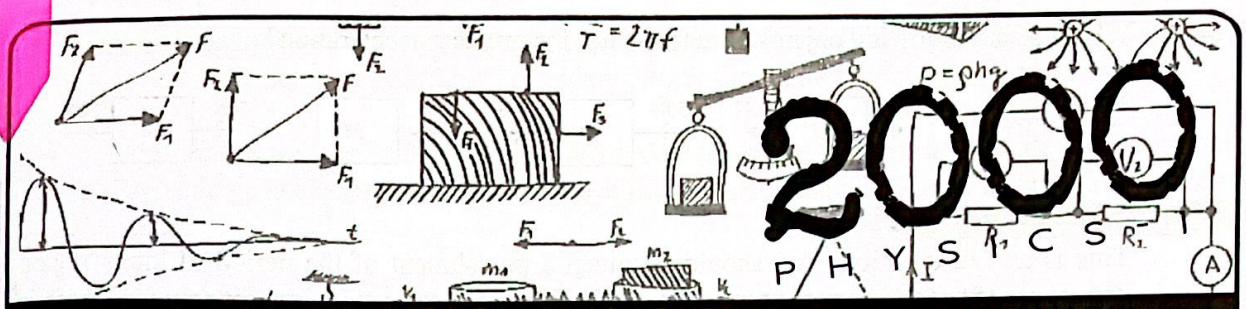


General Certificate of Education (Adv. Level) Examination

01. one of the following units measures a physical quantity that is different from the physical quantity measured by the others. This unit is

(1) eV. (2) J s^{-1}. (3) W s. (4) k W hours. (5) MeV.

Unit and Dimensions 01

Once you look at the answers, it can be clearly seen that eV, kWh, MeV are the units of measuring energy. W s means J. Therefore, the different unit is J s^{-1}. Actually, it is W. It is the unit of power not energy. In a such situation, look at all the choices and find the units that measure the similar physical quantity. Then you can choose the irrelevant unit easily. The correct answer is (2).

02. The dimensions of power are

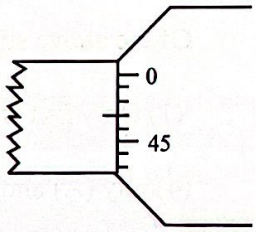
(1) ML^2T^3 (2) ML^2T^2 (3)MLT^3 (4) ML^2T^3 (5) $ML^{-2}T^{-3}$

Measuring Instruments 01

This is the first question of 1988 paper. The easiest method to find the answer is by recalling an easy expression of Fv for power. Dimension of force is MLT^{-2}. Dimension of velocity is LT^{-1}. Therefore, the dimension of power is ML^2T^{-3}. It is not a question that cannot be done from memory.

Or else, this can be easily obtained from the unit of power.W-J s^{-1}- Nm s^{-1} ($MLT^{-2}LT^{-1}$). The correct answer is (4).

03. The figure shows a part of a micrometer screw gauge, when the two jaws touch each other. The zero error of the gauge is,



(1) 0.43 mm and it should be added to the scale reading.

(2) 0.43 mm and it should be subtracted from the scale reading.

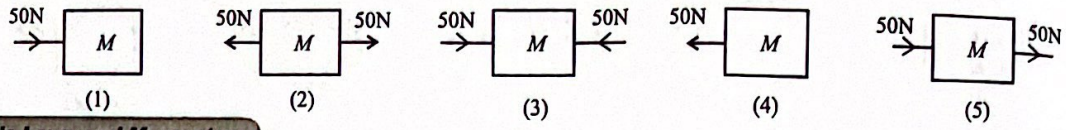
(3) 0.03 mm and it should be added to the scale reading.

(4) 0.03 mm and it should be subtracted from the scale reading.

(5) 0.47 mm and it should be subtracted from the scale reading.

Is not this the 14th question of paper 1996? The only difference is that the zero error is 2 mm in 1996 where as in 2000 it is shown as 3 mm. How much time do you need to identify the answer as (3)? Look at the 14th question in 1996 for the description of this question.

04. Which of the following objects of mass M has the greatest acceleration?



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

02 **Newton's Laws and Momentum**

This is an OL question. You should be given a punishment of the period of kings if yo cannot see (5) as the correct answer. To get the biggest acceleration, biggest resultant force i needed.

