) $\frac{1}{2}MR^2$ (3)MR^2 (4) $\frac{3}{2}MR^2$ (5) $2MR^2$

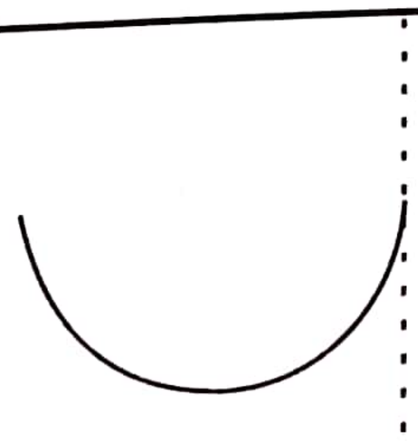
If you get the logic correctly, there will be no time to solve this question. Actually, students say that MCQ questions of Physics (some of them) are hard and time consuming because they do not see the logic or the easiest way to solve. If you catch the logic of hard questions, then you can get the answer in 5 s. This question was hard for many as I got to know. There is a simple logic here.



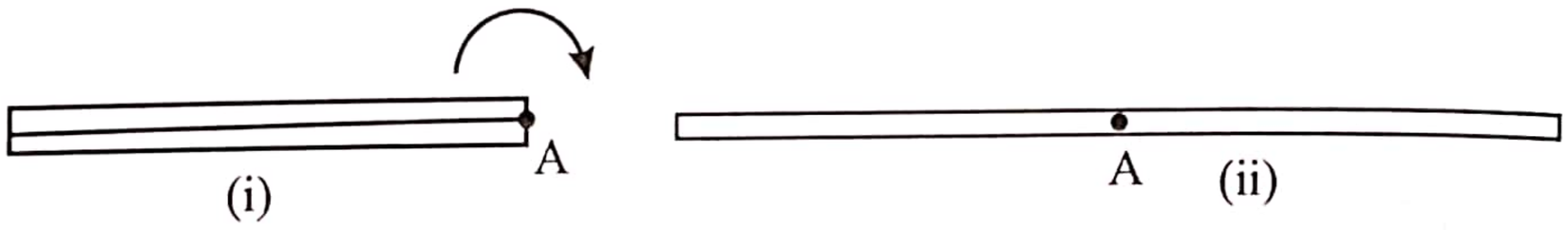
(i) (ii)

If the wires of I and II are identical, how can the moment of inertia be changed? Will the rotational motion change if left hand is cut and connected to right hand? (Right hand must be put to the place of left hand.)

The moment of inertia is dependent on the mass and the square of the distance from the rotational axis (r^2). If the mass is unchanged, then with r or -r the moment of inertia in not changed.

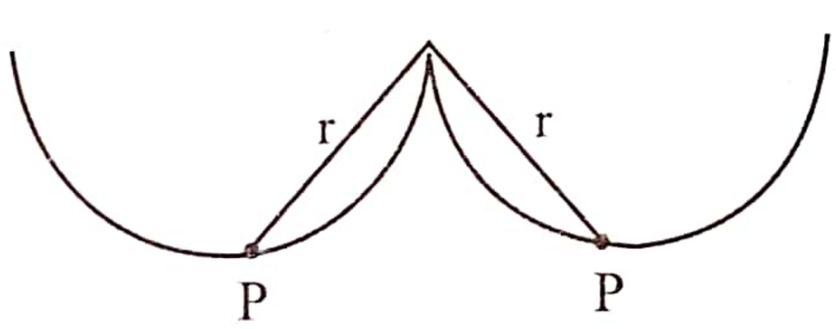


Will the moment if inertia will be changed if this semi-circle is rotating with the shown axis has come to the right-hand side? Once it is rotating, it goes around every location of the axis. Therefore, the answer is $2MR^2$. You do not have to know about how to get $2MR^2$. Another example is below (using two rods).

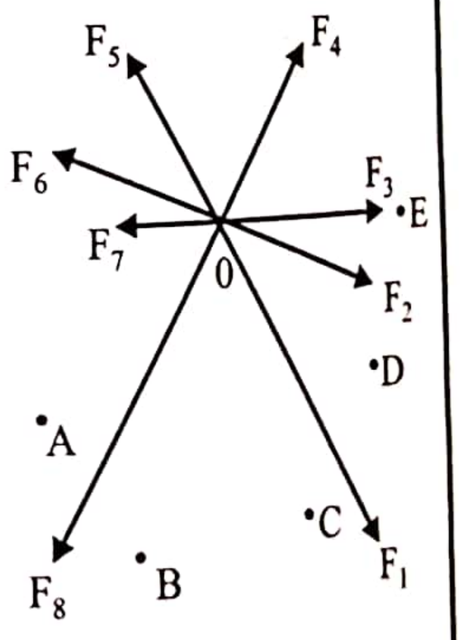


The moment of inertia is same in the above instances. If moment of inertia goes with r instead of r^2, then when the top rod is taken to the right, the moment of inertia across A gets zero. If so, in the second instance, there is no rotational inertia. Great! Nature (Physics) will not act in a foolish way! This can be described in a simple way.

For the point P which is in r distance, there is another point called P' with the same distance and symmetry. It is true for every particle. Therefore, Physics principles cannot be changed for these two instances. You really see your beautiful face from the mirror.



35 A system of coplanar forces F_1 and F_8 drawn to scale act on a point object O as shown. The resultant force will most probably be a vector represented by



(1) $\overrightarrow{OA}$ (2) $\overrightarrow{OB}$

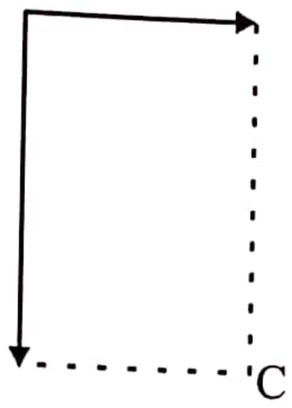
(3) $\overrightarrow{OC}$ (4) $\overrightarrow{OD}$

(5) $\overrightarrow{OE}$

02 ***Equilibrium of forces***

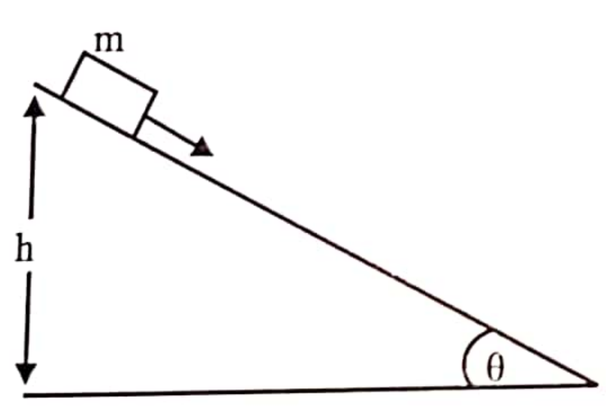
You can finish easily if you start from the correct place. Truly, you do not have to draw. F_2 and F_6 can be forgotten because they are equal in magnitude and opposite in direction. Therefore, F_2 and F_6 are cut off from each other. Now the resultant of F_4 and F_5 can be seen to be in vertically upwards direction. Likewise, the resultant of F_1 and F_8 can be seen in vertically downwards direction. These forces are drawn so that their resultants are being situated in vertically upwards and downwards directions. The downward resultant of F_1 and F_8 is greater than the upwards resultant of F_4 and F_5. Therefore, the resultant of two resultants is in vertically downwards direction.

Now have your attention on F_7 and F_3. As $F_3 > F_7$, the resultant force of these two forces lies towards F_3. Actually, theresultant of F_3 and F_7 is half of F_3. Now what is left is a vertically downward force and a horizontal force to the right. As these forces are perpendicular (horizontal and vertical), the resultant should lie across half way of F_3 which is drawn down. Point C is the only point that lies on that drawn downwards line.



If we summarize, F_2 and F_6 are cut off.The resultant of F_4 and F_5 is vertically upwards whereas the resultant of F_1 and F_8 is vertically downwards. The resultant of them is again downwards (resultant of F_1 and F_8> the upwards resultant of F_4 and F_5).

This can be looked in another way. If we reduce F_5 from F_1 and F_4 from F_8, then the residual forces are along F_1 and F_8. Now the resultant of the residual forces is clearly in vertical downwards direction. When F_7 is reduced from F_3 the rest is towards F_3 side. That means the resultant should lie on the vertical line which is drawn from nearly the centre of F_3. It is C. Any other point is not drawn near to that. Examiners will never do such a thing. Once F_2 and F_6 are cut off, if we decide that the net of F_1, F_5 and F_8, F_4 is downwards and the net of F_3 and F_7 is towards right, then points A and B are removed automatically. As F_1 is nearly half of F_3, points E and D are cut off. Here it is mentioned how the question is solved from the theory of removal. If you do not have the logical power with eagle eyes, after 5 minutes you can solve this question.

36 

A wooden block of mass m is sliding down an inclined plane at constant speed from a height h above the ground as shown in the figure. The total energy dissipated due to friction by the time the block reaches the bottom of the plane is

(1) $\frac{mgh}{\cos\theta}$ (2) $\frac{mgh}{\sin\theta}$ (3) $mgh\ \tan\theta$ (4) mgh (5) 0

You will be again confused if you do not use the logic. Pay attention to the words that are being bold. It was bold because it is important. If you catch the logic, then you can get the answer without any rough work. If the mass is coming in a constant speed, then its kinetic energy is not changed. If the kinetic energy is unchanged, then what happened to the initial potential energy? It should be completely equal to the dissipated energy due to friction. If not, it is equal to the work done against the friction.

First method: According to the above logic, you can decide that the answer is mgh. No rough work.

Second method: Using conservation of energy thinking there is friction (in a height of h and to the bottom of the inclined plane) $mgh + 1/2\ mV^2 = \frac{1}{2}\ mV^2$+ the energy wasted on friction

There is little bit of rough work.

Third method: Coming with a uniform speed means the acceleration is zero. If so, the frictional force is equal to parallel component of the weight to the inclined plane (mg sin θ).If the length of the inclined plane is l, the work done against friction = mg sin θl =mg (h/l) l =mgh

There is more rough work. You can choose any method that you like.

37 Two identical conducting spheres A and B carry equal charges. The spheres are separated by a distance which is much larger their diameters. The electrostatic force acting between them is F. Now a third identical uncharged conducting sphere is first made to touch A and secondly B, and then removed. The new value of the force acting between A and B is

(1) 0 (2) $\frac{F}{16}$ (3) $\frac{F}{4}$ (4) $\frac{3F}{8}$ (5) $\frac{F}{2}$

06 **Electric Field intensity and coulomb's Law**

Here you have simple arithmetic with dividing equal concept. As the two spheres are identical, once they are touched whatever they have, they divide with each other. Let us take Q as the charge of each sphere. When the sphere with no charge is touched with A, A has Q on it. Third sphere has nothing. Therefore, they mutually divide Q with each other. Then A gets Q/2 and the third sphere gets Q/2. Now the third sphere with Q/2 is touching B. B has Q. Now the total charge is 3/2Q (Q+Q/2). Once that is divided B get 3/4Q. That means half of 3/2Q. The initial electric force F is proportional to Q^2. Now that force is proportional to $\frac{Q}{2}\frac{3Q}{4} = \frac{3}{8}Q^2$. So, the new force is 3/8 F.

It is enough to write $\frac{Q}{2}\frac{3Q}{4}$ in the rough paper. No need to write $F = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$ for F.

The distance of A and B has not been changed. Always when there are two instances, if you seek the help of the proportionality method, then it saves time. The residual charges on spheres, you can do it from your memory. Q and Q/2. Half of $1\frac{1}{2}Q$ is 3/4Q.

38 The standard length of the filament of a 60 W, 230 V electric bulb has shortened due to a certain defect. When this bulb is glowing,

(A) it will glow brighter and consume more power than a standard 60 W bulb.

(B) the wavelength corresponding to the maximum intensity of the light emitted will be lower than that due to a standard 60 W bulb.

(C) surface temperature of the glass envelop of the bulb will be at a higher temperature than that of a standard 60 W bulb.

of the above statements,

(1) only (A) is true. (2) only (A) and (B) are true.

(3) only (B) and (C) are true. (4) only (A) and (C) are true.

(5) all (A), (B) and (C) are true.

08 **Kirchhoff's Law - Combinations of Cells**

These three sentences are inter-connected. (A) is correct. When the filament is short, its resistance is less. Then the consumed power gets increased. ($\frac{V^2}{R}$, R is reduced) This question has been asked early regarding an iron. In the 54th question of paper 1986 and the 30th question of 1991, when the coil of the iron gets short, its power is increased.

When a filament is broken in a bulb, you can shake a little to fix and the light bulb can be used again (Especially when I was small, I had done such things.). But due to high power, it gets heated more. So, the bulb cannot be used for a long time. There is a high tendency to burn the filament again. As the filament get heated, its temperature goes up. Therefore, according to Wien's displacement law in black body radiation, ($\lambda_m T$ = constant)the corresponding wavelength λ_m to maximum intensity gets less. (B) is correct. (C) is just a statement. If the filament gets heated more, then it is unnecessary to know Physics to decide that (C) is correct. It can be decided from the general knowledge too. All (A), (B) and (C) are correct.

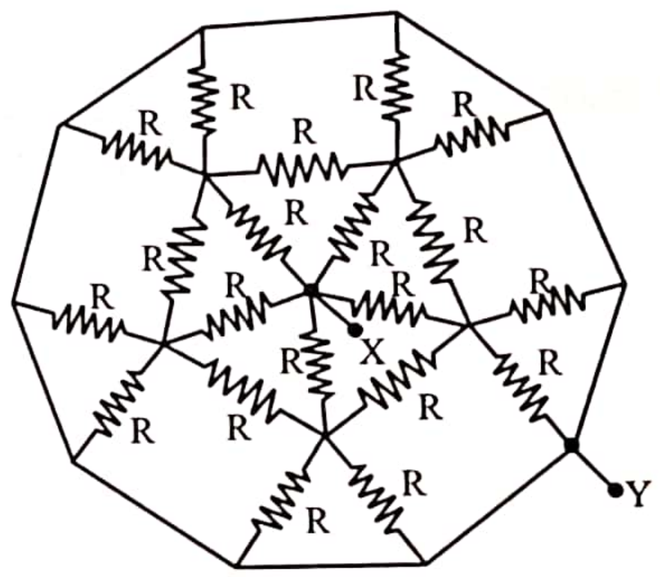
39 A long uniform wire of resistance R is cut into n number of pieces of equal length. These pieces are bundled together to make a composite wire of length that is the length of a piece. The resistance of the composite wire is

(1) R (2) nR (3) n^2R (4) $\frac{R}{n}$ (5) $\frac{R}{n^2}$

This can be done instantly from the memory. The resistance of one piece should be R/n as it is cut for n pieces of equal length. By making a bundle from those pieces means that they are being connected parallelly. When n number of R/n resistances are connected parallelly the equivalent resistance is R/n^2. Writing equations for this is one of the five sins. Once they are connected parallelly, the equivalent resistance should be lesser even more. The only expression with less than R/n is R/n^2.

