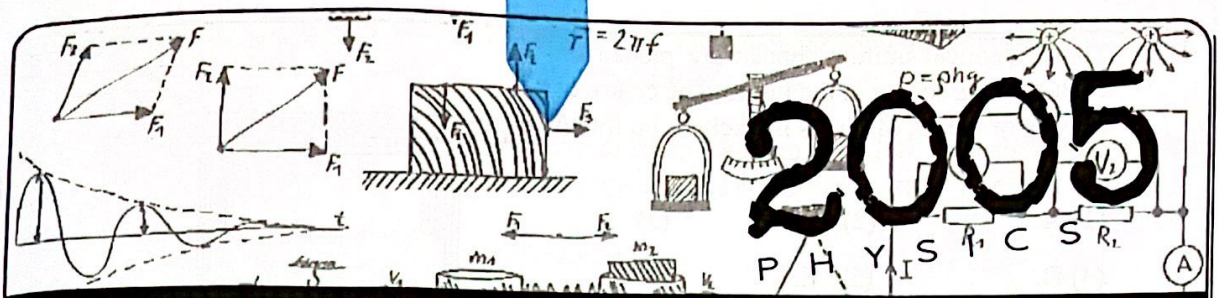


General Certificate of Education (Adv. Level) Examination

($g = 10\ Nkg^{-1}$)

01 The variation of rate of decay (A) of a radioactive sample with time (t) is given by the relationship $A=A^0 e^{-\lambda t}$. The dimensions of λ is

(1) T (2) T^{-1} (3) MT.

(4) $M^{-1}T$ (5) MT^{-1}

Unit and Dimensions 01

If a correct equation of Physics has a certain power, then it cannot have dimensions or units. This I have mentioned in the previous reviews as well. According to that,λt cannot have dimensions. That means the dimensions of λ should be equal to the reciprocal of the dimensions of time. The answer is (2). If λ is identified as the decay constant, then you can get the answer. The unit of the decay constant is per second or per unit time.

2. In the question $C= \sqrt{(k/\rho)}$, C is speed and ρ is density. The units of k are

(1) kg m s^{-2} (2) kg 1/2s (3) kg m^{-1}

(4) kg m^{-1} s^{-2} (5) kg m1/2s

Unit and Dimensions 01

When the equation is squared and the units of C^2 and ρ were substituted, you will get the unit of K. $m^2s^{-2}kgm^{-3} = kg\ m^{-1}s^{-2}$

3 The capillary rise of water, in a certain glass capillary tube is h.The angle of contact between glass and water is zero. Another capillary tube having the same dimensions as the glass tube is made with a material for which the angle of contact with water is 90^0C. The capillary rise of water in the second tube is

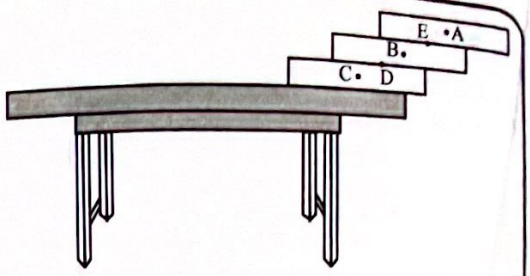
(1) 0 (2) h/4 (3) h/2

(4) h (5) 2h

Surface Tension 10

You do not need any calculation for this question. You should recall the 4th essay question of paper 2003. If the contact angle is 900, then there is no capillary rise. That question has even mentioned to draw the liquid level and the curves. Therefore, if you have investigated the previous papers, then the answers should be remembered when you read the questions.

4 Three identical uniform books are placed on each other as shown in the figure. The centre of gravity of the set of books is likely to be found at



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

(4) D. (5) E.

02 **Centre of Gravity**

A, B and C directly represent the centre of gravity of the three books. As the books are identical, their net gravity point is in the middle of the joining line of A and C. That is point B. This point can be decided at a glance.

5. A violin string of length of 0.5 m is turned to a Fundamental frequency of 440 Hz. To obtain a fundamental frequency of 550 Hz, from this string, at what distance the finger be placed from the sound box end?

(1) 0.1 m (2) 0.2 m (3) 0.3 m

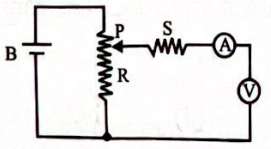
(4) 0.4 m (5) 0.5 m

03 **Transverse Waves**

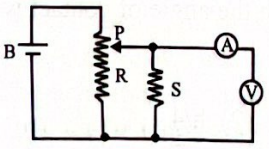
As the string is vibrated in the fundamental tone in both occasions, the multiple of the frequency and the vibrating length should be equal in both of the occasions. There is no point in drawing wave patterns or writing the wavelength (λ) with the length of the string (l). The relevant answer is (0.5 X 440)/550. This can be simplified by memory. For convenient simplification 44 and 55 are given. The answer is 0.4 m. It was heard that some children have taken the answer as 0.1 m after the subtraction of 0.5 from 0.4. Especially, the children who know music have taken the end of the sound box as the side that the finger is kept. Their argument is that, the wires tend to go up to that end of the box.

The correct answer has been taken as both 0.4 and 0.1 by the examiners as the question checks Physics not music. A violin is given to make the question beautiful. Not to check whether children know music is my feeling.

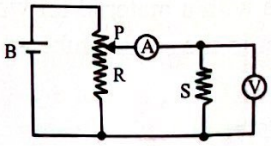
6 In the circuits shown B is a battery. R is a variable resistor with a sliding contact P, and S is a fixed resistor. Which of the following circuits is most suitable to verify Ohm's law.



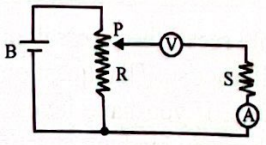
(1)



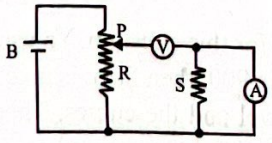
(2)



(3)



(4)



(5)

08 **Potentiometer**

I think you can remember the drawing of the circuit for the verification of Ohm's law which has been given in the 4th structured question of paper 2003. However, the voltmeter should

be connected parallelly across the resistor (S). The ammeter should be connected in series. According to that the correct answer can be decided as (3).

7 Hydrogen gas is introduced into a container having Helium gas, Until the pressure is doubled while keeping the volume and the temperature of the container constant. The ratio $\frac{\text{number of Helium atoms}}{\text{number of Hydrogen molecules}}$ in the container is

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

(4) 2 (5) 4

Expansion of Gases 04

I feel that by writing PV = nRTequation for this question has consumed lot of time. You do not have to write any equation for this question. If the existing pressure was doubled, then according to the law of partial pressures, the added pressure of Hydrogen should be equal to the initial value of pressure (P + P + 2P). Now the volume is same. Even the temperature is not changed. If so, then the initial Helium number of atoms should be equal to the added Hydrogen molecules. Is not it? If this cannot be seen directly, argue like this. As P, V and T are same, the moles of the two different gases should be same. A mole is the division of relevant number of atoms/molecules by the Avogadro's number. Therefore, the number of moles is directly proportional to the number of atoms/molecules.

8. A given parallel plate capacitor is connected to a battery. When the e.m.f. of the battery doubled, the electric cold between the plates.

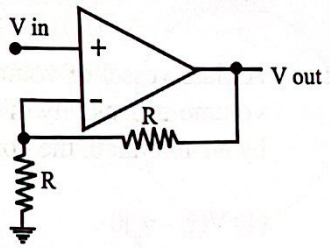
(1) remains unchanged. (2) is halved. (3) is doubled.

(4) is quadrupled. (5) is trebled.

Electrostatic Potential 06

As soon as you read the question, you can get the answer. By doubling the e. m. f value of the battery means doubling of the potential difference between the plates. As the distance between the plates is unchanged, when V is doubled E gets doubled. (E = V/d)

9. The voltage gain of the circuit shown is



(1) +2 (2) –2

(3) +1 (4) –1

(5) +4

Integrated Circuits 09

Once you see this, you can decide that this is an irreversible operational amplifier. The voltage gain here is 1 +(R/R) =2. Look at the essay question of 5 (b) of year 2003.

10 Consider the following statements made regarding the refraction of light.

(A) Refractive index of a medium is equal to the ratio, $\frac{\text{speed of light in a vacuum}}{\text{speed og light in the medium}}$

(B) As light travels from one medium to another, its frequency does not change.

(C) The wavelength of light is reduced when it passes from vacuum to a medium.

Of the above statements.

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

(2) only (A) is true.

(3) only (B) is true.

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

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

03 **Refraction**

These statements are given every day. At a glance, you will realize that all three statements are correct. As the speed of light reduces when going into a medium, the wavelength should be reduced because the frequency is not changed.

11. The period of an object performing a simple harmonic motion depends on

(A) the amplitude of the oscillation.

(B) the speed of the object at the equilibrium point.

(C) the initial position of the object.

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) all (A), (B) and (C) are not true.

03 **Simple Harmonic Motion**

The time period does not depend on any of the facts. Recall a simple pendulum. Then you can decide quickly that the time period is not dependent upon its amplitude, speed or initial position. Even if you think of a mass in a spring, its period is dependent upon the spring constant and the mass. In simple terms, the period is dependent upon the characteristics of the system of the motion and the other constants. It is not dependent upon the characteristics or facts that are relevant to the motion. The given characteristics are all related quantities of the motion.