05. Two particles A and B have equal kinetic energies, but the velocity of the particle B is fou times that of A. The ratio $\frac{\text{momentum of } A}{\text{momentum of } B}$ is

(1) 1 (2) 2 (3) 4 (4) 8 (5) 16

02 **Work Power and Energy**

The easiest method is to write kinetic energy in terms of momentum and velocity.

Kinetic energy $=\frac{1}{2}mv^2 = \frac{1}{2}mv\,v = \frac{1}{2}\,pv$ (p is momentum)

As kinetic energies are equal, $P_A V_A = P_B V_B$, $\frac{P_A}{P_B} = \frac{V_B}{V_A}$

The correct answer is (3).

It is important to separate kinetic energy in terms of momentum and velocity. If you do not see that, then it consumes more time to solve it. The ratio of masses can be found but it is not necessary. You can do this question from memory, if you identify kinetic energy as ½ pv. You can neglect ½ as the kinetic energies are equal. Maximum requirement needed is the identification of $P_A V_A = P_B V_B$ only.

06. A Geiger counter can be used to detect

(A) α particles.

(B) γ rays.

(C) neutrons.

Of the above statements.

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

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

11 **Radioactivity**

Only charged particles can be identified by Geiger counter. To get a value, electrons should be produced to create electric pulses in the counter. Direct ionization of gas inside the counter by alpha particles cerate the electrons. Gamma rays falls on the metal walls of the counter and electrons are released into the gas by photo electric effect. These two functions are not occurring with neutrons. A gas cannot be ionized by a neutron as it does not have an effective charge in it.

Therefore, neutrons cannot be identified by a normal Geiger counter. But by filling a specific gas inside Geiger counter, neutrons can be identified. There are no interactions with electrons as a neutron does not have a charge as mentioned before. Therefore, neutrons are wasting their

kinetic energy by colliding with nuclei. At such an occasion, if there is an emission of gamma ray or alpha particle, then those secondary effects can be identified by Geiger counter.

Boron trifluoride gas is filled insidea Geiger counter so that it can be used to identify neutrons. High energy neutron (greater than 1 eV) collide with Boron nucleus and the following reaction occurs.

$$^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{11}_{5}B^{*} \rightarrow {}^{11}_{5}B + \gamma$$

An excited state of the nucleus $^{11}_{5}B$ is shown by $^{11}_{5}B^{*}$ Moderate speed neutrons (less than 1 eV) undergo the following reaction.

$$^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{7}_{3}Li + {}^{4}_{2}He(^{4}_{2}\alpha)$$

The produced alpha and gamma rays can be discovered easily. This does not contain in the syllabus. Geiger counters used in school laboratories can only identify charged particles. Both choices of (4) and (5) can be considered correct as neutrons can also be identified by special Geiger counters.

07. An organ pipe closed at one end resonates with one of the strings of a guitar. The length of the string is 0.8 times that of the pipe. If both the pipe and the string vibrate at their fundamental frequencies, and the end correction of the pipe is neglected, the ratio $\frac{\text{speed of wave on the string}}{\text{speed of sound in air}}$ is equal to

(1) 0.1 (2) 0.2 (3) 0.4 (4) 0.8 (5) 1.6

Vibrating frequency is equal as the tube and the string are in the resonant state. Therefore, the ratio of (wave speed on the string/sound velocity in air) is equal to (wavelength of the wave on the string (λ_1)/wavelength of the wave inside the tube (λ_2)). Now the answer is nearby. As the string and the tube are vibrating on their fundamental frequencies,

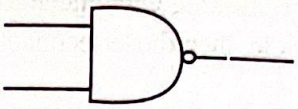
$$\lambda_1 = 2l_1$$

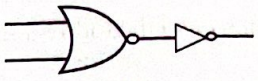
$$\lambda_2 = 4l_2$$

$$\frac{\lambda_1}{\lambda_2} = \frac{l_1}{2l_2} \text{ but } l_1 = 0.8\, l_2 \text{ Therefore, } \frac{\lambda_1}{\lambda_2} = 0.4$$