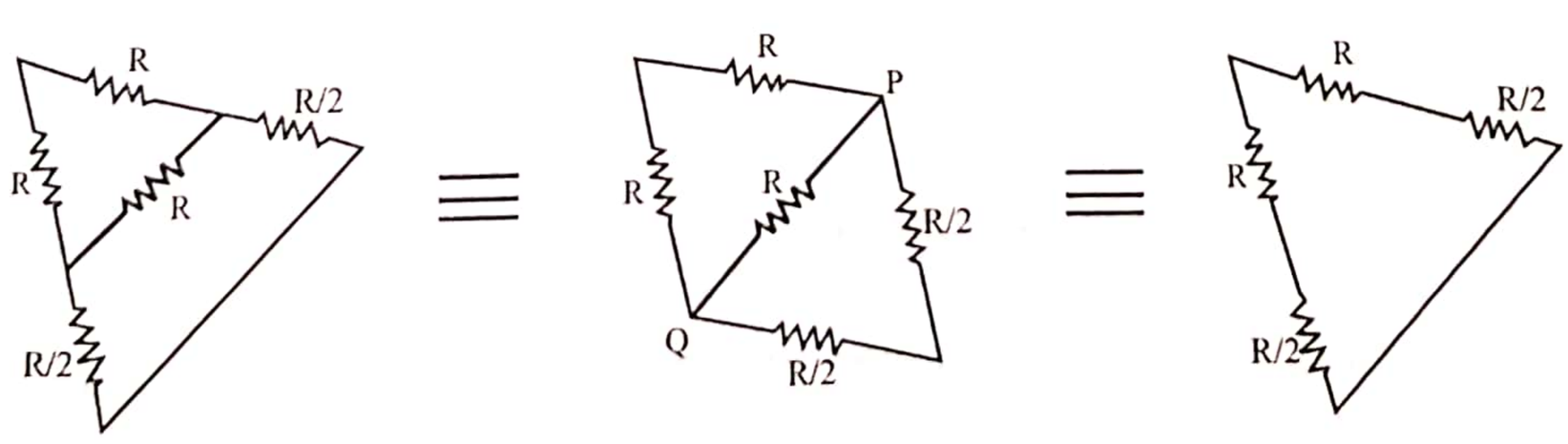
40 Resistance across XY of the network shown is

(1) $2R$
(2) $\frac{3}{2}R$
(3) R
(4) $\frac{2}{5}R$
(5) $\frac{3}{10}R$

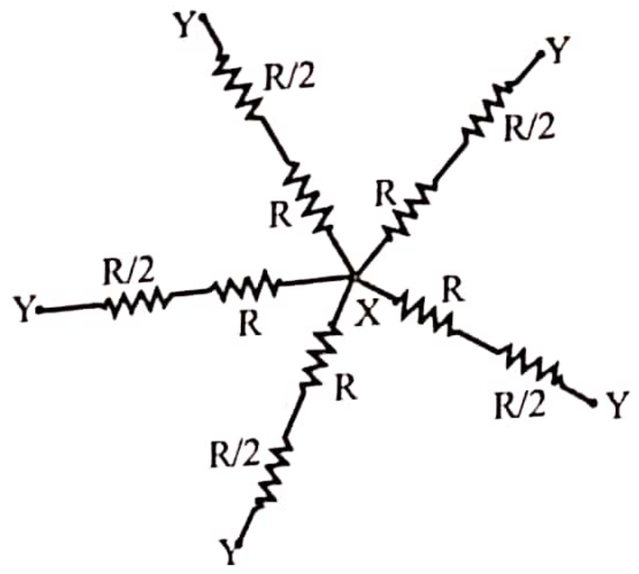


You can come out of this mess if you hold the rope from the correct place. Otherwise, you will not be able to solve for a long time. There are Wheatstone bridge part/s in such networks. If not, you cannot come out of this question. Therefore, check whether you have a network of Wheatstone bridge carefully.

Actually, same potential is there around the Vesak lantern. Because there are no resistances in the sides. So, if we consider a pentagon, it will look like this.



The corner R of each corner is parallel to each other. It can be seen easily. After that, if you see the above Wheatstone bridge, then you are done. That means, there is no use from the middle R (as P and Q points are in the same potential).



The rest is very easy. Now R and R/2 are in series. Their total is 3/2R. How many arms like that are around? There are five. They are also parallel to each other. When five 3/2R are in parallel, the equivalent is 3/10 R. Is not it? If you do not get a way to solve such questions, just leave them. If not choose randomly with a blind sight. If you do not release, you can do this for the two hours. If so, it is hard to come out as you go deeper and deeper in it.

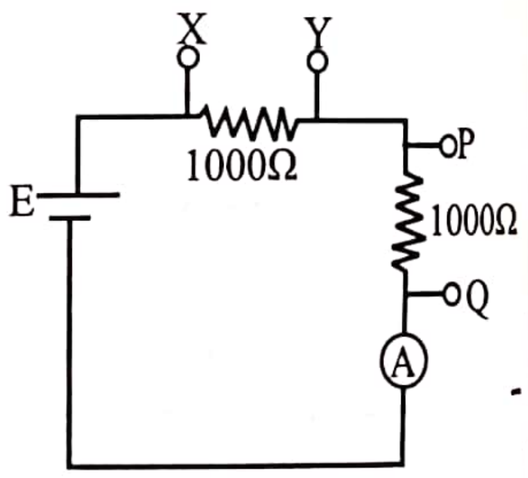
41 A point source of sound emits sound emits sound equally in all directions. For such a situation the sound intensity at a point is inversely proportional to the square of its distance from the source. If the intensity level at a distance of 5 m from the source is 70 dB then the intensity level at a distance of 50 m from the source is

(1) 30 dB (2) 40 dB (3)50 dB (4) 60 dB (5) 80 dB

03 ***Intensity of Sound***

This is the 48th question of paper 2004. There is only a difference in the numbers. If you do such decibel questions in rough papers, then you are not in the correct track. As the distance is increased from 5 m to 50 m, the increment of the distance is ten times. As sound intensity is inversely proportional to the square of the distance, the reduction of intensity is 100 times for a 10 times distance change. The change of decibel according to 100 (10^2) is 20. This has been described repetitively in previous reviews. Therefore, the new intensity level is 70-20, 50. This can be done in 5 s.

42 In the circuit shown the cell E and the ammeter A have negligible internal resistance.



When a voltmeter having internal resistance of 2000 Ω is connected across XY,

(1) the voltage across XY drops and the ammeter reading decreases.

(2) voltage across PQ increases and the ammeter reading drops.

(3) voltages across XY and PQ remain the same.

(4) both the voltage across PQ and the ammeter reading increase.

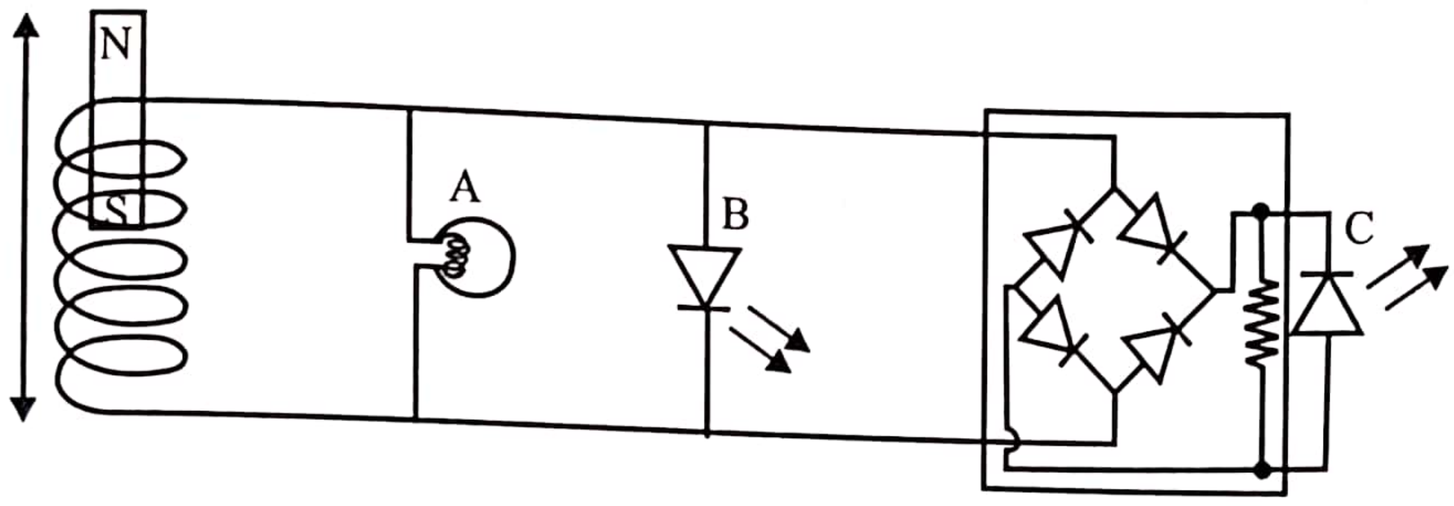
(5) voltage across PQ remains the same and the ammeter reading increases.

08 ***Ohm's Law Combination of Resistances***

This is also a very easy problem. You do not have to write any equation. There is a simple logic. When the voltmeter with internal resistance 2000 Ω is connected across XY, the equivalent resistance is reduced up to 1000 Ω. This is not needed to calculate. You can just decide that. Then the current in the circuit is definitely increased whereas the voltage difference across PQ

is increased. Then the potential difference across XY should be reduced. The total potential difference of PQ and XY should be equal to E (as there is no internal resistance in the cell). The answer of ammeter reading is reduced are cut off. As the current is increased the potential difference of PQ should be definitely increased. The correct answer is (4).

43



In the figure shown, A is a torch bulb, B and C are light emitting diodes. If a strong bar magnet is moved up and down continuously at a high rate through the coil and generates an ac voltage of peak amplitude 4 V,

(1) onlyA will light up.

(2) onlyA and B will light up.

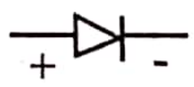
(3) onlyB and C will light up.

(4) onlyA and C will light up.

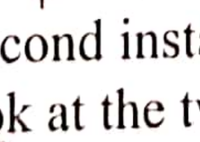
(5) all A, B and C will light up.

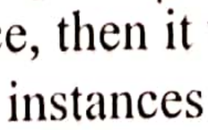
This is a different type question. It has been given that an alternative voltage is generated when the magnet is moved up and down inside the coil. You should know that, even if it was not given. It has been mentioned that 4V is generated by it to hint that it gets an adequate voltage to light the bulb. We know that the generated voltage here is not direct and constant. The voltage is fluctuating. Therefore, the bulb is not glowing with the same brightness. The brightness can vary (theoretically).But it has mentioned in the question that the magnet is moving at a fast rate up and down continuously. That indicates the variation of the brightness of the bulb is not caught from our eye. The frequency of our main power voltage is about 50 Hz. Therefore, even though we get an alternating voltage, we have not seen flickering bulbs. Due to the 'fast rate' word we can decide that we see the bulb glowing in the same way.

However, it has not been mentioned in any choice that the bulb or LED is flickering. It has mentioned only as 'lit'. So, there cannot be a problem in that.

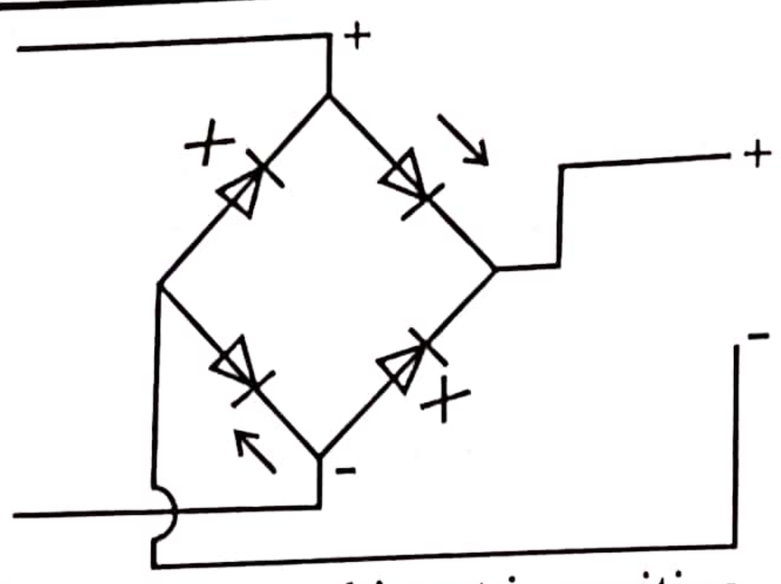
To light a LED, the left side must be at a higher potential than the right side. 

When we consider LED of B, its two ends are changed with +,- with time. But as the magnet is moving very quickly, LED can be seen as continuously lit. Lighting of the bulb is a sense that we can feel. If it was given as there is a continuous flow of current across LED of B, then it is wrong. The flow of current is not felt by ourselves. Therefore, in an alternative voltage, even if there is no current across Bin one half, there is no wrong in taking as the bulb is lit.