12 A glass vessel of volume V is completely filled with a liquid of volume expansivity γ_l. The volume expansivity of glass is γ_g. ($\gamma_l > \gamma_g$). If the temperature of the glass vessel is increased by an amount θ, the volume of liquid that expels from the vessel is

(1) $V(\gamma_l - \gamma_g)\theta$

(2) $V(\gamma_l + \gamma_g)\theta$

(3) $V\gamma_l\theta$

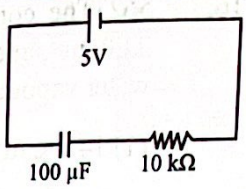
(4) $V\gamma_g\theta$

(5) zero

04 **Expansion of Liquids**

This is just a question. As the container is completely filled, the volume of the container and the initial liquid volume are equal. Therefore, the removed liquid volume is $V(\gamma_l - \gamma g)\theta$ whereas $(\gamma_l - \gamma g)$ is the apparent expansivity of the liquid.

13 A 100 μF capacitor connected in series with a 10 kΩ resistor is connected to a 5 V battery as shown in the figure. The charge stored in the capacitor in this circuit at the steady state is



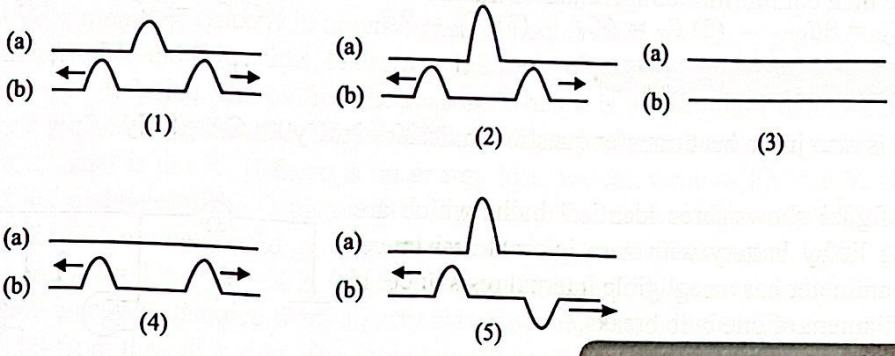
(1) 5.0×10^{-5} C (2) 5.0×10^{-4} C

(3) 5.0×10^{-3} C (4) 5.0×10^{-2} C (5) 5.0×10^{-1} C

Electrostatic Potential 06

It is question that you can get the answer without writing the numbers. When the continuous state is reached, there is no current flow in the circuit. Then, total 5 V is across the capacitor. That means according to Q =CV, the stored charge is $100 \times 10^{-6} \times 5$.

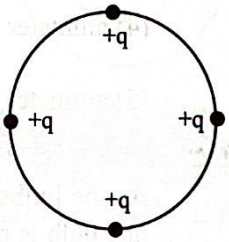
14  Figure shows two identical pulses moving towards each other along a string. The two instants where (a), the two pulses overlap completely, and (b), sometime after the overlapping occurs are best represented by



Wave Properties 03

This is a very simple question. According to the superposition principle, when the pulses are on top of each other, they must be added algebraically to get their resultant. As the pulses are identical, when they are added together, the amplitude gets doubled. Then the pulses are separated from each other as before. The answer is (2). Look at the 24th question of paper 1999.

15 Four point charges, each having charge q are fixed to the circumference of an insulating disk of radius r as shown in figure. When the disk is rotating about an axis passing through its centre and perpendicular to its plane at n revolutions per second, the mean electric current along the circumference of the disk is



(1) $\frac{4q}{n}$ (2) $8\pi rqn$ (3) $4qn$ (4) $\frac{2qn}{\pi r}$ (5) qn

Current Electricty 08

Current is the number of charges in a unit time. Therefore, the net current from one q charge is qn. So, the net current from four charges is 4qn. Even if we look from the units, Ampere is Coulomb per second. Therefore, to get a current the amount of Coulomb should be multiplied by the frequency.

I can remember that such a question was there in an essay question of the initial time of a paper on 1990. I remember as it asked to find the net charge when a proton is going around a circle. If v is given as the moving speed instead of the revolutions per second, then n = v/2πr.

16. 5623The concentration of water vapour inside a closed room at a certain temperature is 24.0gm^{-3}, and the relative humidity is 60%. If the air inside the room is made to saturate with water vapour at the same temperature, the new water vapour concentration inside the room is

(1) 14.4 g m^{-3} (2) 24.0 g m^{-3} (3) 40.0 g m^{-3}

(4) 60.0 g m^{-3} (5)100.0 g m^{-3}

04 Hygrometry

The answer can be obtained by the interpretation of the relative humidity. 60/100 =24/m; m = 40.0 gcm^{-3}.

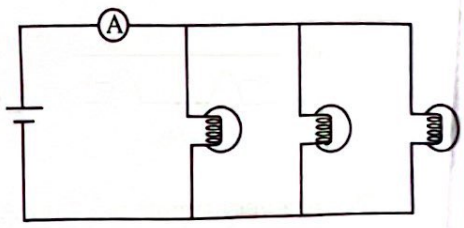
17 A metal block X of mass m at temperature ^{0}C is made to contact with another metal block Y of mass 2m at temperature 100 ^{0}C. Heat transfer takes place between X and Y with no heat loss to the surrounding. The specific heat capacities of the X andY metals are C_X and C_Y respectively. If the final equilibrium temperature of the metal blocks is 20^{0}C, then

(1) $C_X = 8C_Y$ (2) $C_X = 4C_Y$ (3) $C_X = 2C_Y$ (4) $C_X = \frac{1}{2}C_Y$ (5) $C_X = \frac{1}{4}C_Y$

04 Calorimetry

This is also just a heat transfer question. mCx20 =2mCy80; Cx = 8 Cy

18 The figure shows three identical bulbs which are being lit by battery with zero internal resistance. The ammeter has a negligible internal resistance. If the filament of one bulb breaks,



(1) ammeter reading decreases and brightness of each remaining bulb increases.

(2) ammeter reading decreases and brightness of each remaining bulb decreases.

(3) ammeter reading increases and brightness of each remaining bulb increases.

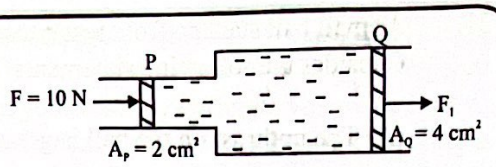
(4) ammeter reading increases and brightness of each remaining bulb decreases.

(5) ammeter reading decreases and brightness of each remaining bulb remain the same.

08 Ohm's Law Combination of resistances

As the bulbs are connected parallelly, the net resistance of the system gets increased when one bulb is burnt. Then the current drawn from the battery gets reduced. If the resistance of a filament is R, then the previous net resistance is R/3. When one bulb is burnt, then the net resistance is R/2. Even if one filament is broken, the current across the bulbs does not change. If the current drawn from the battery is 3I, then that 3I is divided among the three bulbs. After that the drawn current from the circuit is 2I but now there are only two bulbs. Therefore, now the current across one bulb is I. The answer is (5). If such questions can be practiced to solve without calculation, then you do not have to pay for the sins that you collect by scolding to the mothers of the persons who made the paper.

19 A force F=10N is applied to the smaller piston P of area 2 cm² of the hydraulic system shown in the figure to produce a force F_1 on the larger piston Q of area 4 cm². When the surrounding temperature is decreased the liquid inside in solidified. The solidified block moves freely inside the system and the new force produced on Q due to the force F=10N become F_2. The respective values of F_1 and F_2 are



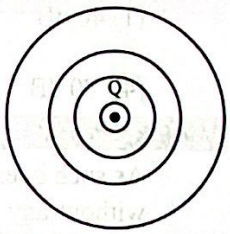
(1) 20 N, 20 N (2) 20 N, 10 N (3) 5 N, 10 N

(4) 5 N, 20 N (5) 20 N, 5N

Hydrostatics 02

According to Pascal principle, when pressure is applied to a liquid, if it is non-compressed, then that pressure is uniformly distributed across the liquid. The pressure from the left piston is10/2 (5). So, according to that the force on the right piston is 5 X 4 = 20. You can do it from your memory. Once it is transformed into solid state, the force applied on the left side is transferred to the right side. Therefore, the force obtained by the other side is equal to the force on the left side. Let us find the reason. When it is in the liquid state, think that piston (P) was pushed by a distance X by the force F. Then how much the right piston (Q) is pulled forward? That is not X. If there is no energy loss, we can write as $FX = F_1Y$. Here Y is the travelling distance of the Q piston. If a liquid is pulled forward from the left side, then that pulled liquid volume should go forward from the right side. That means $A_PX = A_QY$. As A_P = 2 cm² and AY= 4 cm², Y =X/2. So, F_1 =2F. But if the liquid become a solid X = Y. If a solid is pulled a certain distance from a particular distance, then an equal distance should be gone forwards from the other side. The molecules in a solid cannot move from one side to another side. But liquid molecules are not like that.

20. The figure shows a set of circles centred on a stationary point charge Q. The circles could be used to represent



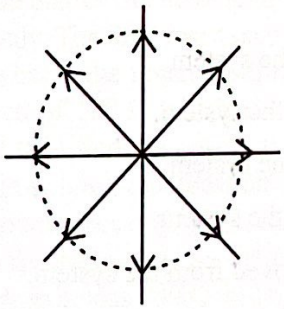
(1) the electric field lines. (2) the magnetic field lines.

(3) the magnetic equipotential lines. (4)the gravitational field lines.

(5) the electric equipotential lines.

Electrostatic Potential 06

The electric force lines from a point charge are radial. As the charge is still, there is no chance of generating a magnetic field. In a radial electric field, the equipotential surfaces are spherical. The equipotential surfaces should be perpendicular to the force lines. Because when taking a charge through an equipotential surface, there is no need to do work against the field.



21. A small ball starting from rest rises through a viscous liquid and reaches its terminal velocity. Consider the following statements,

(A) The upthrust on the ball is greater than the weight of the ball.