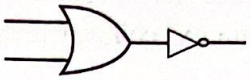
The correct answer is (3). I have drawn figures for the ease of explanation. It is surprising if you do not know the fact by memory that when a string with both ends fixed is vibrating on its fundamental frequency, its wavelength is double the length of the string and when a tube is one end closed is vibrating on its fundamental frequency, its wavelength is four times the length of the tube. These points are being tested repetitively in each and every past question papers. Therefore, only one relationship should be written to enter into the question. It should be noted directly that the questioned ratio is equal to the respective ratio of wavelengths (as frequencies are equal; that means due to resonance). No need to write any equation to obtain that. Therefore, if you have got the real practice of answering MCQs, then you should only write $\frac{\lambda_1}{\lambda_2} = \frac{2l_1}{4l_2}$. If you write or calculate an equation more than this, then you are wasting your time. Once you write the above relationship, cannot you do the residual calculation from memory? Is not this mathematics of year 9?

08. The gate shown in figure is equivalent to



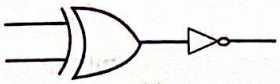


(1)

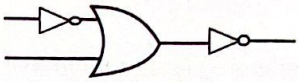


(1)

(3)



(4)

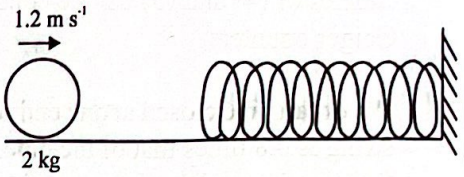


(5)

09 **Digital Electronics**

This is an easy question that can get the answer by instance. NAND gate is given. Is not a NAND gate equivalent to a connection of AND gate and NOT gate with each other? Is not 5 enough to identify the answer as (3)?

09. A mass of 2kg moving with a velocity of 1.2 ms^{-1} collides with a light spring of spring constant 50 $N\ m^{-1}$, kept horizontally on a frictionless table as shown in the figure. The maximum compression of the spring after the collision will be



(1) 0.024 m. (2) 0.048 m. (3)0.12 m. (4) 0.24 m. (5) 0.36 m.

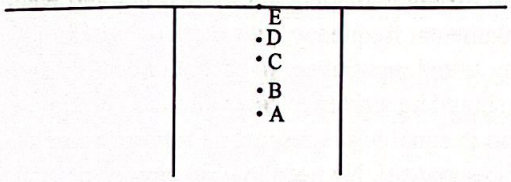
02 **Energy**

This question is also being checked in many occasions. Look at the 20th question of pape 1987. Kinetic energy of the mass should be equal to the stored energy in the spring. Write th following equation directly.

$$\frac{1}{2} \times 2 \times 1.2^2 = \frac{1}{2} \times 50x^2$$

After this,the residual calculations can be done from your memory. Numbers are given t simplify every easily. ½ is simplified by ½. You get 1/25 once 2 is divided by 50. Wher finding square root of x, square root of 1.2^2 is 1.2 where as square root of 25 is 5. Therefore is not the value of x 1.2/5? That means is not the answer 0.24 mm? Check the time you take for simplification. What a sin to waste time on this? Once you understood the question, ½ cannot be written. 2 and 50 is given to get 25. Then you get 5 as the square root of 25. If you like to follow my method, then you only have to write the above boxed equation. Rest should be done quickly from the memory. If not, do not scold paper markers. Scold the teacher who taught mathematics in year 9/10 or to yourself.

10.

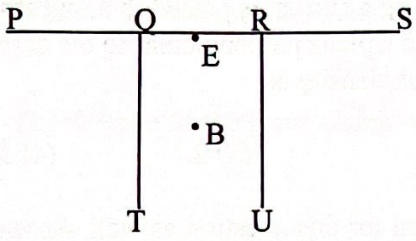


The frame shown in the figure is made from a uniform wire. The centre of gravity of the frame is most likely to be found at

(1) A. (2) B. (3)C. (4) D. (5) E.

02 **Centre of Gravity**

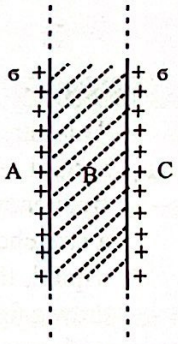
There are plenty of similar questions in previous question papers. Look at 34th question of paper 1998. Cannot we use the same logic which was used to solve that question?