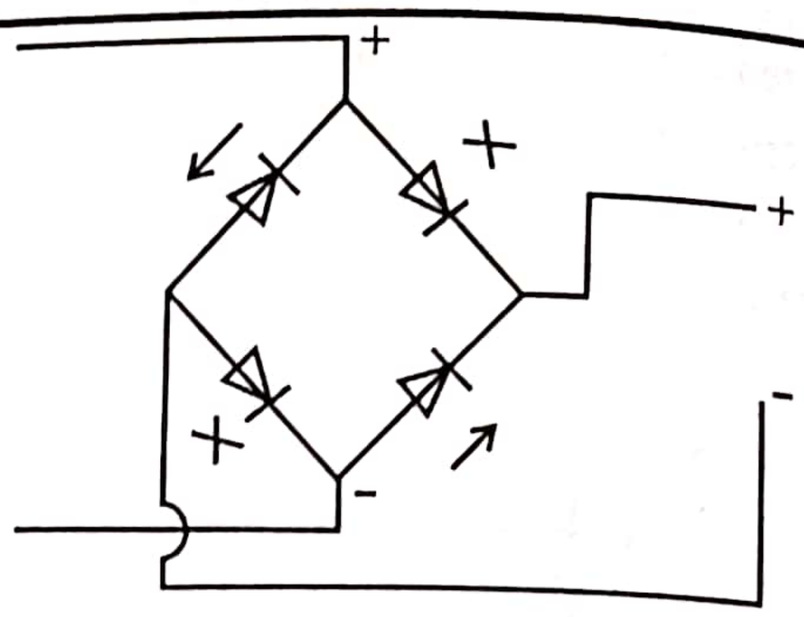
LED C has been connected to a (full wave) rectification circuit as seen. Now there is simple voltage across C. There is no change of +, - sides. So, we need to look at what is given by the rectification circuit across C. It can be either 

or. 

If it is giving the first instance, then the bulb is lit whereas if it is the second instance, then it will not lit. To decide that we need to study the rectification circuit. Look at the two instances below.

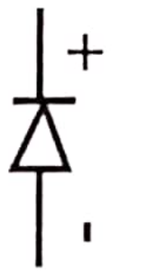


When the upward input is positive



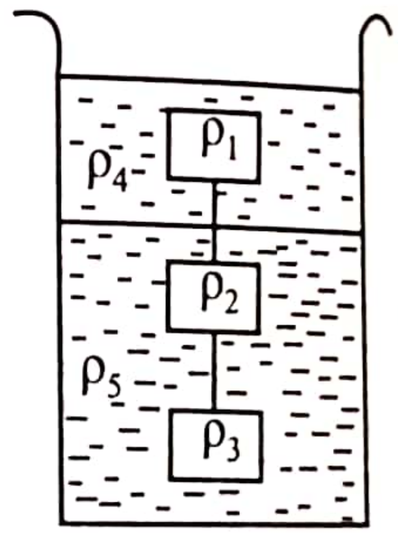
When the upward input is negative

It has shown from the arrow→ about the direction that the current flows. X shows that the current does not flow. It is clear that from the side that LED C has been connected, it is not lit.



Actually, for the sake of completion, the above two instances are mentioned. But one instance is enough to decide whether C is lit or not. Because if one instance is decided, then you should get it from the other also. The polarity of the output is not changed by a rectification circuit. Therefore, when one instance is considered across a rectification circuit we can understand as + on top of C or – as in the bottom of C. Even if it is enough if you can consider only side. When you see the top of C as +, you can decide very quickly that C is not lit.

44 Three masses made of materials having densities ρ_1, ρ_2 and ρ_3, and of equal volumes are connected together with light strings. The system floats in a vessel containing two immiscible liquids of densities ρ_4 and ρ_5 with strings taut as shown in the figure.



Consider the following conclusions made about the system.

(A) $\rho_1 < \rho_5$ (B) $\rho_1 < \rho_3$

(C) If the tensions of the strings are equal, then $\rho_2 = \rho_5$.

Of the above conclusions,

(1) only (A) is true. (2) only (C) is true.

(3) only (A) and (B) are true. (4) all (A), (B) and (C) are true.

(5) all (A), (B) and (C) are false.

02 Hydrostatics

This will be a lengthy process if you keep on writing equations. Never try to write equations. Get it from the logic. When there are inequalities, lot of children get confused as I think. You need to consider about inequalities too. This one is better than the other one. Or else looking good. These are inequalities. The two liquids are not mixing. It is general knowledge to know that the top liquid is with less density than the bottom liquid. So, $\rho_4<\rho_5$.This has not been asked directly. You can just think that $\rho_1< \rho_4$. That is because the top mass is balanced due to an acting downward force (tension). It is like the equilibrium of a cork that is being connected

to the bottom of a water container by a string.

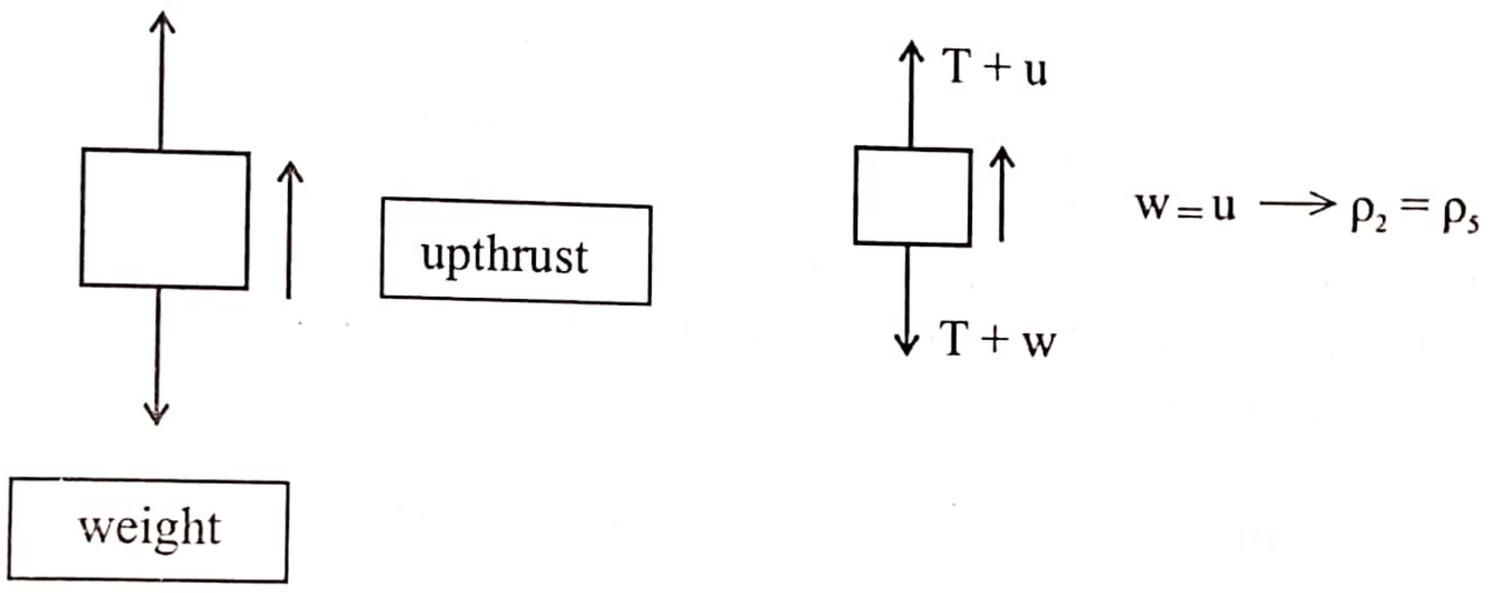
Now $\rho_4<\rho_5$, $\rho_1<\rho_4$

2 3 1 2

With these two inequalities, we get $\rho_1 < \rho_5$. To clarify this, put some numbers like above. But you do not need these. From ρ_1, ρ_2 and ρ_3, you can see that lowest is ρ_1, then ρ_2 and highest is ρ_3. This is general knowledge. My goodness! The top has the mass with least density. The bottom has the mass with highest density. What more can happen as all masses have the same volume. As the volume of each is equal their weight is proportional to their densities directly. If the volumes are different, then less dense one can have more volume and its weight could have been greater than the mass with highest density. To avoid this, equal volumes are given.

So, to judge $\rho_1 < \rho_3$ all you need is a brain of my size. Next if needed, you can think that $\rho_3 > \rho_5$. That is because ρ_3 is balanced by the upward tension of the connected string (it is given that the string is stretched).

If the tensions are equal, the only two forces acting on ρ_2 is weight and upthrust. Therefore, clearly it should be $\rho_2 = \rho_5$.

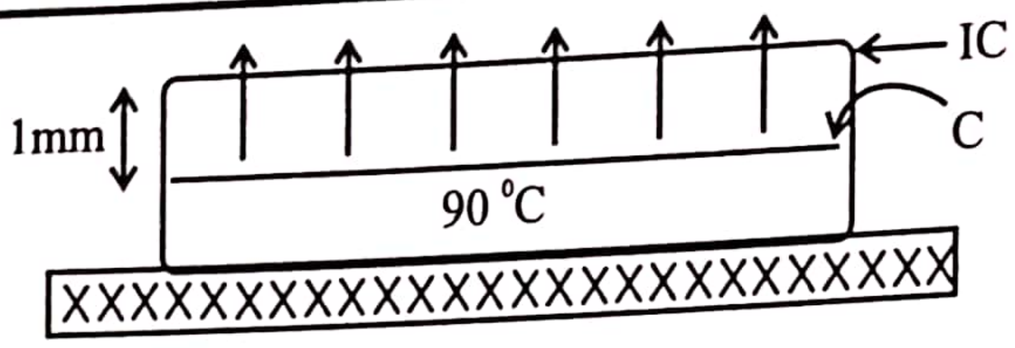


This is equal of keeping an egg inside the water after dissolving salt. Then the density of the egg is equal to the density of the salt solution.

So, all the statements are correct. You need to think such problems in a simple way. Do be tempted to write equations as soon as you saw the question. Such complex problems are not given fro MCQ.

If we summarize, think like this. The density of ρ_1 is less than ρ_4. But ρ_4 is less than ρ_5. So, (A) is correct. Once you look at the three masses (B) is correct. As the tension is equal ρ_2 is balanced by the weight and the upthrust only. Therefore, (C) is also correct.

45



The figure shows a cross section of an integrated circuit (IC) mounted on a circuit board. The core (C) of the IC (the electronic circuit) dissipates 60 W of power as heat. The core is covered with a material of thermal conductivity 6 W m^{-1} K^{-1}. The direction of heat flow is shown by the arrows. The top surface of the IC is cooled by forced convection. The top surface has an area of 10 cm^2 and the distance from the core to the top surface is 1 mm. At what temperature the top surface be kept in order to maintain the core at 90^0C? (Assume that no heat flows through the bottom surface and the sides.)

(1) 70^0C (2) 80^0C (3)89.9^0C (4) 91^0C (5) 100^0C

04 **Conductivity**

Once you remove all the unwanted facts, this is a question where you just have to apply the equation of heat conductivity. The problem is beautiful along with the description. It is a truly practical problem. It is relevant to the computer. In that case, a fan is activated and get the things done. Just substitute.

$$60 = \frac{6(90-\theta)}{10^{-3}} \times 10 \times 10^{-4}$$

$$10 = (90-\theta) \quad \theta = 80$$

It simplifies nicely. But the unites must be substituted properly. Units must be changed to mm, m and cm^2, m^2. Otherwise, the work will be worsened. However, you can smell the answer as either (1) or (2). As the answer should be less than 90, it cannot be (4) and (5). Choice (3) is a confusing answer. The problem does not talk about a near value. Otherwise, 89.9 is like 90. So, this cannot be an answer.

These are true values. In the CPU of the computer the temperature rises up to 90^0C. This is also a high temperature. But if the fan does not work, then the temperature can go even higher. If so, the computer can get a break down as the ICs in it can get over heated. Therefore, if the fan is not working, then the usage of the computer is not advisable. Because of the description of this question, it gets lengthened. It is true. But as you read it, just grasp what is needed and understand that it is just another heat conductivity question. Filtering what is need from the unwanted crap is a skill that you should have.

46 An ideal gas undergoes the cyclic process ABCA in the PV diagram shown. BCis an isothermal path. The work done by the gas during one cycle is nearly equal to

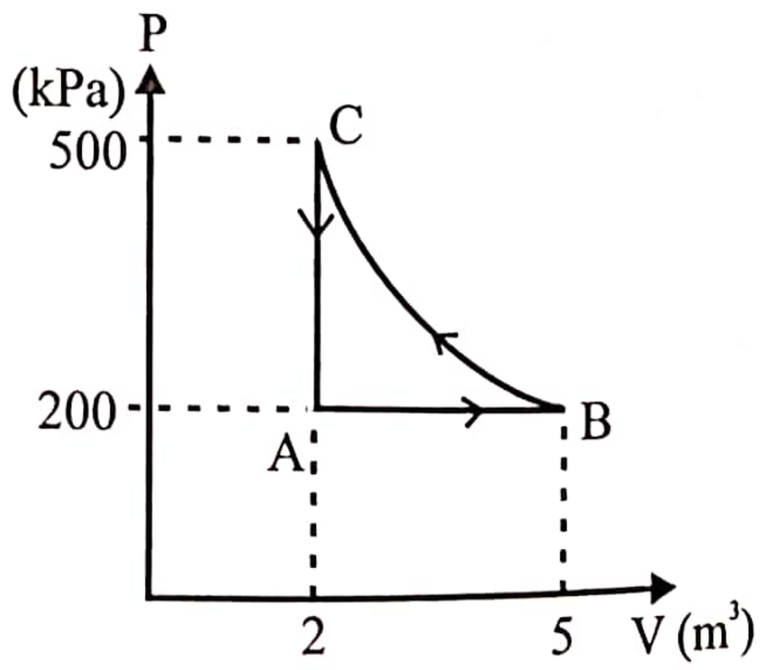
(1) 600 kJ

(2) 300 kJ

(3) 0

(4) -300 kJ

(5) -600 kJ



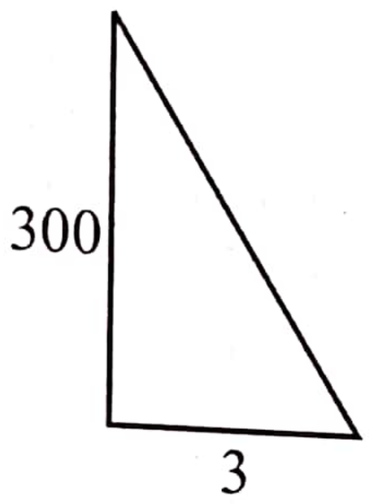
04 **Thermodynamics**

You can get the answer quickly, if you get in to the track. Previous questions have been given with BC section in a straight line. Look at the 20th question of paper 2004 and the 23rd

question of paper 2005. From the previous questions you know that the work done can be obtained by the area enclosed by ABC. But BC part is a curve not a straight line. Then how to find the area? What should be done? The questions mentioned a story of being nearly equal. This indicates that the accurate answer cannot be obtained. So, what you can do is think it as a triangle and find the area. Then find the answer which nearly has a less value (numerically) amongst the answers. Area = ½ X 3 X 300 = 450

↓ (5-2)

First, it should be decided that whether the work done is + or -. In a PV curve, if the arrows are going anti-clockwise, then the net work is (-). If the arrows are going in the clock wise direction, the net work is (+). I have mentioned this in the previous reviews. Therefore, here there is a negative work. So, the only answer that is nearly equal -450 (numerically less) is -300. If any other answer would have given you cannot do this.