(B) At the initial moment of the motion the viscous force on the ball is zero.

(C) The acceleration of the ball remain constant until the ball reaches the terminal velocity.

Of the above statements

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

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

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

10 Viscosity

This is a very easy question. As you read the sentences, you can decide whether they are correct or not. Definitely (A) should be true as the sphere moves upwards and gets the continuous velocity. As the object is starting from rest, the viscous force at that instance should be zero. Therefore, (B) is also true. It is a common fact that, an object travels in a viscous road cannot have a constant acceleration before it gets the continuous velocity. That is because the viscous force is dependent upon the velocity. Therefore, (C) is false.

22. Ten persons are standing on a circle. When one of them shouts, the intensity level at centre of the circle is 50 dB. If all ten persons shout at the same each producing the above sound level, the intensity level at the centre becomes

(1) 40 dB (2) 50 dB (3) 60 dB

(4) 80 dB (5) 90 dB

03 Intensity of Sound

As such questions can be seen in every paper, as soon as you see, you should get the answer without any calculations. If not, then you have not learnt anything from the past papers. It should be directly seen that, there is a 10 dB increment from 10 people. It is a sin to write equation for it. From 100 people, there is an increment of 20 dB. Look at the 16th question of paper 2000.

10^1--> 10; 10^2--> 20;10^3--> 30; Therefore, the new intensity level is 60 dB.

23 Figure shows a PV diagram of a perfect gas subjected to a cyclic Process ABCA. In this process

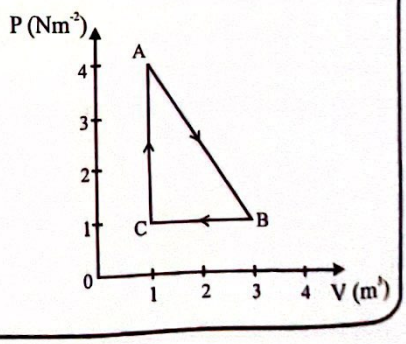
(1) 3 J of heat is absorbed by the system.

(2) 3 J of heat is remove from the system.

(3) 6 J of heat is absorbed by the system.

(4) 6 J of heat is remove from the system.

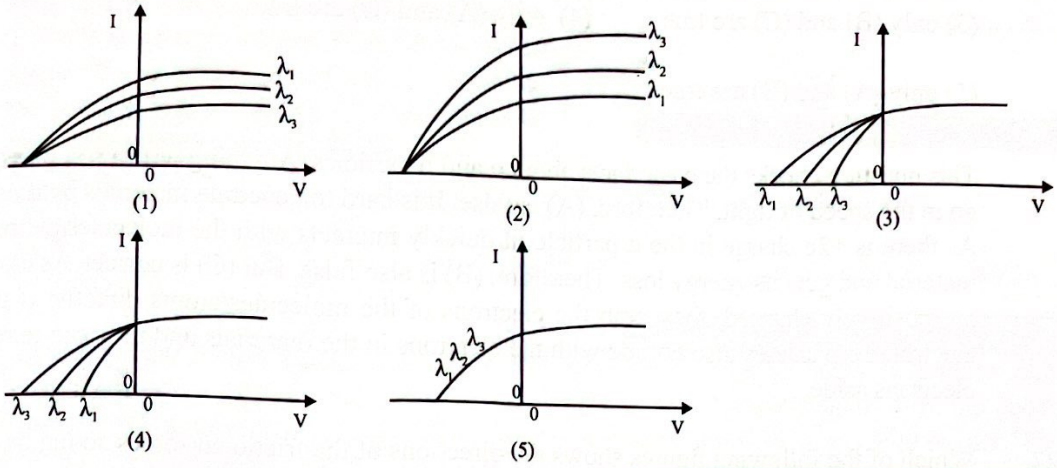
(5) no heat is absorbed or removed from the system.



04 Thermodynamics

This question was there in the paper of 2004 as I remember (20th question of paper 2004). As it is a cyclic process, $\Delta U = 0$. Therefore, $\Delta Q = \Delta W$. The magnitude of the work done is obtained from the area of the triangle. Cannot you get it from your memory? Why do you waste time to write the numbers? ½ X 2 X 3. As the arrow of the process is clockwise, the work is taking a positive value. That means the system is doing work. Therefore, ΔQ is also positive. What it implies is that, the heat is getting absorbed. The correct answer is (1).

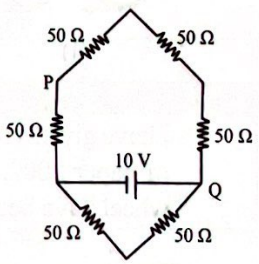
24 A photosensitive surface is illuminated separately by light of wavelength λ_1, λ_2 and λ_3 ($\lambda_1 > \lambda_2 > \lambda_3$). On all three occasions the intensity (number of photons per second) of the light used is kept at the same value. The current- voltage characteristics of the photo electrons for the three situations are best represented by



Photoelectric Effect 11

This is also related to the I-V curves of photoelectric effect that you know. If λ is small, then the frequency is high. Therefore, the stopping potential should be greater for a small λ value. You only have to look into that. (1), (2) and (5) are just dumb choices. In those, the stopping potential is same for each λ. The correct answer is (4).

25 Six resistors each of value 50 Ω are connected in a circuit as shown in the figure. The 10 V battery has negligible internal resistance. The potential difference between P and Q is



(1) 0.5 V (2) 2.5 V (3) 5.0 V

(4) 7.5 V (5) 10 V

Ohm's Law Combination of Resistances 08

Even though you need a calculation, this is not a difficult question to do from the memory for a child who got A pass for Mathematics. As there is no internal resistance for the battery, the calculation can be done very easily. The total resistance above the battery is 200 Ω. Therefore, if 10 V is across 200 Ω, then what is the potential difference across 150 Ω of PQ? (10/200) X 150 = 7.5 V. There is no need of 100 Ω which is below the battery. Find the equivalent resistance, the total current and then find the potential difference across PQ that can also be done as an alternative method in solving the question. But it is traditional and it takes some time. How hard is it find the amount across 150 if 10 is across 200? This cannot be done easily if there is an internal resistance for the battery. As there will be a voltage drop across the two ends of the battery, the voltage drop across 200 Ω will not be 10 V in that case. If so, you need to find currents for that purpose.

26 Consider the following statements regarding α and β particles

(A) Both α and β particles travel with the speed of light.

(B) Generally α particles penetrate deeper into material than β particles.

(C) Both α and β particles can ionize atoms when they travel through materials.

Of the above statements

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

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

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

11 **Radioactivity**

This question checks the basic facts about α and β particles. Anything with a rest mass cannot go in the speed of light. Therefore, (A) is false. It is hard to penetrate materials by α particles. As there is +2e charge in the α particle, it quickly interacts with the molecules/atoms of the material and gets its energy loss. Therefore, (B) is also false. But (C) is correct. As α particles are positively charged, they grab the electrons of the molecules/atoms directly. If they are electrons, β particles also collide with the electrons in the materials and they can remove the electrons aside.

27 Which of the following figures shows the directions of the frictional forces acting on the two tyres of a bicycle when it is paddled by a rider on a surface with friction?

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

02 **Friction**

I have given a review about the directions that the frictional force acts in the first essay question of paper 2002. The direction of frictional forces when a man is walking and in the bicycle wheel have been described in detail. Again that description is presented here.

The forces acting on the rear wheel of a bicycle has been shown below in figure 1. There is a driving torque on the rear wheel at such an instance. These are considered as the driven wheels. Such a wheel presses the ground backward. Then keep an eye on the nature of the surface on the ground. Thesurface shape has been distorted than the normal way to understand easily. Sometimes even if we do not see this for our naked eye, it is true in the limit of atomic scale. Then does not the horizontal force (friction) from the ground on the wheel is acting to the forward direction?

The forces on a rolling undriven wheel from the ground is shown from figure 2. Then the firctional force is acting backwards on the wheel.

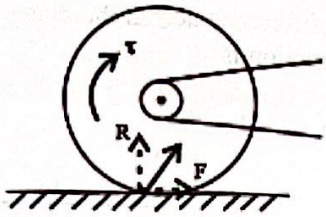


figure 01

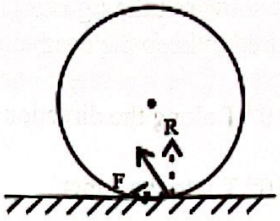
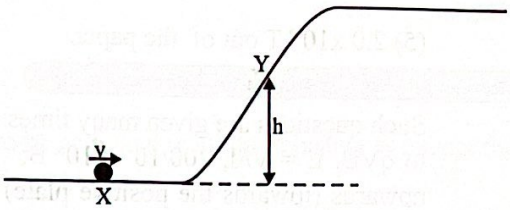


figure 02

28 An object of mass m moving on a frictionless plane passes a point X with a velocity v and rises up a frictionless inclined plane to a point Y that is at a height h above X as shown in the figure. If a second object of mass m/2 passes the point X with a velocity v/2 , the height to which the second object will rise is



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

Work Power and Energy 02

You can get the answer quickly by writing the conservation of energy equation ½ $mv^2 = mgh$. If you do an investigative study, you can see that h is not dependent upon m in the above equation. If you argue according to that, there is no issue even if the mass is m or m/2. The term h is dependent upon v^2(if g is constant). If you look from that way, then the object with the speed of v goes to a height of h. If the object is coming with a speed of v/2, then the object reaches a height of h/4. The answer is (2).

29. Figure 1 shows a book A placed on top of a box B which rests on the floor. Figure 2 shows the free body force diagram for the box. P,Q,andR indicate the forces acting on the box. Which of the following statement is true?