The centre of gravity of wires PQ, QR and RS lies at point B whereas the centre of gravity of QT and RU lies at point B. Therefore, the centre of gravity of the whole wire frame should lie in between E and B. But if one wire part (like PQ) has a weight of W, then 3W weight and 2W weight are acting upon E and B respectively. Therefore, the centre of the gravity of the frame should be closer to E compared to B. Point D is only acting like a similar point.Point C is closer to B than E. The correct answer is (4).

There is no need to take the distances accurately. If needed, a conclusion can be drawn that the distance of ED should be 2/5 times of EB. Because EB distance should be divided by 2:3 ratio by the point D. But actually, this does not need a calculation. You only need to know that more weight is acting on E compared to B. From that, the needed centre of gravity should be a closer point to E than B. Do you need to think differently to identify that specific point as D? There is no point marked in between E and C to reach your answer easily.

11. An infinitely long thick conducting sheet shown in the figure carries a uniform surface charge density σ.



The electric field intensities in the regions A, B, and C respectively are

(1) $\frac{\sigma}{2\epsilon_0}, \frac{\sigma}{\epsilon_0}, \frac{\sigma}{2\epsilon_0}$

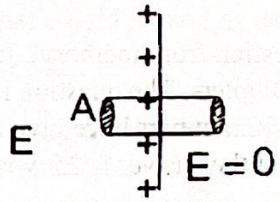
(2) $\frac{\sigma}{\epsilon_0}, 0, \frac{\sigma}{\epsilon_0}$

(3) $\frac{2\sigma}{\epsilon_0}, 0, \frac{2\sigma}{\epsilon_0}$

(5) $0, \frac{\sigma}{2\epsilon_0}, 0$

(5) $\frac{\sigma}{2\epsilon_0}, 0, \frac{\sigma}{2\epsilon_0}$

Answer can be obtained easily once you put everything what you know in one place.No need to tell you that under static condition, electric field intensity is zero inside a conductor. Therefore, choices (1) and (4) can be omitted. Electric field intensity outside the conducting surface with a uniform surface charge density is $\frac{\sigma}{\epsilon_0}$. If needed, Gauss law can be used to get this.



$EA = \frac{\sigma A}{\epsilon_0}$ $\quad E = \frac{\sigma}{\epsilon_0}$

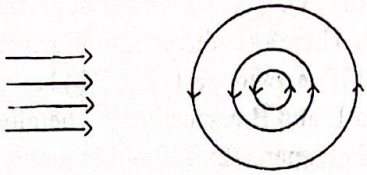
As E= 0 inside, flux E is flowing only from the outer surface. The correct answer is (2).

12. Strong straight wire carrying a current is placed in a uniform magnetic field at right angles to the direction of the field. In a plane perpendicular to the current, the number of point having a zero resultant magnetic flux density is

(1) zero. (2) 1. (3) 2. (4) 3. (5) 4.

Calculations are not needed for this question as well. Answer can be obtained as soon as the nature of the fields are roughlymarked.

07 **Magnetic Effect of Electric Current**



The wire is considered perpendicular to the paper plane. Once you consider the pair of force lines, only one place can be found where the arrows are in the opposite direction. As the path shape of magnetic force lines from a straight wire is circular, the resultant magnetic flux density from a uniform magnetic field on the same plane can be zero at only one point.The correct answer is (2). Does not the 29th question of paper 1987 check the same thing?

13. One end of a stretched string is attached to a wall. When the other end of the string vibrates with frequency f_1 a standing wave is set up along the string. The tension in the string is now tripled while maintaining the same number of loops in the string. If the new frequency of vibration of the string is f_2, the ratio $\frac{f_2}{f_1}$ is

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

03 **Transverse Waves**

This can be done from memory. If the loops of the string are unchanged, the wavelength also should remain unchanged. This is the important gripping part of this question. Therefore, the frequency ratio is equal to the respective velocity ratio. The velocity of a transverse wave in a stretched string is proportional to the square root of its tension. Therefore, if the tension is tripled, the velocity is increased by $\sqrt{3}$ times. The correct answer is (3). There is no need to draw a figure or write an equation. If you still tend to draw figures and write equations to solve such questions, then you are a child who knows the suffering of an essay question but does not know the taste of a short question. Compare the 11th question of paper 1989 with this.