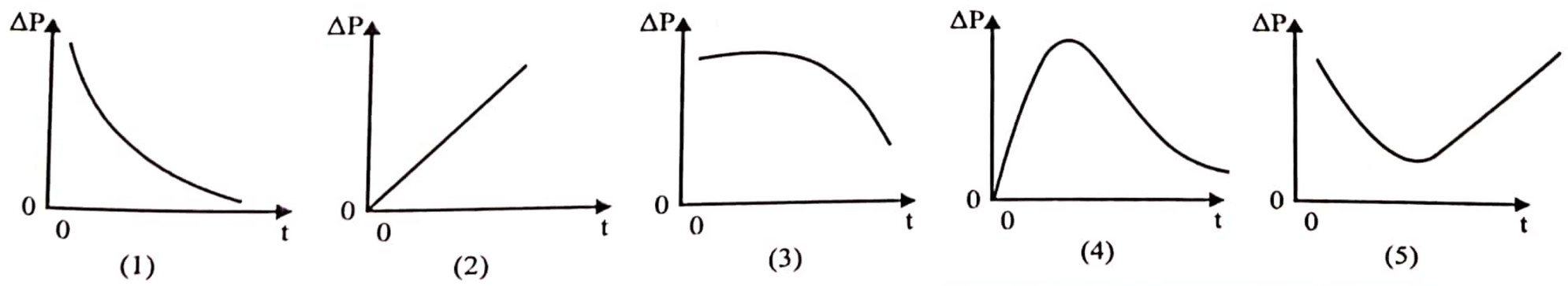


Even if you cannot find a way to solve the problem, there are only two choices with negative work. Therefore, if you choose blindly, you have (4) and (5). From that the probability of getting the correct answer is increased by 50%.

It is practical to be an isothermal curve than BC being a path of straight line. But you do not have to be excited from the isothermal story. However, when the temperature is constant, you know that PV graph is a curve (Boil Law).

As the answers are in KJ, there is no need to transform kPa into Pa. If you keep on thinking, then you cannot get the answer. You should think like this. To find the work, we need to find the area enclosed by ABCA. As BC part is a curve, you do not know how to find that part's area. Then what can you do? You know how to find the area of ABC triangle. Even the answer is being asked for the near value. So, the way of getting the answer should be clicked quickly.

47 A soap bubble is formed gradually at one end of a glass tude from time t= 0 by slowly blowing air from the other end. The variation of excess pressure (ΔP) inside the bubble with time (t) is best represented by



Eventhough it is not asked from acurve, several MCQ and essay questions are being given on the creation of a bubble in one end of a tube. First, the radius is reduced gradually from infinity. This happens until theradius of the bubble is equal to the radius of the tube. So, ΔP should go

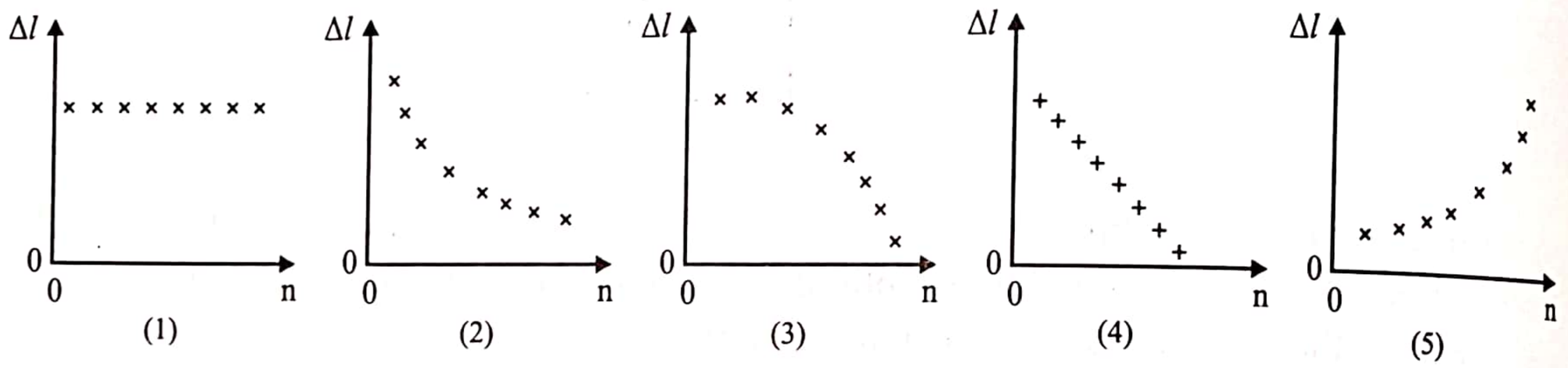
to a maximum from zero. The facts of the radius of the bubble is in minimum when it is equal to the radius of the tube and at that instant, the pressure inside the bubble is maximum, have been checked many times. Next, as the radius of the bubble is gradually increasing, ΔP gets gradually reduced $\Delta P = \frac{4T}{r}$. Only graph (4) has this shape.

Out of the two points that are mentioned below, from one of them you can get the answer even if you donot think something.

(i) If a bubble is created at the end of a tube, then ΔP is maximum when the radius of the bubble is equal to the radius of the tube. Only graph (4) shows a maximum.

(ii) At t=0, Δ Pshould be zero. This is general knowledge. Before blowing how can there be a ΔP? When t=0 ΔP gets zero in (2) and (4). You should know from the scent that the shape of (2) (straight line) cannot be true.

48 A heavy metal box is to be supported by n number of uniform identical legs of the same material in such a way that the entire weight of the box is equally distributed among all legs. In this situation, the variation of the contraction Δl of each leg with the number of legs n, due to the weight of the box, is best represented by



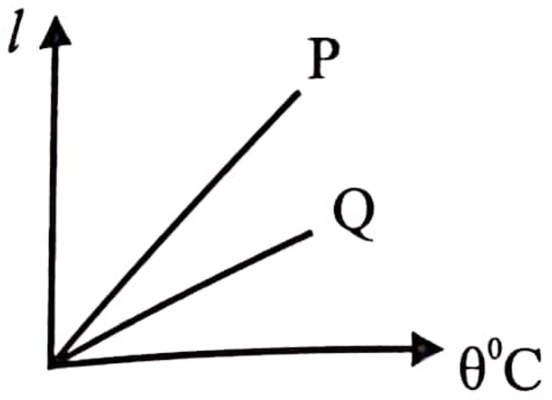
10 **Elasticity**

This is the 45th question of paper 2003. You should have gone back to year 1, if you cannot decide that Δl should reduce when the number of legs are increased. You donot need to know Physics for this. When n is incresed, only (2) and (4) have the reducing Δl. Out of this (4) must be defintely removed. The axes of n and Δl are cut from the straight line. Then when n=0, there is a value for Δl. How can there be a value for Δl evenwithout a leg? On the other hand, if n axis is cut in one of the values of n, then Δl=0. These two cannot happen. Therefore, the axes cannot cut always. Then the remaining is (2).

For children who cannot solve without equations can also think like this. If there are n legs, as they are identical, the force on one leg is W/n. Now according to Young modulus relationship,

$$E = \frac{W}{nA}\frac{l}{\Delta l}$$

From this also it is clear that, $\Delta l \propto \frac{1}{n}$. But writing equations for this is a foolish act.

49 

graph shows the variation of the length (l) of the liquid columns of a certain mercury-in-glass thermometer (P) and an alcohol-in-glass thermometer (Q) with temperature (θ).

A student draws the following general conclusions solely based only on the graph.

(A) Mercury thermometer are more sensitive than alcohol thermometers.

(B) Mercury thermometer are longer than alcohol thermometer.

(C) Volume expansivity of mercury is greater than that of alcohol.

He can truly conclude

(1) only (C). (2) only (A) and (B). (3) only (A) and (C).

(4) all (A), (B) and (C). (5) none of (A), (B) and (C).

There is logic in this question than Physics. This has to be decided by solely based on the given facts not on the known true facts by yourself. Even in the question the phrase of 'this graph only', the 'only' part has been bold to emphasize this fact. At a particular temperature, the length of mercury in the mecrury-glass thermometer has drawn longer in the graph than the length of alcohol in the alcohol-glass thermometer. But based only on that fact, can you say that mercury thermomters are more sensitive than alcohol thermometers?

Look at the question properly. In the question, it has given a description regarding two thermometers. The graph is drawn for those two thermometers. The statements have sentences about thermometers in general. So, if you think in a simple way, by looking at two persons and coming to conclusions about everybody is dangerous.

At a given temperature, it is true that the length of mercury in P is greater than the length of alcohol in Q. It is a characteristic of being sensitive. But we do not know about the capillary radii of the size of bulbs in the two thermometers. If the capillary radius of the mercury thermometer was made smaller than the radius of the alcohol thermometer, you can get the given graph. So, you cannot come into the general conclusion that all mercury thermometers are sensitive than alcohol thermometers.

You should enter the question as an unknown person of thermometers and thermometric liquids. A person who does not know anything will not come into a genral conclusion just by looking at the graph.

It can be clearly seen that (B) is wrong. You cannot decide that by looking at the graph. (C) is correct as a sentence. But again it cannot be decided only by looking at the graph. Visually, we can make the diameter of the capillary as small as possible and show that the expansion is greater. A child with 57 correct answers has gone wrong in this question. You can get this wrong if you start to think as an intelligent Physics child. You should have forgotten Physics a liitle when you are doing this question.

Always pay attention to the words that are being bold. If you have done so, by looking at the characteristics of two specific thermometers, you will understand that you cannot come into conclusions generally about all the thermometers.Look at the following example.

Consider two young girls. One girl is wearing long skirts always. The other wears short skirts all the time. By looking only at these two observations, can you come into the following general conclusions?

(i) The girls who wear short skirts are more beautiful than the girls who wear long skirts.

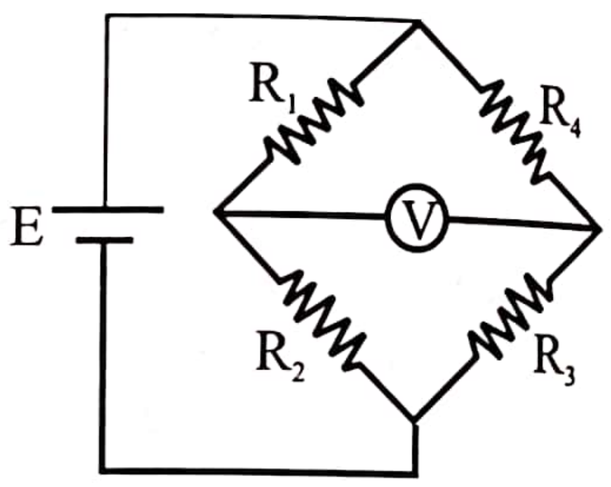
(ii) The girls who wear long skirts have a good character than the girls who wear short skirts.

(iii) Girls who wear short skirts have more boy friends than the girls who wear long skirts.

Think aboout this!!

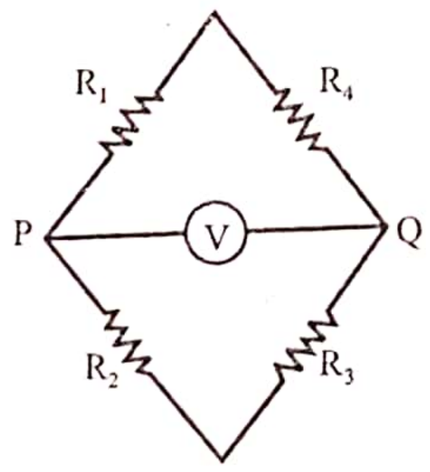
50 The following table indicates five different sets of resistance value that can be allocated for R_1, R_2, R_3 and R_4 of the bridge circuit shown. Which of the following sets produces the largest deflection in the voltmeter (V) ?

	Set	R_1 Ω	R_2 Ω	R_3 Ω	R_4 Ω
(1)	1	30	5	30	5
(2)	2	20	15	10	25
(3)	3	25	10	10	25
(4)	4	10	25	25	10
(5)	5	30	5	5	30



08 Wheatstone Bridge and Meter Bridge

This is a bit different question. There are several instances where Wheatstone bridge has been asked. This has the other end. We know very well about the zero deflection in the voltmeter. Here it is being asked about the instance which has the highest deflection. If you are going to write equations for this also, then you will be in trouble. I will draw the diagram again for the convenience of explaination.



The logic of this question is like this. The deflection of V is getting higher when the potential of P is relatively at maximum compared to Q. Otherwise, the potenetial of Q should be a maximum relative to P. The total voltage difference between R_1 and R_2 and R_4 and R_3 is the same (either E or E-ir).

If the potential of P should be increased, then R_1 should be made small as possible relative to R_2. If R_1 is small compared to R_2, then the voltage drop across R_1 is smaller than the voltage drop across R_2. Then the potential of P gets smaller than E or E-ir in a minute way.