(1) Q>P+R

(2) Force on the floor exerted by the box is indicated by P

(3) Force on the floor exerted by the box is indicated by Q

(4) Force exerted on the box by the book is indicated by R

(5) Q<P+R

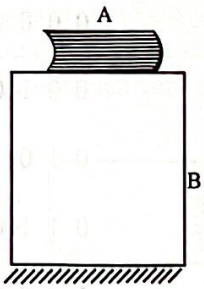


Figure 1

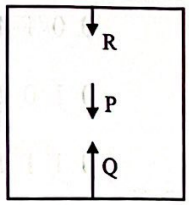
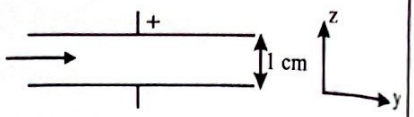


Figure 2

Equilibrium of forces 02

If a certain object is separated (isolated) and the forces acting upon it is marked, then it known as the free body diagram. Accroding to that, you can quickly decide that P is the weight of the box, R is the force acting on the box by the book and Q is the force acting by the ground on the box. As they are in equillibrium, Q = P + R. From that, (1) and (5) choices are just removed. The drawn forces are acting upon the box and not on any other else. Even the phrase 'on the box' is given only in (4).

30 A beam of electrons enters the region between two charged parallel plates with speed 10^6 m^{-1} as shown in the figure. The potential difference across the plates is 200 V. Magnetic field required to keep the beam along the y direction is



(1) 2.0×10^{-4} T along the direction of the beam.

(2) 2.0×10^{-4} T into the paper.

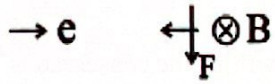
(3) 2.0×10^{-2} T along the direction of the beam.

(4) 2.0×10^{-2} T into the paper.

(5) 2.0×10^{-2} T out of the paper.

07 Force on a Moving Charge in a Magnetic fields

Such questions are given many times in the previous papers. The force of qE should be equal to qVB. E = V/d; $200/10^{-2} = 10^6$ B; B =2 X 10^{-2}. As an electron is entered, it is deflected upwards (towards the positive plate) due to the electric field. To cancel that, the magnetic force should be directed downwards. To do that, the magnetic field should be directed towards the paper.



31 An alarm is to be sounded in a car at least when the car is started while a door is open or the car is started while the driver is not wearing seat belt. Three sensors A,B and C provide signals such that A=1 when at least one door is open, B=1 when the engine is running and C=1 when the driver is not wearing seat belt. If the alarm is activated when F=1, the correct truth table for F is

A B C F	A B C F	A B C F	A B C F	A B C F
0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
0 0 1 1	0 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0
0 1 0 1	0 1 0 1	0 1 0 1	0 1 0 0	0 1 0 0
0 1 1 1	0 1 1 0	0 1 1 1	0 1 1 0	0 1 1 1
0 0 0 1	1 0 0 0	1 0 0 0	1 0 0 0	1 0 0 0
1 0 1 1	1 0 1 0	1 0 1 1	1 0 1 0	1 0 1 0
1 1 0 1	1 1 0 1	1 1 0 1	1 1 0 0	1 1 0 1
1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
(1)	(2)	(3)	(4)	(5)

09 Logic Gates

The easiest way to check the given truth gates is to design the truth gate that needs to be given F =1 by yourself. Next, the needed requirements should be checked with each choice.

The simplest way to think is whatever the method, definitely the engine has to be activated to get the signal. Who cares about opening doors or not wearing seat belts when the engine is switched off? Therefore, B=1 needs to be satisfied when F =1 definitely. It is a stupid thing even to think of B = 0. Now, when B = 1 A and C can take only 4 alternatives.

B	A	C
1	0	0
1	0	1
1	1	0
1	1	1

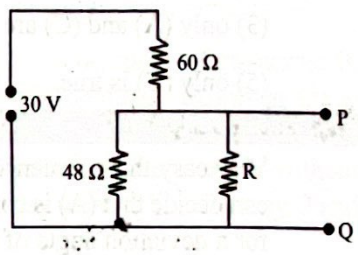
From this, do not you get that the signal needs to be activated in all three instances except the first instance?

A = 0 means the instance where even one door is not closed. C = 0 means the instance where you wear seat belt. Actually, the bell should ring when the engine is on, doors are closed (A = 0) while not wearing seat belts (C = 1) orwhen the engine is on, either one door is open (A = 1) while wearing seat belts (C = 0) or when the engine is on,either one door is open (A = 1) while not wearing seat belts (C = 1). So, F = 1 should be when

B	A	C
1	0	1
1	1	0
1	1	1

instances only. Those requirements are at (5). If you identified that only at three instances that F should be 1 initially, then you need to look at only (2) and (5). Once three choices are removed like that, the answer can be obtained very easily.

32 The potential divider circuit shown is powered by a 30 V d.c. supply of negligible internal resistance. The potential different across P and Q is 5 V. The value of the resistance R is



(1) 10 Ω (2) 12 Ω (3) 16 Ω

(4) 24 Ω (5) 28 Ω

You can solve this without going into a calculation. If the potential difference between P and Q is 5 V, then the rest of 25 V drops across 60 Ω. Therefore, the equivalent resistance between P and Q should be (60/25) X 5 = 12 Ω (If 25 is for 60, then how much is for 5?) Now, 1/R + 1/48 = 1/12. 1/R = (4-1)/48; R = 16 Ω.

33. The image of an erect virtual object which is situated between the lens and its focus, formed by a diverging lens is

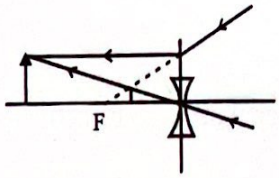
(1) real, erect and larger than the object. (2) real, inverted and larger than the object.

(3) real, erect and smaller than the object. (4) virtual, erect and smaller than the object.

(5) virtual, inverted and smaller than the object.

03 **Refraction through Lenses**

Such questions can be easily solved by reversing the rays. What we are familiar is that when a real object is placed in front of a concave lens, the image will be unreal, non-inverted and small than the object.



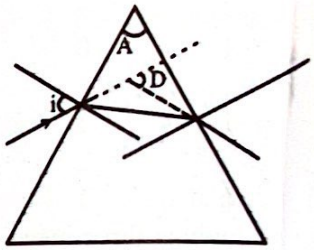
Now think that the image is an unreal object (by reversing the rays), the created image should be the previous object. That means it should be real, non-inverted and a bigger one than the object. The correct answer is (1). Look at the 32nd question of paper 2004.

34 A monochromatic ray of light is incident upon a prism of refracting angle A and emerges as shown in the diagram. Consider the following statements made about the angle of deviation D.

(A) As the angle i is increased from zero the value of D passes through a minimum.

(B) D is zero when the ray enters the prism normally.

(C) For a given value of i, D does not depend on A.



Of the above statements

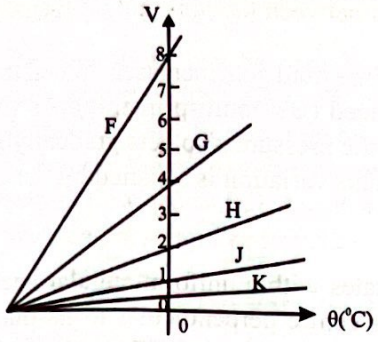
(1) only (A) is true. (2) only (A) and (B) are true.

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

(5) only (C) is true.

03 **Refraction through Prisms**

Very easy three sentences are there. Such sentences have been checked by many times. You can decide that (A) is correct when reading it. Everyone knows that there is a minimum value for a deviation angle of a prism. Even the ray is incident perpendicularly, D cannot be zero. Even there is no deviation from the first surface, there will be a definite deviation from the second surface. Either the ray gets refracted from the second surface or it will be subjected to total internal reflection. You know that $D = (i_1 + i_2) - A$. It can be clearly seen that D is dependent upon A.

35 

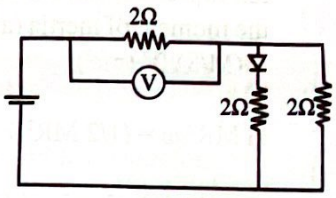
The variation of the volume V with the temperature θ of an ideal gas of mass m at a constant pressure P is shown by the line H of the graph. The variation of V with θ of the same ideal gas of mass 2m at constant pressure P/2 is shown by

(1) F. (2) G. (3) H.
(4) J. (5) K.

Expansion of Gases 04

Every straight line is cut on one point (in a negative value of θ). Therefore, you do not need to worry about that. You need to think of the gradient of the straight line. If P/2 and 2m are there instead of P and m, then the gradient should be four times increased than the initial value. This is the only fact that you need to look. Writing equations is a waste of time. As each straight line is directed to one point in the axis of θ, it is enough to decide the place where the straight lines are cut in the V axis (intercept). As the cutting place of H line is 2 units, the fourth multiple of it is 8. The correct answer is (1).

36 The diode in the circuit shown has zero forward bias resistance and a reverse break down voltage of 75 V. Internal resistance of the cell is negligible. The voltmeter reads 12 V. When the terminals of the diode are reversed the voltmeter reading is

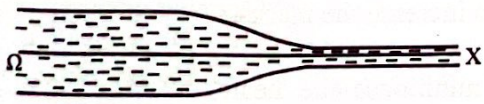


(1) 6 V. (2) 8 V. (3) 9 V.
(4) 10 V. (5) 18 V.