14. Power of lens combination is 44 diopters and the power of one of the lenses is 40 diopters. The magnitude of the focal length of the other lens is

(1) 0.25 cm (2) 2.5 cm (3) 4.0 cm (4) 25.0 cm (5) 84.0 cm

03 **Optics**

Cannot you also do this question from memory? It should be directly seen that the power of the other lens as 4 (44-40) Diopters. The question is asking the focal length in cm. So that the value is (100/4) cm. Is not it?Examiners have given the power of the second lens as 4 because in year 4, you have learnt that the answer is 25 when 100 is divided by 4. The correct answer is (4).

15. Consider the following statements made regarding the Hall effect.

(A) The sign (positive or negative) of the Hall voltage is independent of the sign (positive or negative) of the current carries inside the metal.

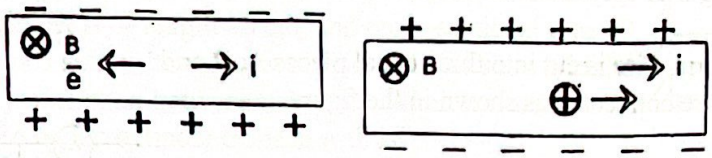
(B) A Hall voltage is not generated when the direction of the magnetic field is parallel to the direction of the current.

(C) The Hall effect is a consequence of the force acting on a moving charge in a magnetic field.

Of the above statements

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

Here you have got three statements of Hall's Effect. Statement (A) is not correct. The sign of Hall voltage means its direction. The current can be carried by negatively charged electrons and/or positively charged holes. Look at the following figures.



i) Electrons as carriers ii) Positive holes as carriers

Consider that the magnetic field is directed into the paper. At the two instances think that the current is flowing to the right. If the current carriers are electrons, then they are flowing to the opposite direction of the current. That means electrons are moving to the left. Then the force due to the magnetic field on the electrons are acting upwards (-qvB). As a result, the top plate is negative compared to the bottom.

If the current carriers are positive holes, then they are flowing to the direction of the current. Then the force due to the magnetic field is acting upwards (qvB). Therefore, the top plate becomes positive compared to the bottom. It seems that the direction of Hall voltage is not independent from the sign of the current carriers.

Once the direction of the magnetic field is parallel to the direction of the current, no force is generated on carriers due to magnetic field (as v and B are parallel). Therefore, statement (B) is correct.

Hall effect is occurring due to the force acting on the moving charge in a magnetic field. The statement is opened by mentioning 'Hall effect is'. Therefore, some treat it as the definition of Hall effect. This is wrong. Once you read the sentences properly, by the end of the sentence, it has mentioned as 'an occurring result'. If the statement is written as 'Hall effect is the force acting on a moving charge in a magnetic field', then it is wrong. But this meaning is not in the statement.

For example, the statement 'surface tension is a result of lesser bonding of molecules in a free liquid surface compared to the molecules inside the liquid' is correct. Yet, it is not the definition of surface tension. Instead of introducing how Hall effect is occurred, we never try to talk about a definition of Hall effect. Actually, there is no such definition for Hall effect.

Therefore, statement (C) is also correct. Hence, the correct answer is (3).

It is true that Hall effect is not produced by the force in a magnetic field for freely moving

charges. But statement (C) indicates that Hall effect is occurring due to thatas a result. It is not wrong.

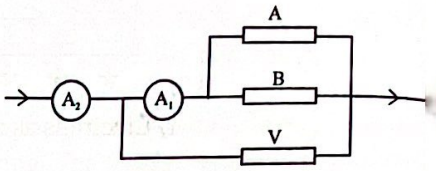
16. A uniform wire of length L fixed at one end attains the proportional limit when a mass m is hung from the other end. If a $\frac{L}{2}$ length of the same wire is used the proportional limit will attain when the mass hung is

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

10 Elastisity

It is difficult to get the answer by writing equations. It is true that, once the length of the wire is halved, its respective extension for a given mass is halved.But there is no change in the strain. The cross-sectional area of the wire also has not been changed. Therefore, to be in the proportional limit, the same mass m should be hung even though the length is halved. Therefore, the correct answer is (3). The respective stress or strain is not changed even though the length of the wire is reduced.