Now when we look at the values of R_1 and R_2, there is no such instance where R_1 is so small compared to R_2. As you look at the values that are given in the table, the biggest value is 30 where is the smallest is 5. Therefore, if you need to increase the potential of P, then from the given values R_1 should be 5 and R_2 should be 30. But this is not given.

Now let us look at the other side. If the work cannot be done from this side, we will try to get it done from the other side. According to the above logic, if you need to maximize the potential of Q, then R_4 should be made as small as possible relative to R_3. It is there in (1) from the given numbers. $R_3 = 30$ and $R_4 = 5$. This cannot be accomplised from any other choice. Values of R_3 in (2), (3) and (5) are smaller than R_4. In choice (4), R_4 is smaller than R_3 but that difference is smaller than 30 and 5. Now if it is correct, then you need to check whether the potential of P is minimum when Q's potential is at maximum. To minimize the potential of P, it should be dropped more across R_1. That means R_1 should be greater than R_2. It is there in (1). But you do not have to look at that to get the answer. The numbers are positioned to get the work done nicely if the logic is caught.

The other way to solve is by checking at the usual Whetstone bridge occasion and remove it basically. To get the Wheatstone bridge, $R_1/R_2 = R_4/R_3$

The couples of (3), (4) and (5) are obeying this nicely. They can be selected for the convenience. Now the remaining is (1) and (5). Take their ratios.

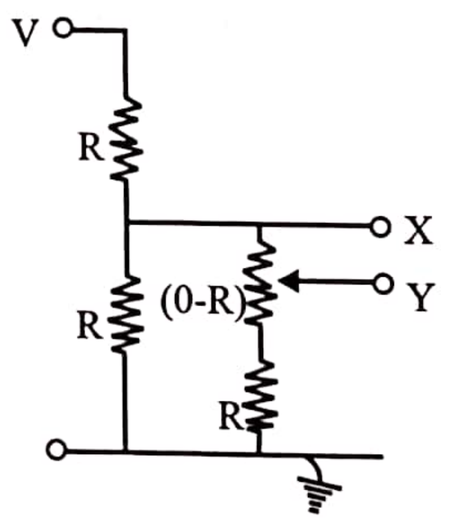
(1) $R_1/R_2 = 6$ $R_4/R_3 = 1/6$

(2) $R_1/R_2 = 20/15 = 4/3$ $R_4/R_3 = 20/10 = 2.5$

Out of this, the highest ratio difference of R_1/R_2 and R_4/R_3 is seen in (1) (6:1/6). In (2) it is 1.3:2.5. Therefore, the correct answer is (1). As (3), (4) and (5) has given Wheatstone bridge instances, this method has become easy. Otherwise, you have got to check all the ratio values of everybody.

In all answers, $R_1 + R_2$ and $R_3 + R_4$ totals are the same. Does this has an effect on the problem? Think about this. If you are learning properly, then it means that you are building up logic by thinking. Even higher results can be obtained by such children; not the lazy heads who are idling.

51 The circuit shown consists of three fixed resistors and variable resistor which can be varied from 0 to R. The maximum voltage that can be obtained across XY is



(1) $\frac{1}{5}V$ (2) $\frac{1}{3}V$ (3) $\frac{2}{5}V$

(4) $\frac{2}{3}V$ (5) $\frac{4}{5}V$

You know the answer by heart even though you did not solve.
Because it has been given in the previous questions. Look at the 40th question of paper 1999 and the 40th question of paper 2000. As the examiners are shy to give the same question, they have done a fraud. They have put a variable resisitor and asking about the maximum voltage it can get. Is not it an illusion? R. R 2R. When R is parallel to 2R, it is 3/2 R. Oh no! It is wrong. The equivalent should be lesser than R. That means 2/3 R. 2/3R and R are in series. 5/3 R. If 5/3 is V, then for 2/3, 2V/5. Half of this is V/5. If you get the wrong answer, then you are a beautiful animal with four legs not a beautiful child with two legs.

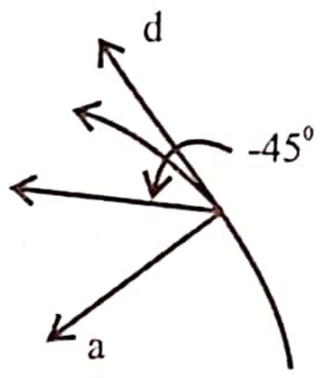
52 A particle is moving in a circular orbit of radius 10 m. At one instant, the speed of the particle is 10 m s^{-1} and is increasing at a rate of 10 m s^{-2}. The angle between the velocity vector and resultant acceleration vector of the particle at that instant is

(1) 0° (2) 30° (3) 45° (4) 60° (5) 90°

02 **Circular Motion**

This is also not a big question. One acceleration (tangential) has been given. It is 10 ms^{-2}. The other accleration is towards the centre. This is there even if it goes at a constant speed in a circular path. It is $V^2/r = (10 \text{ X } 10)/10 = 10 \text{ ms}^{-2}$

It is also 10. The resultant of equal two vectors is going in the middle of those two vectors. As these two acclerations are perpendicular to each other, the angle from the the tangent (velocity) should be 45^0. Otherwise, you should see that the answer is 45^0 as soon as you see these values. The numerical values of the two acclelerations are nicely equal to each other. You cannot get 30^0 and 60^0 values (by looking at the numbers).



If you go from a uniform speed, the accleration (a_c) is directed towards the centre only. Then the angle of the velocity and the acceleration is 90^0. The angle between the velocity and the accleration cannot be zero because $a_c \neq 0$ even if a_T becomes 0.

53 Consider the following statements made regarding the weightlessness experienced inside a satellite orbiting around the earth?

(A) Weightlessness is due to the negligible small gravity at such an altitude.

(B) Due to Weightlessness, the momentum of a person moving inside the satellite is zero.

(C) Due to Weightlessness, natural thermal convection currents cannot occur inside the satellite.

Of the above statements,

(1) only (A) is true. (2) only (C) is true.

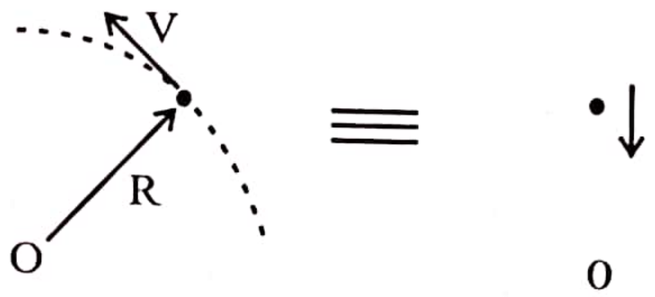
(3) only (A) and (C) are true. (4) all (A), (B) and (C) are true.

(5) all (A), (B) and (C) are false.

05 **Gravitational Fields**

There is no question in the statements of (A) and (B). What is more controversial is (C). (A) and (B) are very simple. The weightlessness is experienced not because of less gravity. A satellite/space shuttle that is in the orbit and a lift that falls with broken cables are examples for objects that are free falling. Therefore, a man in the space shuttle also experiences the weightlessness just as a man in a lift experiences it. If we write equations and show, then for a satellite that is orbiting around the earth (with mass M) in a radius R, $GMm/R^2 = ma$ where a is the acceleration of the satellite towards the centre. So, $a = GM/R^2$

Now think that the satellite is falling to the earth from this height. When F = ma is applied to the satellite towards the earth, you will get the same equation. There is no difference. Is not it? Therefore the acceleration of the satellite towards the centre of earth is same in both occasions. Actually the value of that acceleration is equal to the gravitational acceleration (g) of the object on that specific level (a=g).

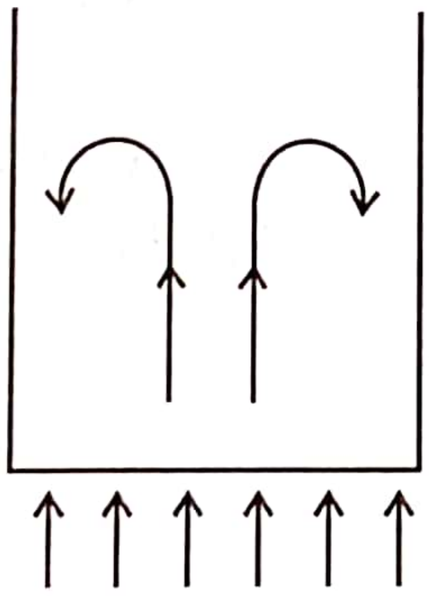


Therefore, the above two instances are equivalent to each other. So, eventhough a satellite or a space shuttle which is going on a stable orbit is not 'falling' to the earth, in Physics we think that as an object which is trying to fall to the earth. It is because the acclelration towards the centre is equal to the gravitational acceleration in both of the instances.

So, the man in the space shuttle also gets the same experience just as the standing man experiences the weightlessness in a freely falling lift (This is a very well known fact. mg - R = mg → R = 0) Therefore, (A) is wrong.

Even a satellite cannot ever be put into an orbit of with lessened gravity in a far far away space. Then how can it find the force towards the centre of the earth? If it is a space shuttle, then we experience the weightlessness due to the reduction of the gravitational force.

Statement (B) can be decided as incorrect from a glance. The momentum goes with the mass (m). Eventhough it is weightless, m (inertia) is not zero. As previously mentioned, lot of arguments were obtained for statement (C) from the teachers. Everybody argues saying that (C) is wrong. I know that, still there are people who hesitate to accept that (C) is correct.



Heat

Here in the phrase of natural convection currents, the two words of natural and currents are very important. How can natural convectional currents be produced? Due to convenience, we will take a simple observation where everyone has learnt and experienced. Can you remember the experiment of potassium permanganate that we put into a water beaker? When the water is heated from below, the heated liquid at the bottom will go up where the cool liquid of above will come down to fill the space.

Why does the heated liquid parts go up? Due to the heat, the liquid gets expanded and its density gets lowered. As the volume is incresed due to the expansion, the upthrust also gets increased as it goes up.Then the upper liquid parts that are with higher density comes down. This process is called the natural convection currents. This happens when the air also gets heated (due to heating of the ground). Gliders and some birds use these heated air currents and go upwards.

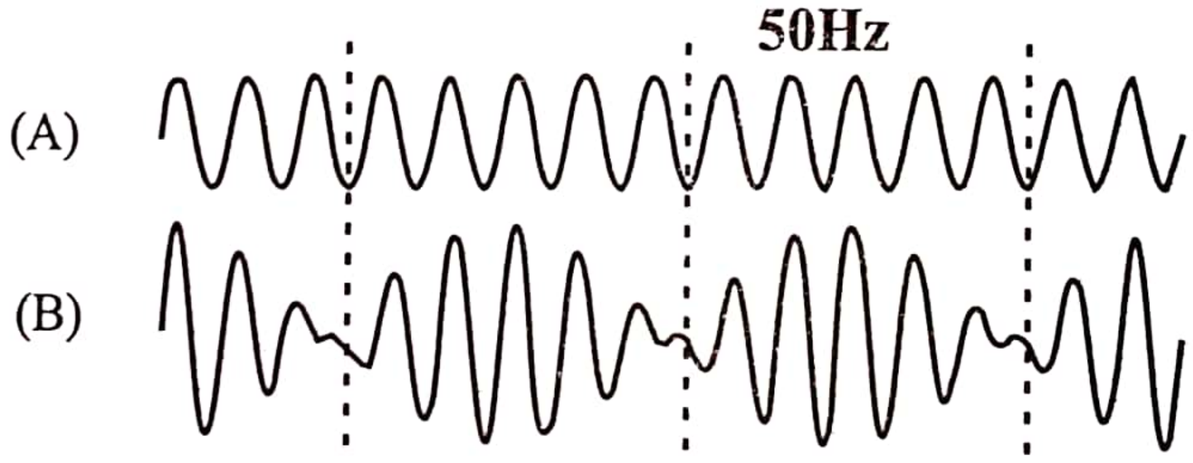
Now think that if this beaker is allowed to fall under gravitational accleration to downwards direction. We know that there is no weight in a liquid which falls under gravity, the pressure from the liquid inside the liquid is zero and therefore the upthrust is zero. Therefore, can convection currents occur as mentioned above?

When the heat is provided as it falls, the temperature of the liquid molecules gets increased and their random motion gets higher. But there cannot be beautiful convectional currents that we interpret. Convection currents are systematic and obedient in motion which are not in random motion. Think of your systematic and obedient motion when you go to the gate after school finishes.Is it the same? But you will go here and there once you hear a sound. That is a random motion. The apparent weight of the liquid is zero. The upthrust in the liquid is zero. Then how can you get convection currents that are going up and down?

I will not say that convection does not occur due to weighlessness. The heat can be transported to another place from the random motion of liquid molecules. Actually, convection is given a definition like this. When parts of mass transfer heat due to the motion from one place to another is called convection. Therefore, heat transfer can occur by convection in any direction. There is no problem. But the natural convection currents are occuring to up and down. There is an agreed pattern.

There can be forced convection other than natural convection. For that, there should be an external agent. You can do it by using a fan if it is a gas or else a pump if it is a liquid.

54 An oscilloscope is connected to a microphone which receives simultaneously a 50 Hz signal and another signal of frequency f(f>50 Hz).The figure A shows the trace with the 50 Hz signal alone while the figure B shows the trace due to the combined signal.



The value of f is

(1) 50 Hz (2) 55 Hz (3)60 Hz (4) 65 Hz (5)70 Hz

03 **Wave Properties**

If you like, you can do it from the memory. Will you agree with me?

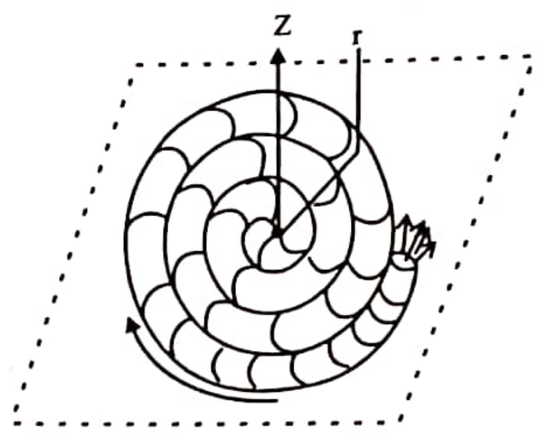
There are dashed lines with a boundary for one beat. Inside a beat, there is 5 wavelengths from (A). It has given like that for the convenience. One wavelength is allocated to one frequency.