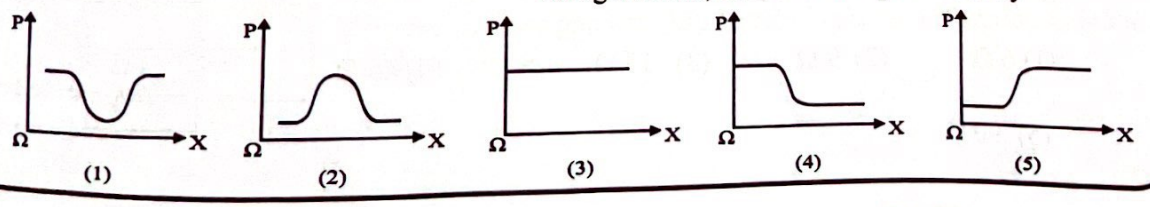
Semi Conductor Diodes 09

As the forward biased resistance of the diode is zero, the resistance of 2 Ω in the circuit branch that the diode is connected and the other 2 Ω are parallel to each other. The equivalent resistance of them is 1 Ω. Therefore, if the potential difference is 12 V across 2 Ω where the voltmeter is connected, then the potential difference across equivalent resistance 1 Ω should be 6V. So, the e. m. f value of the cell should be 18 V. This 18 V is smaller than the back inverse voltage of the diode which is 75 V. What is meant here is that when two ends of the diode are interchanged, it will not go to a state of breakdown. 75 V has been mentioned to emphasize that fact.

Therefore, when two ends of the diode are interchanged, there is no current flow across it. That means there is no use of the resistor that is in series with the diode. However, the e. m. f of the cell which is 18 V, is divided equally among the rest of two resistors of 2 Ω. Therefore, the reading of the voltmeter is 9 V. You can think the question like this without writing calculations on the paper. The problem is that you are lazy to think like this way. 2 and 2 is 1. Then e. m. f of the cell is 18 V. When 18 is divided by 2, it is 9.

37 

A non-viscous and incompressible fluid flows through a tube in which the cross-section is varying as shown in the figure. The variation of pressure P along the axis, OX, is best represented by



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

02 **Hydrodynamics**

This is simple. When the area is reduced, the speed of the fluid gets increased. When the speed is increased, then the pressure of the fluid gets reduced (Bernoulli principle). As the cross section is gradually reduced and takes a small value, the pressure also gets gradually reduced and should get a less pressure than the thicker tube. This variation is satisfied by the curve of (4).

38 A uniform circular disk of radius R and mass M rotates with a uniform angular speed ω in a horizontal plane about an axis passing through its centre perpendicular to its plane. The moment of inertia of the disk about the axis described above is $\frac{1}{2}$ MR². When a ball of clay of mass $\frac{M}{8}$ is placed gently on the edge of the disk and if it sticks, the new angular speed of the system is

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

02 **Rotational Motion**

An expression should be written by conserving the angular momentum. You need to know that the moment of inertia (around the rotational axis) of the clay that is sticky in the circumference is (M/8) R² (mr²).

½ MR² ω = (1/2 MR² + M/8 R²) ω' After that do not write MR².

ω = (1+ ¼) ω'; ω' = 4/5 ω

If you have an experience of simplifying the mathematical expressions, then you can minimize the time for this question.

39 A ray of light travelling in water (refractive index n_1) is incident on the air/water boundary at the critical angle. When a layer of oil (refractive index n_2) is floated on the water surface, the angle of refraction of this light ray in oil is

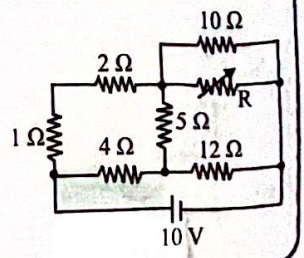
(1) $\sin^{-1}\frac{1}{n_2}$ (2) $\sin^{-1}\frac{1}{n_1}$ (3) $\sin^{-1}\frac{n_1}{n_2}$ (4) $\sin^{-1}\frac{n_2}{n_1}$ (5) 90°

03 **Refraction**

The incident ray in water does not change in the water-oil interface as oil has been put on the water. Therefore, we can build the equation at a row for those two instances. If the incident ray of the water is C, then n_1 Sin C = 1 = n_2 Sin r (r = the refracting angle in oil)

Therefore, r = Sin $^{-1}$ 1/n_2 whereas n_1 is not included in the answer. If needed, you can write the equation for two times. n_1 Sin C = 1; n_1 Sin C = n_2 Sin r. But there is no change in the incident ray as oil has been put on the water. Therefore, as written before, you can save the time by writing the equation at a row and even you can increase the marks.

40 The value of the variable resistor R that minimizes the heat generated in the 5Ω resistor is



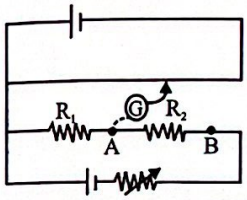
(1) 6 Ω (2) 9 Ω (3) 15 Ω (4) 45 Ω

(5) 90 Ω

Such questions can be seen in many past papers. If you have an experience in answering the past papers, then half of it can be done from the memory. You should know that there is Wheatstone bridge principle by your instinct. The ratio of the resistors on the left side is 3:4. Therefore, the ratio of the resistors on the right side also should be 3:4 if there should not be a current flow across 5 Ω. As the bottom resistor of the right side is 12, the equivalent resistance of 10 and R should be 9 (9:12 = 3:4).

1/10 + 1/R = 1/9 (10 X 9 = 90; 10 - 9 =1); So, R = 90 Ω.

If you have A for Mathematics at O/L, cannot you simplify 1/9 - 1/10 from your memory?10 X 9 = 90 and when 9 is subtracted from 10 is 1. Therefore, R = 90 Ω. Time can be saved if you can do it in your head. Look at the 50th question of paper 1995.

41 

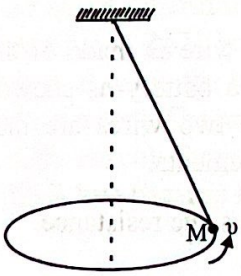
A potentiometer circuit is set up as shown in the figure. When the galvanometer is connected to point A and to point B respectively, the balance lengths obtained are 75 cm and 300 cm. The ratio of R_2/R_1 is

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

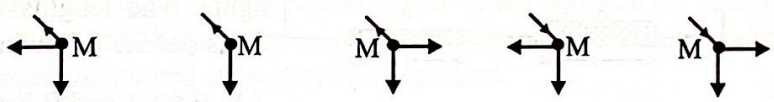
There are many such questions. Same current flows across R1 and R2. Therefore,

$R_1 \propto 75$; $R_1 + R_2 \propto 300$.

If the second is divided from the first, $1 + R_2/R_1 = 300/75$; $R_2/R_1 = 3$ (300, 4 of 75)

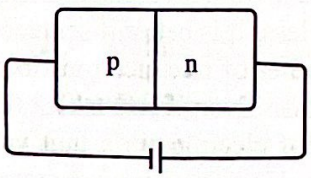
42 

A sphere M attached to a thread is whirled in a horizontal circle at a constant speed as shown in the figure. The forces acting on the sphere observed by a person who is at rest the laboratory are best represented by



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

As soon as you see the question, you can get the answer. Only true forces act on the sphere relative to an observer in an inertial frame. That means the tension and the weight of the object. Look at the 33rd question of paper 2001. The answer is (2). The horizontal component from the tension of the string provides the force towards the centre. The vertical component of the string balances the weight.

43 

A p-n junction is connected to a battery as shown in the figure. When light is shone on the junction, electron-hole pairs are created due to the absorption of photons. The current in the circuit produced by the incident light is

(1) due to electrons moving in the direction of n to p and holes moving in the opposite direction.

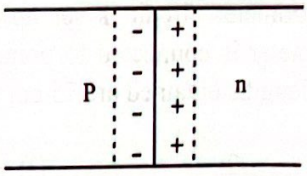
(2) due to electrons moving in the direction of p to n and holes moving in the opposite direction.

(3) due to electrons moving from p to n only.

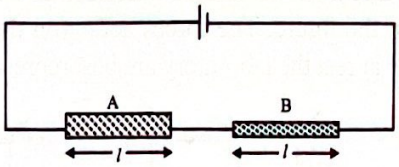
(4) due to holes moving from n to p only. (5) zero

09 **Semi Conductor Diodes**

The majority carriers in n type semiconductors are electrons whereas holes are the majority carriers of the p type semiconductor. Near n-p common junction there is a depletion region where electrons and holes combine with each other. In the depletion region, n side is positive (as there is a certain electron loss) and p side is negative.



Now, when the light is fallen, the incident photons create electron hole pairs. These electrons move to the positive side (n side) whereas the holes move to the negative side (p side). You will get the answer from this itself. If we look in another simple way, the positive end of the battery is connected to n. Therefore, np junction is in reverse biased mode. This circuit gets completed only when the light is fallen and electron holes are created. Then the positive current should flow from n to p whereas electrons should flow from p to n. According to this, if you consider the polarity of the battery ends (positive negative side), then you can get the answer very quickly. Another special point that you need to consider is that, photons create both electrons and holes.

44 

A thick wire A and a thin wire B made of the same material are connected to a battery as shown in the figure. The lengths of the two wires are the same. Consider the following statements.

(A) Both A and B have the same resistance.

(B) Drift velocity of electrons in A is smaller than that in B.

(C) Free electron densities in A and B are different.

Of the above statements

(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.

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

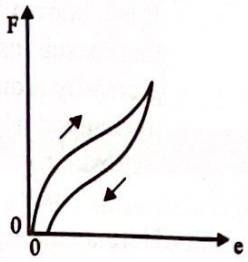
08 **Ohm's Law combination of Resistances**

Sentence (A) can be just understood as wrong. As it has been made from the same material and the length is same, the resistance of the thicker wire should be less. It is better if sentence (C) was there as the next one. The electron density means the number of free electrons in a unit volume. It is dependent upon the material not on the dimensions. Even if you take a thicker wire or a thinner wire with the same material, then number of electrons in a unit volume should be same for that material. Therefore, (C) is also wrong. Hope you can remember the equation of $i=nqAV_d$. Same current goes in two wires and the electron density n is also same.