17. A uniform wire is cut into three equal pieces A, B and C and are connected as shown in the figure.



If the ammeter A_2 reads 1.2 A, then the reading of the ammeter A_1 will be

(1) 0.3 A. (2) 0.4 A. (3) 0.6 A. (4) 0.8 A. (5) 1.0 A.

08 Resistence

Are you going to solve i_1, i_2 and i_3 using Kirchhoff's laws? Then you are not solving a short question. The resistances are equal in all three wire parts. To find the current from A_1, you need to divide 1.2 A in 2:1 ratio. Do not you get that twice the current of C should flow from A_1? Because the resistance of arm A_1 is half of the resistance of C. Therefore, the current in A_1 -1.2 A X 2/3 =0.8 A. This can be done using memory. There are plenty of such questions in past papers.

18. Consider the following statements made about a p-n junction.

(A) Its current (I) - Voltage (V) characteristic is linear.

(B) Built in electric field across the junction is directed from n- region to p- region.

(C) Currents carried by holes and electrons are in opposite directions.

Of the above statements

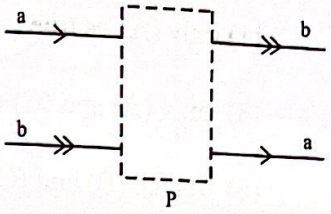
(1) only (B) is true. (2) only (A) and (B) are true. (3) only (B) and (C) are true.
(4) only (A) and (C) are true. (5) all (A), (B) and (C) are true.

09 P-n Junction

These three statements are very simple. As soon as you read, you can get that statement (A) is false. No need to explain about it. Statement (B) is true. There should be no problem in it. Statement (C) is false. Current carried by holes and electrons are into the same direction. Conventional direction of the current is always to a direction where a positive charge moves. Therefore, the current carried by electrons and holes are added to each other not subtracted. It can be proved from the mentioned explanation of Hall effect in the above as well. Compare this with the statement (C) of 15th question in paper 1997. Therefore, the correct answer is (1). Ohm's law is not obeyed by a p-n junction. Hope you must have learnt the shape of I-V variation. Near to n-p junction, n region is positively polarized than p region. Therefore, the

direction of the built-up electric field is from n to p (after the migration of electrons).

19. Two monochromatic light rays a and b after passing through an optical element p, emerge as shown in the figure. The optical element is a



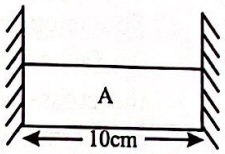
(1) convex lens. (2) convex mirror.

(3) concave lens. (4) plane mirror. (5) prism.

Optics 03

This is directly a question from a past paper. Look at the 39th question of paper 1996. You must directly choose (5) as the correct answer. 35th question of paper 1997 is also relevant to this. Its figure (C) shows this instance.

20. An aluminium (Young's modulus = 7.0×10^{10} N m^{-2} ; linear expansivity = 2.5×10^{-5} K^{-1}) cylinder A of length 10 cm, and cross-sectional area 20 cm^2, is to be used as a spacer between two rigid walls as shown in the figure. At 30 ^{0}C it just slips in between the walls. When it warms to 34 ^{0}C, the force exerted by the cylinder on each wall is,



(1) 1.4×10^3N (2) 3.5×10^3N (3)1.4×10^4N (4) 1.4×10^5 N

(5) 7.0×10^6 N

Elastisity 10

This is also a familiar general question. This has been checked in both short and essay type questions. According to familiar notations,

$$E = \frac{F}{A}\frac{L}{l} = \frac{FL}{AL\alpha\Delta\theta}$$

$$F = EA\alpha\Delta\theta$$

You can substitute directly.

$F=7\times10^{10}\times20\times10^{-4}\times2.5\times10^{-5}\times4$

This can be simplified without any difficulty. $2.5\times4=10$

Cannot you write as $F=14\times10^3$? The temperature difference is given as 4 ^{0}C to get 10 after multiplying 2.5 by 4. Then sort all the powers of 10. Use the knowledge leant about indices in ordinary level. The answer is (3). Initial length of the cylinder (10 cm) is not needed.

21. Consider the following statements regarding the flow of a viscous liquid through a narrow tube.

(A) Speed of follow is maximum along the axis of the tube.

(B) Rate of flow of the liquid is proportional to the internal cross-sectional area of the tube.

(C) Rate of flow does not depend on the temperature of the liquid.