If there is 1 beat for 5, then how much for 50? It will be 10 for 50. That means the frequency of beats is 10 Hz. As f > 50 Hz, f should be 60 Hz. You can get the answer into the brain without wasting a piece of graphite. 1 for 5. 10 for 50. The answer is 60.

If you are allergic for not doing rough work, you can do like this. The frequency of 50 Hz means time for one oscillation (one wavelength) is 1/50 s (T=1/f). The time for such 5 oscillations will be 5X1/50 = 1/10 s. Then time taken for one beat is 1/10 s. Hence, the beat frequency is the reciprocal of this value. That is 10 Hz. Now the answer is 60 Hz.

Each MCQ is made by the examiners to make the candidatesat ease. You should realise that.

55 A circular disc shaped pin wheel type firework shown in the figure performs a rotational motion about the Z-axis on a horizontal smooth floor due to a constant reaction force generated by its burning. Assume that the pin wheel retains the shape of a uniform circular disc throughout and its moment of interlia $I=1/2\ m\ r^2$ about the Z-axis. If m,r,ω and α are the value of mass, radius, angular velocity and angular acceleration respectively of the burning pin wheel at a certain instant, then



(1) $m\ r\ \alpha$ is constant.

(2) $m\ r^2\ \alpha$ is constant.

(3) $r\ \omega$ is constant.

(4) $m\ r^2\ \omega$ is constant.

(5) $m\ r^2\ \omega^2$ is constant.

Have you seen fireworks like these? This is much more safe than the fire crackers, Chinese crackers and sky crackers. You can suspend the middle by using a nail and it will rotate nicely once the end is lit.

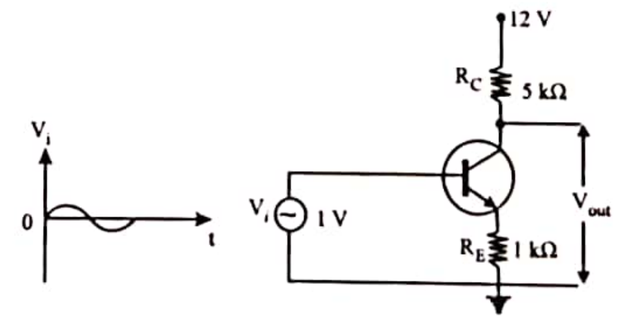
We get two equations to our mind when considering of such a rotational motion. Due to combustion, r is getting reduced and there is no surprise if we tend to apply conservation of angular momentum effortlessly. There is an answer for that if it was applied. But think a bit. You can apply conservation of angular momentum only when there is no external torque around the rotaional axis. Here that force is given by the combustion of gun powder to the circle. It has been mentioned in the question. It has mentioned to keep it as a constant. Clearly there is a moment around the rotational axis from that force. Therefore, you cannot apply conservation of momentum for this question.

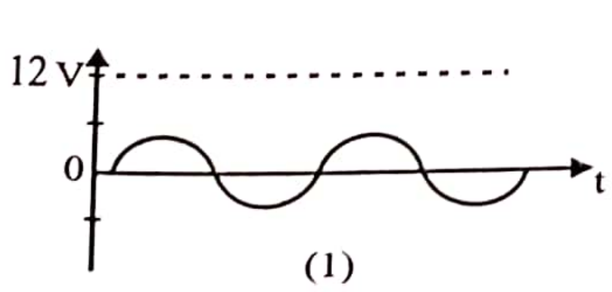
Now what is left is $\tau = I\alpha$ (like $F = ma$ in linear motion) only. I cannot think of another equation. On the other hand, there is a feeling we get that we should apply an equation according to the question. There is no point in talking a constant force when applying conservation of angular momentum. Then what is left is $\tau = I\alpha$.

$Fr = \frac{1}{2}\ mr^2\ \alpha$. You should only write this. As F is constant, as soon as you saw the euqation, you should understand that $mr\alpha$ is a constant.

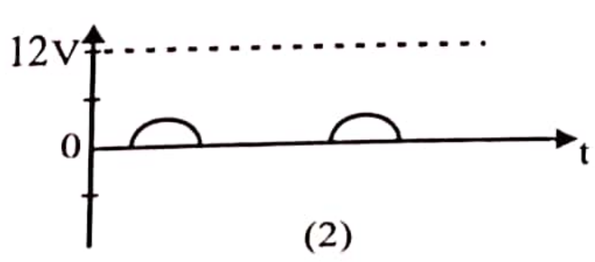
You can understand another point from this. With time, m and r continuously reduce. Therefore, α is gradually increasing. If you have experienced this motion, you will realize that this is true. Have you seen that the rotating circle rotates faster when it is burning more and more?

56 The figure shows a circuit constructed using a silicon transistor. If the peak value V_i of the input alternating voltage is 1 V. output voltage V_{out} is best represented by

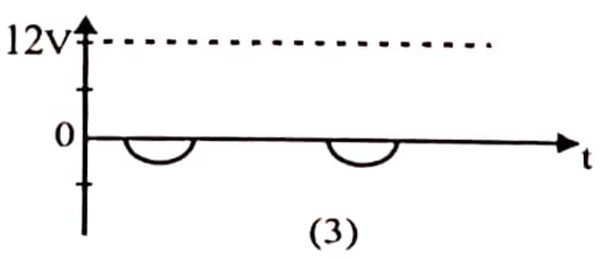




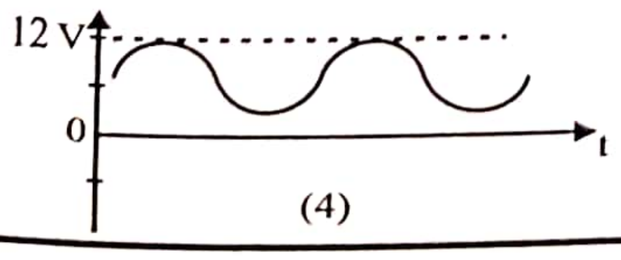
(1)



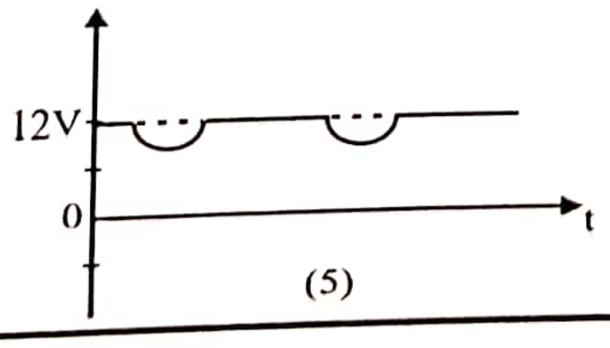
(2)



(3)



(4)

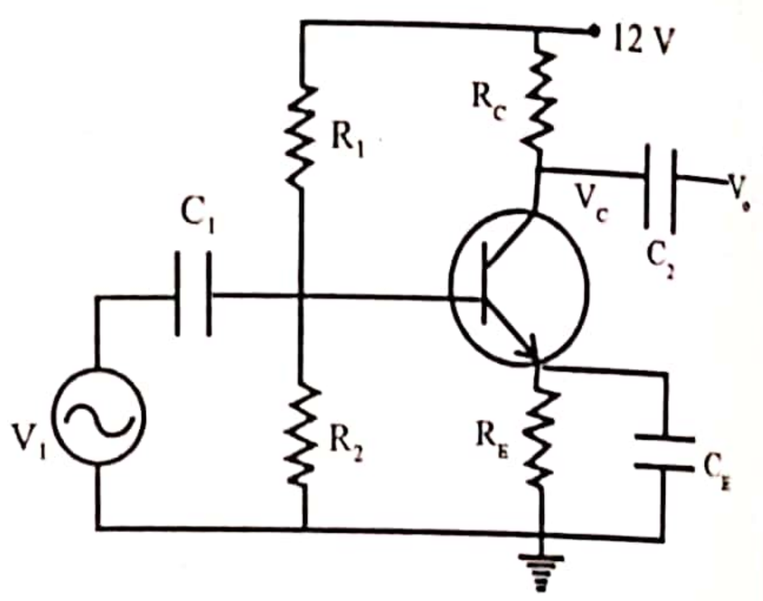


(5)

This was a troublesome question. A student who got 59 correct, got this question wrong.

As soon as you see the circuit, you should understand that it is not a good amplifier circuit. Here the transistor is not biased properly. Even though there is no problem in the dc voltages of V_C and V_E, V_{BE} is not kept at a constant value of 0.7 V. When the transistor is biased in the active reigon, if we take I_c as 1 mA then I_CR_C = 5 V and V_C = 7V.There is issue as V_C should be ~1/2 V_{CC}. Likewise, as I_C~I_E, V_E = 1 V. That is good. But to keep V_{BE} =0.7 V, a method like voltage divider system should be used as a biasing method for transistors most of the time.

Here it has shown a practically good amplifier circuit. You can select R_1 and R_2 values by taking V_B =1.7 V (0.7 +1). I will leave that to you. By the capacitor C_1, the leakage to V_i side from part of dc current of I_B and by the capacitor C_2, the leakage to V_o side from part of dc current of I_C have been stopped.The alternative current component generated in I_E due to V_i by C_E allows to go across C_E. Due to this, the voltage difference acorss R_E is not changed with V_i. By all of these, dc biased voltage is kept at a constant. Now let us turn to the question again. Here, there are few things that you should know.



(i) V_{BE} should be supplied from V_i. We know that the transistor is functioning when V_{BE} exceeds 0.7 V. From this we can deicide that from 0 to +0.7 V of V_i, Vout is zero. Therefore, the rest of 0.3 V is there for the amplification.

(ii) From 0 to +0.7 V of V_i, I_B is zero. I_f I_B= 0, then I_C= 0. So, V_c is kept at 12 V [12 = I_CR +V_C (V_o)]. Therefore, if I_C =0 then V_0 =12 V. From that we can decide quickly that V_o should be on 12 V and vary on it. You can find the answer even on this one fact. Graph (5) is the only graph that has been drawn on Vo by dancing around 12 V.

(iii) Even equation derivation is not in the syllabus, you know that there is a phase difference of 1800 between V_{out} and V_{in}. This has been checked in previous papers. You can decide from the following logic too. When Vi is increasing positively, IB gets increased to its dc value (if it is correctly biased). Accordingly I_C gets increased.

As V_C (V_o) = 12- I_CR_C, when I_C is increased V_o is decreased. When Vi is negative, I_B gets decreased than its dc value and hence I_C is decreased. (When I_C is reduced relative to its dc value, V_o gets increased.)

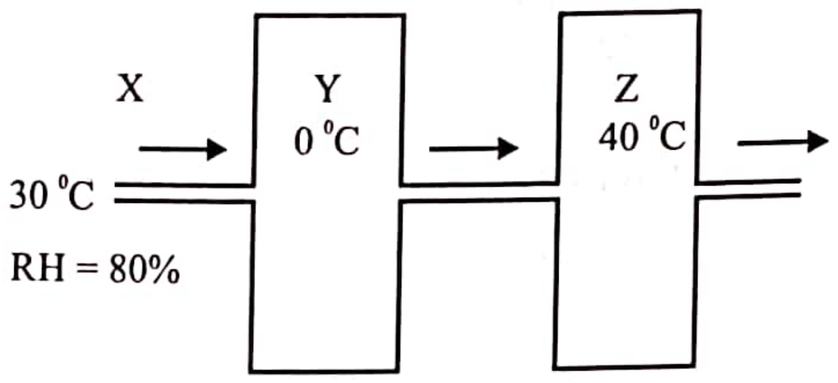
(iv) When Vi is negative, B-E junction remains in the backward biased. Therefore, I_B= 0. I_C=0 → V_0 =12 V. If all the instances are summarized,

V_{in} (V)	V_{out} (V)
0 → + 0.7	12
+ 0.7 → + 1.0	Less than 12. Reduction is increased. (I_C is increased)
+ 1.0 → + 0.7	Less than 12. But reduction is decreased. (I_C is decreased)
+ 0.7 → 0	12
0 → - 0.1	12
- 0.1 → 0	12
Again 0 → + 0.7	12

(Remains a little for along time. Look at the graph.)

This is a thinking problem. But you can learn a lot now. Even without thinking all of these, if you can understand that V_{out} should be 12 or less than 12 V as mentioned before, then the answer is simply in your hand.

57 Atmospheric air at 30°C and having 80% relative humidity is made to flow slowly through two large chambers, Y and Z, maintained at 0°C and at 40°C, as shown in figure. Densities of saturated water vapour in the atmosphere at 0°C,30°C and 40°C are 4.8×10^{-3} kg m^{-3}, 30×10^{-3} kg m^{-3} and 48×10^{-3} kg m^{-3} respectively. Which of the following tables correctly represents the relative humidities (RH), and the absolute humidities (AH) of air in the atmosphere (X), and in the chambers Y and Z?



(1)

	X	Y	Z
RH	80	10	90
AH(kgm^{-3})	30×10^{-3}	4.8×10^{-3}	35×10^{-3}

(2)

	X	Y	Z
RH	80	100	10
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

(3)

	X	Y	Z
RH	80	0	40
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

(4)

	X	Y	Z
RH	80	100	100
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

(5)

	X	Y	Z
RH	80	100	100
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	48×10^{-3}

Both Realtive Humidity (RH) and Absolute Humidity (AH) are being tested in this question. First we will find RH. Outside (at X) it is given as 80%. Therefore, there is nothing to find. If the saturated vapour density of outside (at 30 °C) 30 X 10^{-3} kgm^{-3} with a relative humidity of 80%, then there is 24 X 10^{-3} kg water vapour mass in $1m^3$ of air outside. That is 80% of 30 X 10^{-3}. If there is 30 X 10^{-3} already then RH is 100%. 80% of RH means that there is 80% from the saturated amount.

Now the air is gone to the chamber Y with water vapour mass of 24 X 10^{-3} kg. You need 4.8 X 10^{-3} kg only to saturate $1m^3$ of air at 0 °C.24 X 10^{-3} kg is taken inside but the maximum it can bear at Y is 4.8 X 10^{-3}. So what will happen from 24 X 10^{-3} to 4.8 X 10^{-3} is that the excess of it condenses. You only need 4.8 X 10^{-3} and there is more than enough. Therefore, the relative humidity inside Y is 100%. You can just think this. In a refrigerator you know that there is less absolute humidity whereas it has maximum relative humidity.