Therefore, if A is increased, V_d is less. Therefore (B) is true.

Consider the flow of water from two pipes. In the thicker tube the water flow slowly. Its speed is less. In the thinner tube the speed is high. But the water weight per a unit volume cannot be changed. If you consider the water flow of two tubes, then the answer can be obtained very easily.

45 The figure shows a force (F) – extension (e) graph for a rubber band. Consider the following statements.



(A) The rubber band does not return to its original length after stretching.

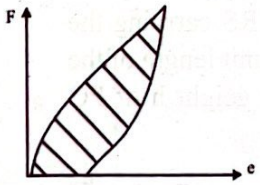
(B) The magnitude of the total work done during the increase of the length is less than the magnitude of the total work done during the decrease of the length.

(C) Heat can be generated in this process.

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.

As soon as you see the graph, you can decide the correct incorrect nature of the sentences. At a glance it can be seen that (A) is correct. The extension should be zero if it comes back to its initial length. The work is equal to the area in between the curve and the extension axis. Therefore, it can be clearly seen that when the length is increased, the work done is also increased. Therefore, (B) is false. This is like a P-V curve. As work can be obtained by the multiple of $P\Delta V$, here the work is obtained by the multiple of $F\Delta e$. As the relevant works are unequal when the length is reduced and increased, the difference of these works is changed into the heat. The produced heat is equal to the area in between the curves (with the boundaries of the curve). Even if you do not think about these, you can decide without an argument that (C) is true because it has been mentioned as heat can be generated.



46. The filament of a 100 W bulb takes 200 ms to reach its full brightness when the bulb is connected across a constant voltage supply of 230 V.

Consider the following statements

(A) During the 200 ms period the resistance of the filament increases.

(B) During the 200 ms period, power drawn from the supply decreases to 100 W, starting from a higher value.

(C) Filament emits energy in the form of electromagnetic radiation.

Of the above statements

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

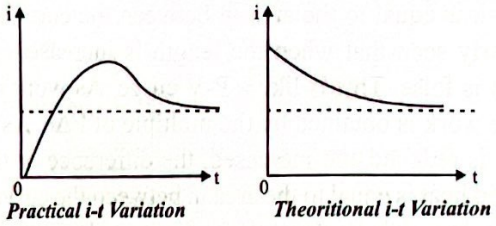
08 **Heating Effect of Electric Current**

It is a known fact that when the filament gets heated, its resistance is increased. According to that reason (as R gets increased), the power (or else the current) drawn from the source should gradually reduce and be constant. When R is increased, V^2/R gets reduced. As the resistance is unchanged when the filament reaches its maximum brightness, the power of the bulb becomes a constant.

Here a small practical question is arisen. When the switch is on to light the bulb, the drawn current actually starts from zero. If there is no inductance (no need to know this), then the current gets increased to a certain amount from zero as soon as the switch is on. As there is some inductance in any circuit, it takes some time for the current to reach the maximum from zero. When a capacitor is connected to a circuit, it takes some time to charge completely. This is similar to that process.

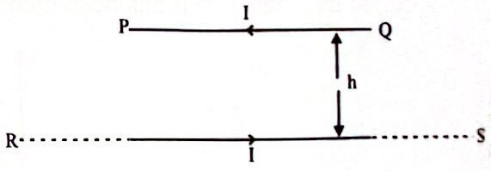
Therefore, one child can consider this process and can decide that statement (B) is false. There is no wrong in that argument.

You can directly see that (C) is correct. Even if light is distributed or heat is emitted, all are electromagnetic waves. Both choices of (3) and (5) have been considered as correct for this question. That is because of the uncertainty in statement (B).



Practical i-t Variation *Theoritional i-t Variation*

47 A thin uniform wire PQ carrying a l could be held without any mechanical support above an infinitely long horizontal wire RS carrying the same current I. If the mass per unit length of the wire PQ is m, the equilibrium geight h of PQ above RS is given by



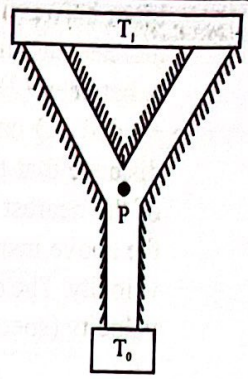
(1) $h = \frac{\mu_0 I^2}{mg}$ (2) $h = \frac{\mu_0 I^2}{2\,mg}$ (3) $h = \frac{\mu_0 I^2}{2\pi\, mg}$ (4) $h = \frac{\mu_0 I^2}{\pi\, mg}$ (5) $h = \frac{\mu_0 I^2}{\pi^2 mg}$

07 **Magnetic Effect of Electric Currents**

There are many such questions in the previous past papers. The force of ilB should be equal to the weight. Due the current in the lower wire, the magnetic field intensity created in height of h is $\frac{\mu_0 I}{2\pi h}$.

Directly ilB should be equalized to mg. $\frac{Il\,\mu_0 I}{2\pi h} = mlg; \quad h = \frac{\mu_0 I^2}{2\pi mg}$

48 A well lagged Y-shaped structure made of copper has three thin identical limbs. Free ends of two of the limbs are connected to a metal block which is maintained at temperature T_1 while the free end of the third limb is maintained at a temperature T_0 The steady state temperature of the junction P of the structure is



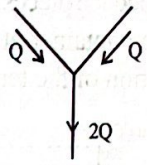
(1) $\frac{T_0+T_1}{2}$ (2) $\frac{3T_0+T_1}{2}$ (3) $\frac{2T_0+T_1}{3}$

(4) $\frac{T_0+3T_1}{2}$ (5) $\frac{T_0+2T_1}{3}$

Conductivity 04

There is no need to solve this question by writing standard equations. All the arms are made from the same material. Its area and the length are same. So, why do you need to write them? The other point is due to symmetry, the heat flow rates of the top two arms of Y shape are same. Both heat rates from the sides are added and entered into the lower arm. So, if T is the temperature of the joint, then cannot you directly write as $2(T_1 - T) = T - T_0$? Why do you need to keep on writing the heat conductivity, the cross-sectional area and the length?

$2T_1 - 2T = T - T_0$; $T = (2T_1 + T_0)/3$



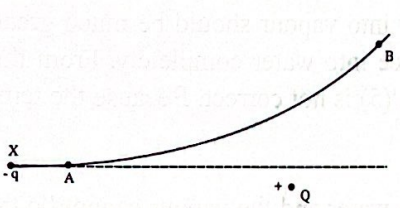
49. The oxygen molecule has 16 times the mass of the hydrogen molecule. At room temperature the ratio $\frac{\text{root mean square speed of oxygen molecule}}{\text{root mean square speed of hydrogen molecule}}$ is

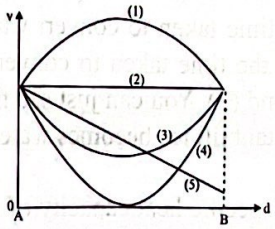
(1) 16. (2) 4. (3) 2. (4) $\frac{1}{4}$ (5) $\frac{1}{16}$

Expansion of Gases 04

This is a very easy question. It should have been put to the beginning of the paper. You know that root mean square velocity $\propto 1/\sqrt{M}$. Therefore, no need to do any calculations. The root mean square velocity of Hydrogen molecules are at the bottom of the ratio. It should be larger than the corresponding value of O_2. Therefore, then answer is (4). You can get it wrong in between 4 and ¼. You need to look carefully of what is there at the top and the bottom in the ratio.

50





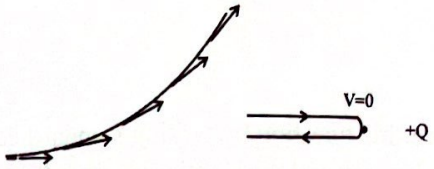
The figure shows the path of a particle X of charge +q moving in the vicinity of another fixed particle of charge +Q. Variation of the speed v of the particle X with the distance d travelled from A along the path the container with time is best represented by

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

Electrostatic Potentiol 06

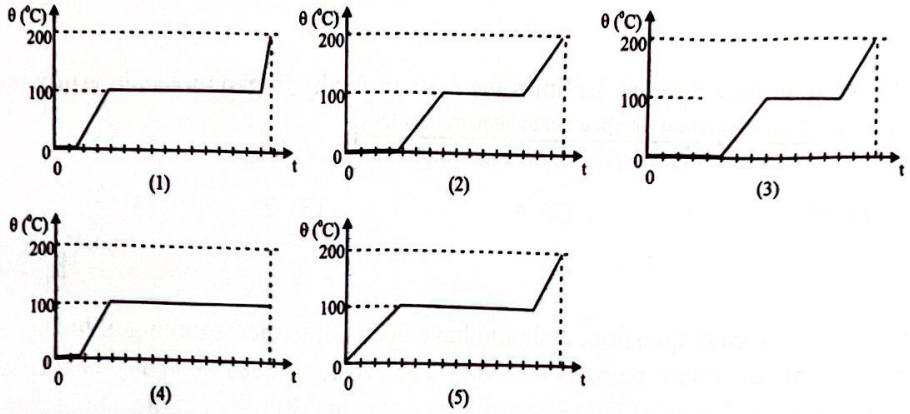
There is no need to write equations for this question. When a positive charge gets closer to another positive charge, the speed gets reduced. That is because of the static electric repulsive

force between the two charges. When +q and +Q comes near and gets separated, the speed increases again. Therefore, without a doubt (3) curve should be the correct curve. The selection is between (3) and (4). You should be able to decide that other variations are not correct. If +q and +Q came directly by face to face, then the speed suddenly gets zero at the nearest distance that they get closer. But as the +q charge goes at a distance, even though the speed of the nearest point gets a minimum value, it will not be zero. A good practical example for the above instance is when an α particle gets closer to the nucleus. Here you cannot draw the velocity. The direction of the velocity changes instantly. But we can draw the magnitude of the velocity (speed). The information about the atomic model of Rutherford was found like this.