Next, the air goes to chamber Z with 4.8 X 10^{-3}. Because the absolute humidity lessens till 4.8 X 10^{-3} in Y. Now from where can we get again? Therefore, the absolute humidity in Z is 4.8 X $10^{-3}$$kgm^{-3}$. If you need to saturate in 40°C, then you need 48 X $10^{-3}$$kgm^{-3}$. But now it has 1/10 of its value. So, the relative humidity is 10%.

RH values of 80, 100 and 10 are given only in (2). Therefore, it is easy to pick the correct answer. 80% is given in X. As Y is in 0^0C, you can feel that RH is 100% by your instinct. Then what is left is (2), (4) and (5). Any child can decide that RH cannot be 100% in Z (as the temperature is high). Then what is left is (2). Because RH in both (4) and (5) are given as 100%.

I will not invite you to do questions like this way. Some teachers may also scold me. But if you cannot do anything, then I will not see it as a wrong thing by finding a small piece and solve the problem (by being cunning, nobody gets angry or nobody gets hurt). This is relevant to the 56th question as well.

If we substitute water vapour by money, you go to the shop with some money. There you have a definite amount that you need to spend where you cannot skip. But you cannot spend all. Next, you come out of the shop with the residual money. Is not it?

From this method you can reduce the relative humidity of air to a requied amount. This is being used practically. First, the absolute humidity is reduced by making air as cool as possible. Next, by heating you can reduce the relative humidity. If the temperature of the room Z is increased more, then the relative humidity can be reduced more than 10%.

I think you can understand that why there are big chambers and why it has allowed air to flow slowly across chambers. Can you do this work by allowing the air to flow quickly?

58 In the circuit shown in figure(a), the supply voltage (E) increases linearly with time (t) as shown in figure (b).

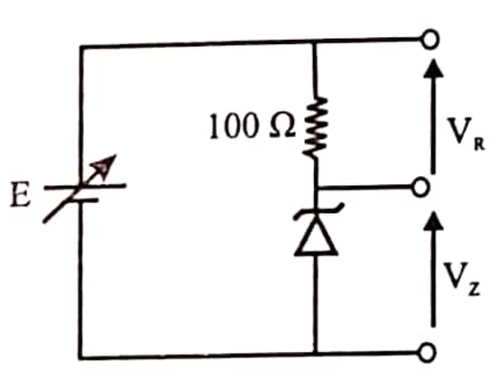


Figure (a)

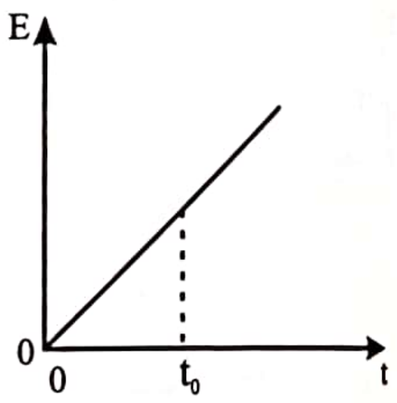
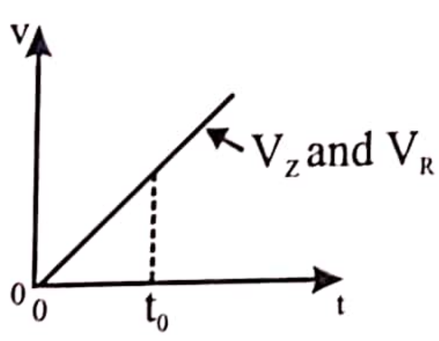


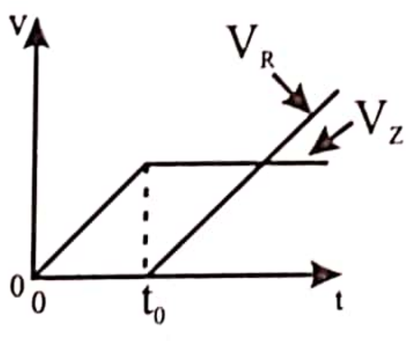
Figure (b)

At time $t=t_0$, supply voltage surpasses the breakdown voltage of the Zener diode.

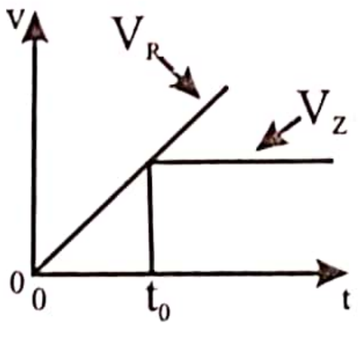
The variation of the voltage (V_R) across 100 Ω resistor, and the voltage (V_Z) across the Zener diode with time (t) is best represented in



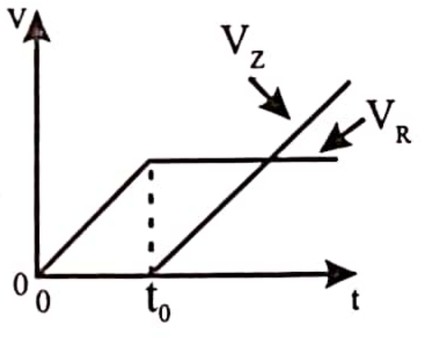
(1)



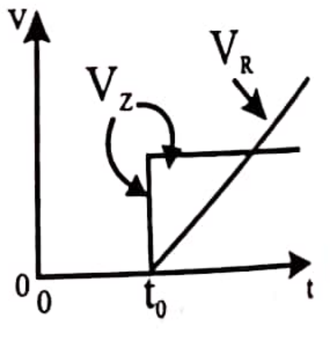
(2)



(3)



(4)

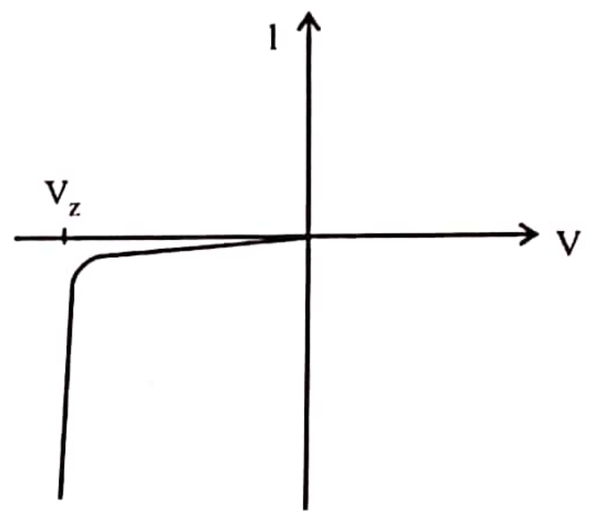


(5)

09 **Semi conductor**

Zener diode is connected in the reverse biased mode. It should be connected like that. It has been given that, at to the input voltage is exceeding the breakdown voltage of the zener diode. Therefore, after that, V_Z should be at a constant value (until it gets burnt out). Everyone knows this and everyone should have known this. Therefore, the correct choice is either (2), (3) or (5). According to I-V graph of zener diode, its resistance is very large in the reverse biased mode. Look at the figure.

The gradiant of I-V curve is very less till V_z. It indicates that the resistance is very large and it is in kΩ range. (Even you cannot apply Ohm's law to a diode, according to I = 1/R. V, if the gradiant is smaller, then the resistance is higher.)

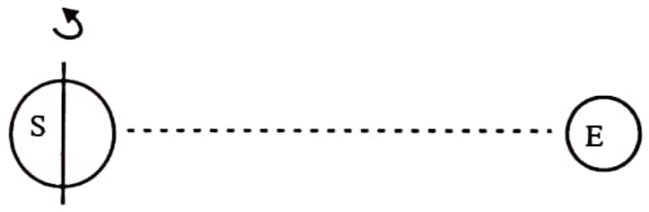


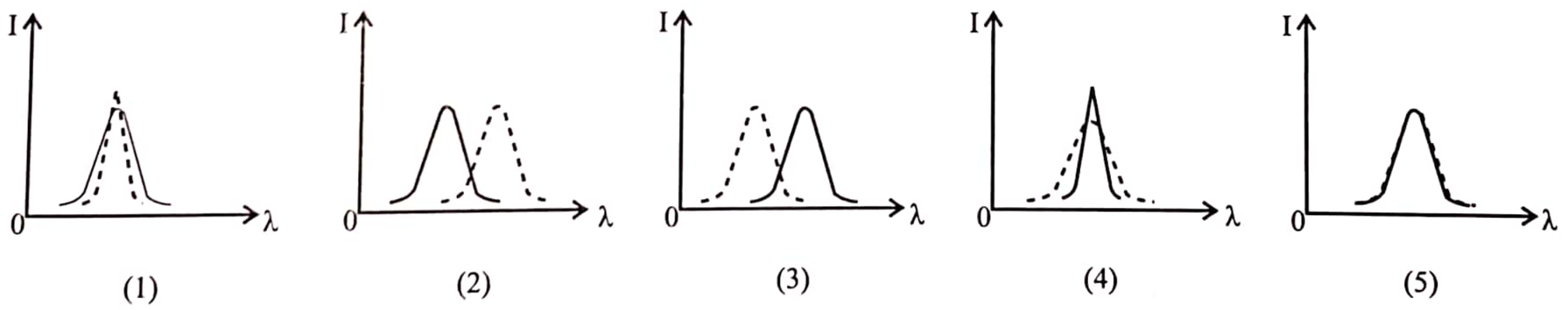
Now there is a 100 Ω small resistor which is connected in series to the resistance in kΩ range. Hence, the input voltage is almost dropped across the zener diode. There is less voltage difference across R. When two resistors of R_1 and R_2 are connected in series and applied a voltage,then the voltage across R_1 is higher than the voltage across R_2 if $R_1 > R_2$.

So, initially V_Z cannot be zero or a near value to zero. There should be a finite value. So you can remove (3) and (5) directly. V_R initially gets nearly zero. When V_Z is constant, V_R is looking forward to take care the rest of E.

Another trick that you can use is test whether $V_Z + V_R$ is equal to E (if r=0). This has not being satisfied in (3) and (5). Look at (3). After t0, $V_Z + V_R$ is exceeding E. from 0- to VR is in the road of E. After that some time, a ghost has come and has increased the total of both the values. Even this is according to the conservation of ghosts but it is contradictory to the conservation of energy in Physics. At (5), from 0 – to, the ghost has eaten both of them. $V_Z = V_R = 0$. What has happened to E? Have you all eaten? For a child who knows that after to that V_Z is contant, can work the rest with a simple loigc.

59 A star (S) rotates about its own axis as shown in the figure. Which of the following graphs best represents the observed distribution of intensity (I) as a function of wavelength (λ) of a spectral line emitted by a certain gas in the star, when view from the earth (E)? The broken lines represent the expected intensity distribution of the spectral line if the star does not rotate about its axis.

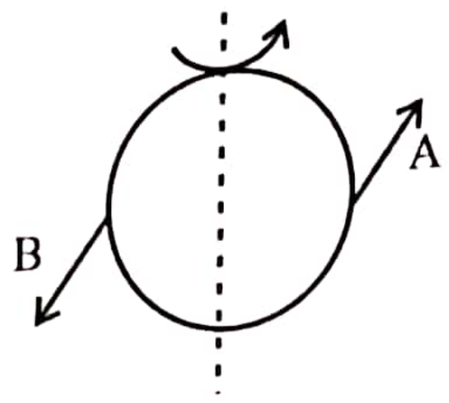




(1) (2) (3) (4) (5)

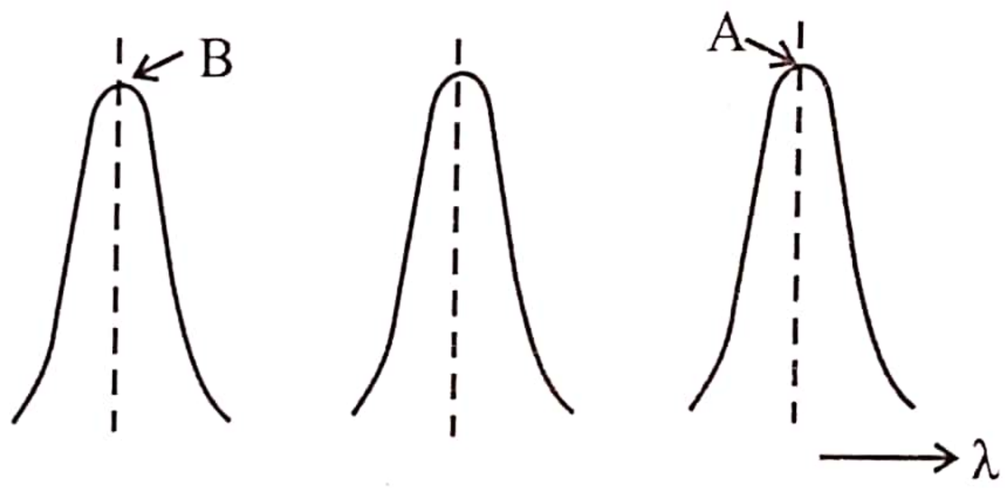
This is also a troublesome headache. It is complex to identify which principle of Physics is relevant to the question. This is a question based on Doppler's effect. This is a practical method that is being used to find the rotational speed of a star. If you read books, then you can get to know such facts easily.

You need to think this much if you want to think in a simple way. When the star is rotating about its axis, it moves away from A and goes away from us. Then the measured wavelength is increased. When it is coming towards us from a point B, the observed wavelength is reduced from the emiting light of an air molecule. Due to this reason, the spectral line gets widened. Only graph (1) is drawn with a widened width. You do not have to see any other graphs. The widening of a spectral line is known as Doppler Broadening.