Especially, as shown in the second figure, some α particles turned back and came. Accordingly, Rutherford decided that positive charge was centred in the nucleus.According to his words, "This is like the turning back of a bullet when it was pointed to a tissue paper."

51 Crushed ice pieces at 0^0C are kept inside a thermally insulated closed container. Heat is supplied to the container at a constant rate and the pressure inside the container is kept constant. The variation of the temperature inside the container with time is best represented by



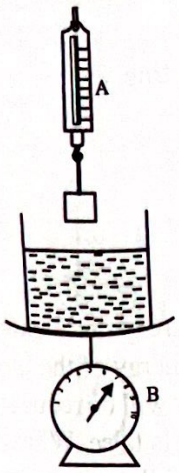
04 Calorimetry

You need to consider the following facts here.

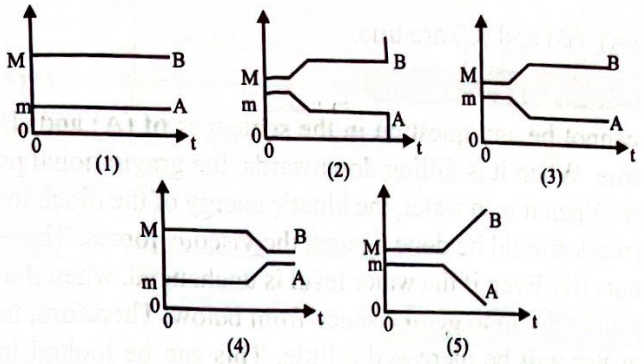
(i) The time taken to convert water into vapour should be much greater (about 7 times) than the time taken to convert ice into water completely. From this you can remove (2) and (3). You can just see that (5) is not correct. Because the temperature should be constant till ice becomes water.

(ii) The specific heat capacity of the water and the vapour cannot be the same. Water is a liquid whereas water vapour is like a gas. Therefore, the gradient of the relevant parts cannot be same. So, the correct curve is curve (1). The specific heat capacity of a gas is lesser than a liquid. Therefore, the gradient for the water vapour ($\Delta\theta/\Delta t$) should be greater.

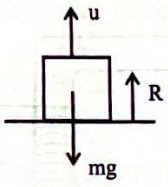
Here there can be a problem on how the pressure can be kept as constant in a closed container when the water evaporates. The closed container can have a piston which can move. Then the piston moves and the volume can get increased to keep the pressure at a constant value.Look at the 59th question of paper 1996.

52 

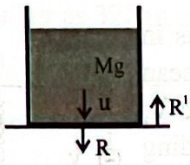
A uniform metal cylinder of mass m hangs from a spring balance A and is lowered slowly and steadily into a water container of mass M (M>m) until it rests totally submerged on the bottom of the container. The container is placed on the pan of a weighing scale B as shown in the figure. The variations of the readings of A and B with time t are best represented by



This has been checked. When the cylinder is gradually sinking in water, the reading of the A spring balance gets reduced. An equal amount of that reduction is shown in the B spring balance as an increment of the reading. After the cylinder is completely sunk, the readings of the balances are not changed. The upthrust that is acting on the cylinder when it is completely sunk and the downthrust acting upon the water will not be changed. When the cylinder gets still at the bottom of the beaker, the reading of the A spring balance gets zero. Because the string that is connected to the cylinder gets shrunk. Then the reading of the B balance should be m +M. For your understanding, the free object forces of the cylinder when it is at the bottom and the beaker have shown below.



$R + u = mg$



$R' = Mg + R + u$

$R' = Mg + mg$

Another important fact is that at any moment, the total of A and B readings should be m +M. Look it has been proved in the second diagram. It has been done not just because of anything. But when the cylinder and the water filled container are taken as one, their weight is only acting downwards.

The upthrust and its equal and opposite reaction which is the downthrust, as well as the reaction of m that is in the bottom of the beaker and its equal and opposite force that is acting downwards on m on the bottom of the beaker, are being cancelled off with each other. Look at the 58th question of paper 1998.

53 A metal block is suspended at rest below the surface of water in a tank as shown in the figure. When the block is released it falls to the bottom of the tank. Consider the following statements

(A) The block gradually loses its gravitational potential energy as it falls.

(B) Although the height of the water level does not change the water gains gravitational potential energy.

(C) If water was not present, the kinetic energy of the block at the point A would be less than that at A when water was present.

Of the above statements

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

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

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

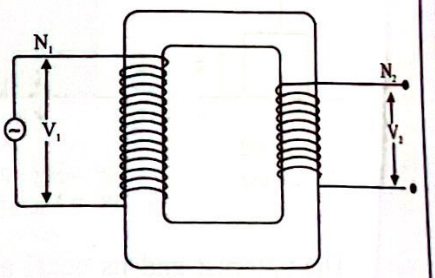
(4) only (A) is true.

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

02 **Hydrostatics**

There cannot be any question in the sentences of (A) and (B). They are general knowledge. (A) is true. When it is falling downwards, the gravitational potential energy of the block gets reduced. When it is in water, the kinetic energy of the block in the water will be reduced a little at A as work should be done against the viscous forces. Therefore, (C) is false. What can you say about (B)? Even if the water level is unchanged, when the block is fallen, some amount of water should go up to get the space from below. Therefore, the gravitational potential energy of the water will be increased a little. This can be looked in a simpler way. Consider only water when the block is above. There is no water shown in the part of the square. Therefore, at the first instance, the centre of gravity of water is not in the middle of the water volume. It is situated little bit below (as there is no water content above). When the block is fallen downwards, the centre of gravity is located little bit above the middle point. Because there is a shortage of water below. So, G' is located above G. That means the gravitational potential energy of water has been increased.

54 The transformer shown in the figure has N_1 turns in the primary and N_2 turns in the secondary. Root mean square voltages across primary and secondary are V_1 and V_2 respectively. The correct statement regarding the transformer is



(1) $V_1 N_1 = V_2 N_2$

(2) if the A.C.source is replaced by a battery with the same voltage, V_2 will remain the same.

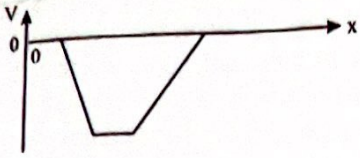
(3) when secondary is connected to a load, the current in the secondary will not depend on the load.

(4) the only reason why the core becomes warm after sometime is the heat generated due to the resistance of the coils.

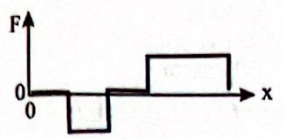
(5) if the core is removed, V_2 will decrease.

08 **Mutual Induction**

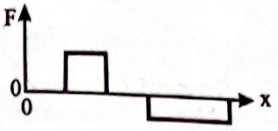
There are four sentences about the transformer and an expression. You need to be careful from (1) even it is felt as correct. $V_1/V_2 = N_1/N_2$. Therefore, (1) is wrong. Even it has been checked before that (2) is wrong. The transformers do not work for direct currents. (3) and (4) are false. When the secondary is connected to a load, the current flow should definitely depend on the load. The core of the transformer is heated mainly due to eddy currents. Therefore, (4) is wrong and (5) is correct. When the core is removed, V_2 gets reduced as the magnetic flux is lessened when going across the secondary.

55 

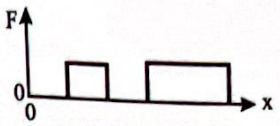
The graph shows the variation of electric potential V with distance x in a certain region. The variation of the force F experienced by a positively charged particle with x is best represented by



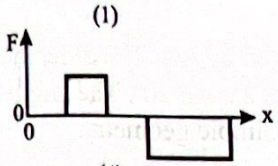
(1)



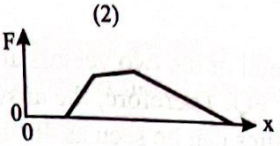
(2)



(3)



(4)



(5)

Electrostatic Potential 06

This is a question that is being asked always. The direction of the force on a positive charge is equal to the direction of the electric field. $E = -\Delta V/\Delta x$. The electric field is equal to the negative gradient of the potential. First, V is constant. So, E is zero. Finally, V has a positive gradient. So, E is negative. Another fact that needs to consider is that the numerical value of the negative gradient gets increased. The slope is greater in that line. Therefore, the corresponding E value should be increased. The correct choice is (2). In addition, the time is greater that E remains in a negative value. Look at the 55th question of paper 2000.

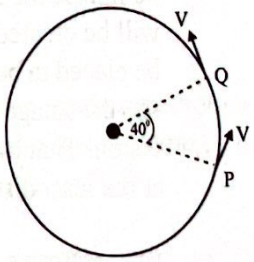
56 A car travels at a speed of 20 m s^{-1} towards a stationary sounds source that produces sound at a frequency of 1 kHz. Waves that are reflected from the car and return to the source are used to produce beats with the original waves. The approximate value of the beat frequency is (use the speed of sound in air as 320 m s^{-1})

(1) 59 Hz. (2) 62 Hz. (3) 111 Hz. (4) 118 Hz. (5) 133 Hz.

Doppler Effect 03

You need to do a calculation for this question. First, the source is still. The observer (motor vehicle) comes to the source. After that the motor vehicle acts as a source and the sound source becomes an observer. First the felt frequency to the motor vehicle f'= 1 (320+20)/320. Next, the felt frequency to the sound source $f'' = \frac{(320+20)}{320} \cdot \frac{320}{(320-20)} = \frac{340}{300} = 1.133\ kHz$. Therefore, the beat frequency = 0.0133 kHz = 133 Hz. Due to two occasions, the apparent frequency should be increased. As 320 is cut off with each other, there is no need to simplify f'.

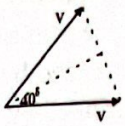
57 A particle is moving in a circle with constant speed V as shown in the figure. The magnitude of the change in velocity of the particle between points P and Q is

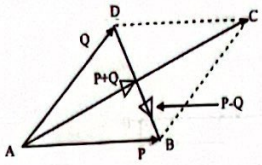


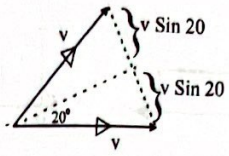
(1) 0 (2) V sin 40° (3) 2V sin 20°

(4) 2V cos 20° (5) V

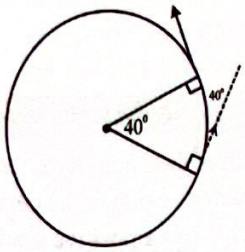
This is a question that you need to find the difference of two vectors. Such a question with two forces has been given in a previous paper. Look at the 29th question of paper 1986 and the 34th question of paper 1981. The difference of two vectors is given by the side that is shown in the dashed line.





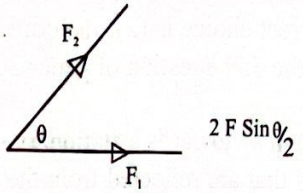


The total of the two vectors are given by AC. The difference is given by QP or PQ. Therefore, the answer is 2V sin 20^0. The angle between two velocities can be seen as 40^0 from simple geometry.



29th question of paper 1986

According to the figure two forces of F_1 and F_2, that means if the angle is θ in between the two forces with a magnitude F, then the magnitude of $F_2 - F_1$ is,



58. The furthest point of distinct vision of a long sighted person is at infinity. This person uses a magnifying lens to view close objects. He finds that he can see a clear magnified image of an object if it is held anywhere between 50 mm and 60 mm from the lens, but nowhere else. His least distance of distinct vision is

(1) 25 mm. (2) 50 mm. (3) 250 mm.

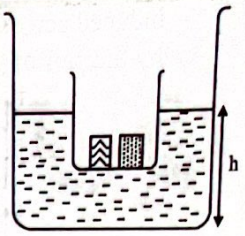
(4) 300 mm. (5) 350 mm.

If this question was understood, then the calculation is easy. The work is easy if you identify 60 mm as the focal length of the lens. When the object is placed away from 60 mm, the image will be created behind the eye. If a bigger image is needed to be seen, then the object should be placed in between the lens and the focal length. If it is kept less than 50 mm, then he cannot see the image because the image that is created is nearer than the least distance of distinct vision. That means if an object is placed at 50 mm distance, then its image should be created at the least distance of distinct vision. When the lens formula is applied to the lens,

1/D -1/50 = -1/60; 1/D =10/(60 X 50); D =300 mm

Even if you do not think any of these arguments, only two distances are given. From that, 60 mm can be thought as focal length and 50 mm can be thought as object distance (in a cunning way). The object distance cannot be greater than the focal length. Because the image should be made in front of the eyes. The other fact is that the least distance of distinct vision of the person should be greater than 250 mm. Because the least distance of distinct vision of a normal person is 250 mm. Therefore, the correct answers are 300 or 350.

59 As shown in the figure, a small beaker containing a piece of wood and a piece of stone floats in water inside a larger beaker. The density of the stone is larger than that of water and the density of the piece of wood is smaller than that of water. Consider the following statements made about the height h of the water level inside the larger beaker.



(A) When the stone is taken out and dropped in water h decreases.

(B) When the piece of wood is taken out and put in water h remains unchanged.

(C) When the stone and the piece of wood are taken out, tied together and then put in water, if they go to the bottom of the beaker h will increase.

Of the above statements

(1) only (A) is true.

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

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

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

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

Both (A) and (B) sentences have been checked before (57th question of 1990). A question of throwing a stone from a boat that is floating on the pond has also been given in a previous paper. When the stone is inside the small beaker, its displaced water is equal to its weight. But when the stone is sunk on water, the displaced water volume is proportional to its volume. Therefore, h difference of is proportional to the difference m_1 and m_1/ρ_1 (where m_1 is the weight of the stone and ρ_1 is the density of the stone). As $m_1 > m_1/\rho_1$, h is reduced when the stone is taken out and then thrown into water. As the wooden piece is floating when put into water, in both occasions the displace water volume is proportional to its weight. Therefore, when the wooden piece is put into the water, h will not be changed. When the stone and the wooden piece both are in the beaker, the displaced water is proportional to $m_1 + m_2$ (where m_2 = the weight of the wooden piece). When they are sunk, the displaced water volume is proportional to $(m_1/\rho_1 + m_2/\rho_2)$ (where ρ_2 is the density of the wood). So, h difference is proportional to $(m_1 + m_2)-(m_1/\rho_1 + m_2/\rho_2)$.

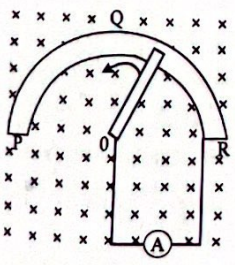
$$(m_1 - m_1/\rho_1) + (m_2 - m_2/\rho_2)$$

$$\downarrow \qquad \downarrow$$

$$+ \qquad - \text{ as } m_2 < m_2/\rho_2$$

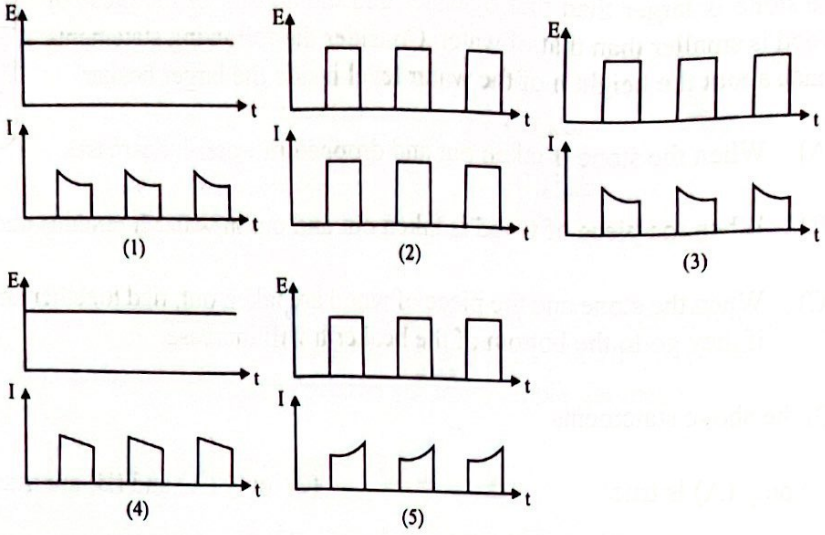
Therefore, we cannot decide whether the total is positive or negative (as we do not know a certain value). If the complete total is positive, then h will be reduced and if it is negative,then h will be increased. Only (A) and (B) are correct.

60



A semicircular conductor PQR having a uniform cross-sectional area is placed vertically in a horizontal uniform magnetic field as shown in the figure. A conducting rod OA pivoted at the centre O of the semicircular conductor, rotates with a constant angular speed about a horizontal axis passing through O parallel to the magnetic field. PQR and OA are made of a material with the same resistivity. An ammeter is connected to the two ends Oand R. If the end A touches PQR, the variation of the e.m.f. E

induced across OA and the current I through the ammeter with time t are the best represented by the pair of graphs.



Compared to the 60th question of last year, this is very easy. You know that the induced e. m. f of the conductor across OA is constant. It has been checked many times. As there is magnetic field across the whole area of the rotation of the conductor, this is a rotating conductor around a magnetic field. Look at the 38th question of paper 1989.

There are questions that have asked for an expression for the induced e. m. f on both ends of a rotating conductor on a magnetic field with a constant angular velocity. According to that only (1) and (4) is left.

From the figure you can see that, the current flows in half of it per a revolution. That is due to that fact that the conductor touches PQR is half cycle. But both (1) and (4) have this characteristic. So, from that fact you cannot get the correct answer. As there is a resistance to the conductor PQR, it should be clear that the current should be gradually decreased when the end of A of the conductor OA goes from R to P. That is because the resistance of PQR is gradually entering the circuit. As E is constant, when the resistance is increased in the closed-circuit part, the current flow should be reduced. Now the question is there to think whether current is reduced linearly (like in (4)) or in a curve (like in (1)). This is how to solve it in a shorter way.

Think that OA was rotated in an angle of θ in a time of t. Then the arc length l that is added to the PQR circuit is $r\theta$ ($r = OA$). But $\theta = \omega t$. So, the flowing current $I \propto l/R \propto l/l \propto 1/t$ (where R is the resistance and $l = r\omega t$).

According to this we can see that the current is proportional to the inverse of the time. If $I \propto t$, then I is reduced linearly with t. But as $I \propto l/t$, the graph of t with I should be a graph with a gradually reducing t. Therefore, the correct answer is (4) not (1).

When point A is connected to R there is the least resistance. The resistance of OA only added to the circuit. When A is touched to P you will get the maximum resistance. Theoretically, there should be a resistance to the rod of OA. Otherwise, when A end of OA is touching R, the net resistance of the circuit will be zero.