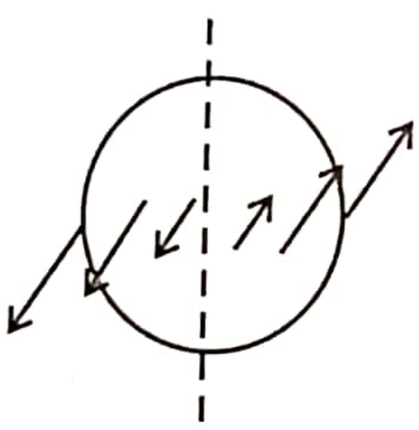


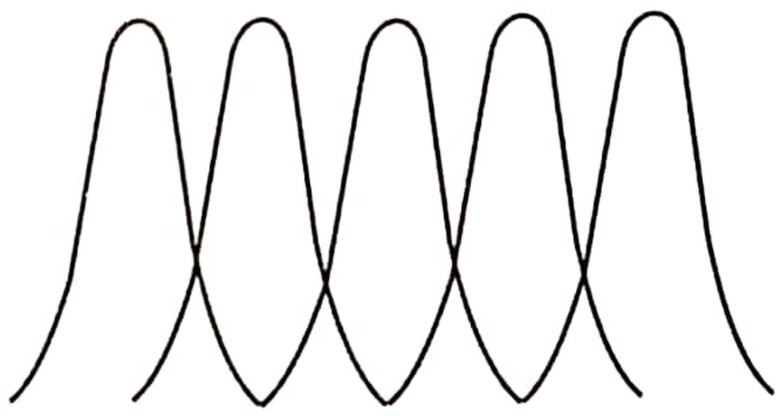
As it was a very troublesome question, we will look into the details. This is not black body radiation. It is a spectral line in the emission spectrum of a particular gas in the star. That means this spectral line is produced from the energy of the emitted photons when the electrons of a gas molecule come to the ground state from an excited state due to the temperature. Even the star is not rotated, a spectral line is not visible as a single line (one wavelength) from the detector. Even a photon has been emitted with a single wavelength from the atom, I-λ graph is taking a shape like this depending upon the resolving power of the detector. Here we take the highest peak of wavelength value as the wavelength.

Now if the star is rotating, the observed wavelength gets increased from the emitting light of an air molecule in A. Look at the figure.



The observed wavelength gets decreased from the emitting light of an air molecule in B (as the air molecule in B comes towards us). There are many more air molecules that situates between A and its rotational axis as well as between B and its rotational axis. But their speeds are very smaller compared to the speed of the atom at A.





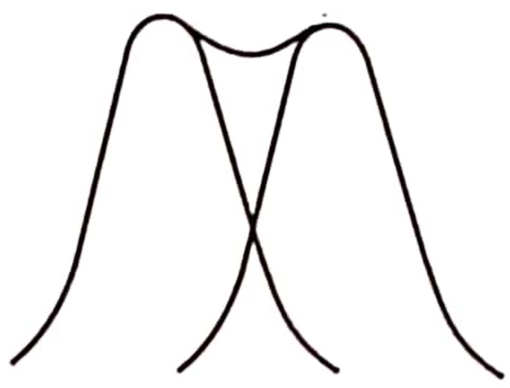
Therefore, the observed wavelengths by the emissions of such atoms lie between the maximum and the minimum limits (look at the figure).

Actually, we cannot never observe the lines of individual atoms. We are looking at the whole star. Therefore, we are observing the resultant of the above pickle. The resultant of the above pickle is widened. Is not that so? Due to the convenince, these distributions are drawn farfrom each other. Practically, it is broadened by a very small amount.

The peak of the bold line is drawn lower than the peak of the dashed line. Even if you do

not check (there is no such widened distribution amongst the answers), it is fair to have a curiosity generated within yourself asking why? The area of the whole spectral line cannot be changed. Energy can be obtained from the area. Therefore, when the distribution (resultant of the pickle) gets widened, the height should be reduced.

To look what is really happening, look at the following figure. If the star is not rotating, the emission curves of I -λ in each atom at A as well as B should superposition with each other. Therefore, the dashed lines show that single total. But as the star is rotationg, the distribution is stretched to the left and right (as it is shifted) its peak gets pushed down when getting the resultant.

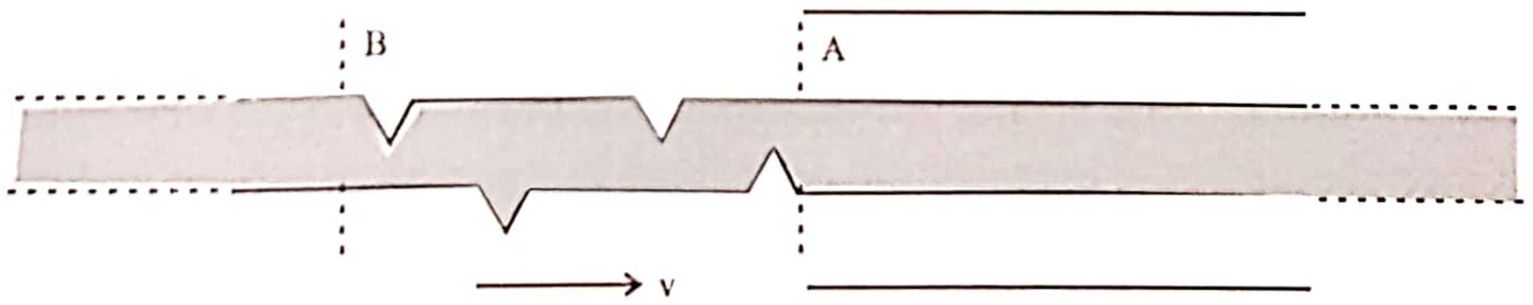


So in the distributions that are being stretched a little to the left and right, the peak of the resultant is situated a little lower than the peak with the superposition of all the distributions on each other. It is dipped down a little. So, the distribution gets widened. Due to that there is no energy damage. Height is reduced while the body gets fatter.

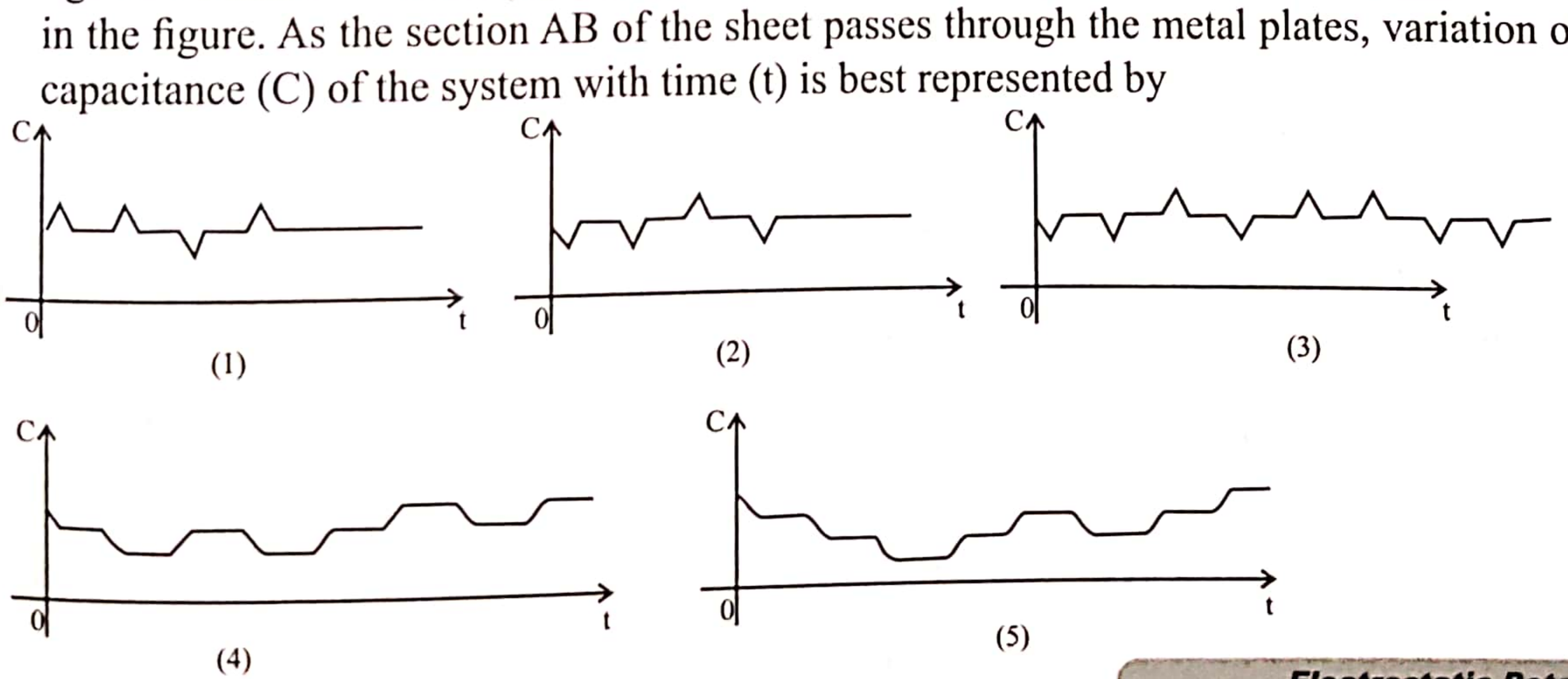
I wrote down all the details for the sake of completion. As mentioned before, once this question was identified as a question of Doppler's effect (if not remove it), it is enough to think of widening of spectral lines due to moving away and coming towards us in a rotation.

If the star doe not rotate and go away from us, then the correct graph is (3). If the star is coming towards us, then the correct graph is (2). (observed wavelength is reduced) The first instance is known as Red Shift (side with high λ) and the second instance is known as Blue Shift (side with low λ).

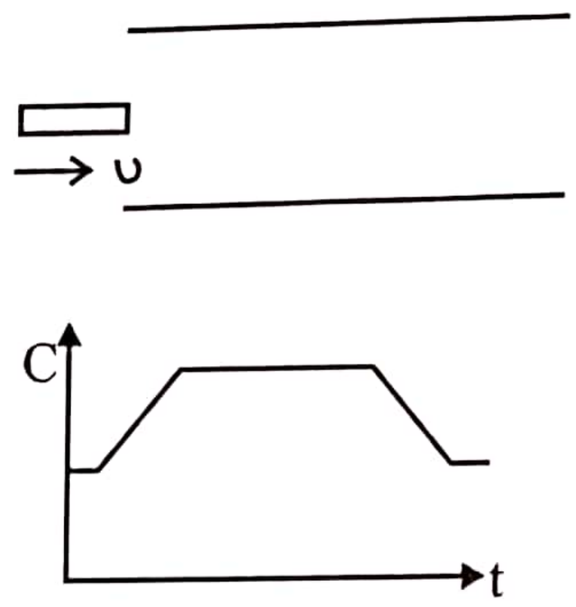
60



A uniform sheet of dielectric material is sent through two parallel metal plates as shown in figure at a constant velocity (v) to check for manufacturing defects. Some of such defects are in the figure. As the section AB of the sheet passes through the metal plates, variation of the capacitance (C) of the system with time (t) is best represented by



If there are no defects in the dielectric plate, it will not be given as the 60th question. Dielectric plates with no defects are sent many times across two plates adequately. Look at the 58th question of year 2000.



According to the above figure, when a dielectric plate is going across the two parallel plates, you can decide easily how the capacity (C) is varying with the time (t). But I am presenting on how to decide the variation of C.

As long as the dielectric plate is in between the plates, the increased value of C is remaining the same. I am presenting this because many have chosen (2) or (3) and argure them as the correct answer.

But the correct variation cannot be either (1) or (2) or (3). Because after when a defect is entered, it is there in between the plates until the defect is gone. Therefore, the decrement or increment of C due to a defect cannot go back to the initial state instantly by reducing and increasing.

The first defect is to the inside. That means part of the dielectric material has gone/eaten. When it comes in between the plates, the value of C should be reduced by some amount. It is not a problem to decide that. Now until the other defect is entered, the value of C remains in this lower amount. That is because the first defect remains in between the plates until it is moved. Once the defect is entered, the contribution remains the same as long as it is kept in between the plates. Therefore, C cannot come to its initial value instantly. If you realise this, you can forget (1), (2) and (3) directly.

Next, the second defect is entered. Even it is situated above the plate, it is to the inside. The dielectric material is lessened more. Therefore, the value of C is reduced more by the same amount again. This value of C remains the same until a third defect is entered. Why? Because both of the dug defects are now inside the plates.

The third defect is to the other side. Now the material is increased. Therefore, once it is entered, the value of C should be increased from one amount of the reduced amount. On the other hand, the contribution of C due to second and third defects cancels with each other. So, even thee are three defects inside, it shows like there is one defect. Therefore, the value of C should go back to the respective value related to the first defect.

The foruth defect is to the inside. Once it is entered C is reduced again. The resultant is equivalent to the two defects that are inside. As 2nd and 3rd cancels off with each other, the total is equivalent to the two defects that are to the inside. Therefore, C should be lowered by

two steps.

To get the correct answer, you should consider the instance where the defect leaves. The length of the metal plates and the defects of the dielectric plate is drawn in such a way, when the 4th defect is entered, the 1st defect is about to leave from them. The question is being asked as find the variation of C with time when AB passes across metal plates. Therefore, we need to study when AB was entered as well as till it leaves the system. It has not been asked to find the variation of C when AB is entering the metal plates.

But it is enough to study the entering part. The variation of (4) and (5) during the entering phase is not drawn in a same way. Therefore, examiners are not such devils!

If we summarize it, (when the defect is entered),

Number of Defect	**Variation of C**
1	Reduced by a step.
2	Reduced by another step.
3	Increased by a step (comes to state 1).
4	Reduced by a step again (comes to state 2).

The correct variation is at (4). At (5), defects 1 and 2 are correct but once 3 comes, instead of increasing a step, it has reduced a step. From that you can remove it.

The study of leaving the defects, I will leave it out to you. From that verify that (4) is correct by yourself. Leaving a reduction is actually an increment. Leaving an increment is a loss.

Once you realise that the shapes of (1), (2) and (3) are wrong, then getting the answer is not hard. If you forget that a person who entered a room should stay in the room till s/he leaves, then your eyes go to (2) or (3). Actually, this is a practical method of studing the defects in dielectric materials. You can study even very small defects from this. But you cannot find whether the defect is either in up or above the plate. If there is a defect, then you can remove it without usage.