Of the above statements

(1) only (A) is true.

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

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

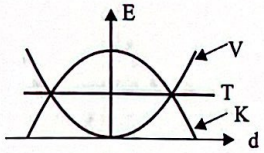
(4) only (B) and (C) are true.

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

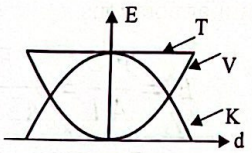
10 **Viscosity**

All the statements are known to you. There is no extra difficulty in those. From the mor you start reading, you are able to understand whether they are true or false. Even from gen knowledge, (A) can be seen as correct. Flow rate of viscosity is proportional to the fo power of internal radius of the tube. Therefore, (B) cannot be true. As the coefficien viscosity is changing due to temperature, flow rate of viscosity is needed to be depend on temperature. Therefore, (C) is also wrong. Accordingly, the correct answer is (1). As flow rateof viscosity is proportional to πr^4, you cannot argue that (B) is correct by consider the fact as $(\pi r^2)r^2$. If this logic is correct, the flow rate should be increased by 10 times wh the cross-sectional area is increased by 10 times. One unit is proportional to another u means that when the second unit is increased or decreased by a certain power, the first u should also be increased or decreased by the same amount of power. It is clear that this is n happening here. Flow rateof viscosity is proportional to pressure difference and inversel proportional to the length of the tube.

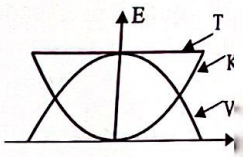
22. Which one of the following energy (E) – displacement (d) graphs best represents the variati of the kinetic energy K, the potential energy V and the total energy T with displacement d a particle performing simple harmonic motion?



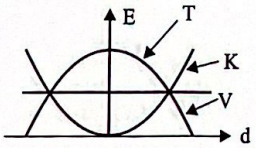
(1)



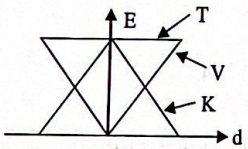
(2)



(3)



(4)

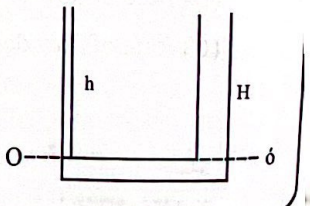


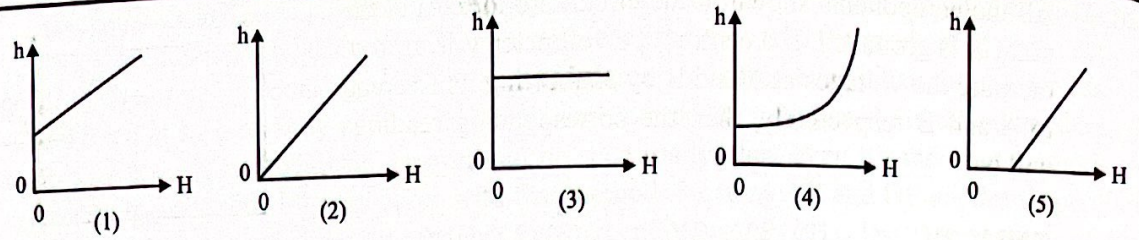
(5)

03 **Simple Harmonic Motion**

The kinetic energy of simple harmonic motion is maximum when it passes the equilibriur position (in the middle). The velocity of the particle instantly becomes zero at the two corner of motion. Therefore, kinetic energy is zero on those locations.The potential energy is behaving complementary to this. It is maximum at the two corners whereas it is zero at the equilibrium position. But the total energy (kinetic energy + potential energy) is constant every time. These facts are being satisfied in graph (2).

23. One limb of a glass U tube is made of a capillary and the other limb is made of a wider tube as shown in figure. When water is poured into the U tube, the equilibrium heights of the water columns inside the capillary and the wider tubes as measured from the OO' level are h and H respectively. The variation of h with H is best represented by

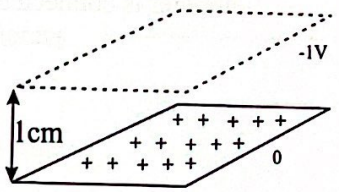




Hydrostatics 02

This is directly the 20th question of paper 1989. Even though H can be zero, h cannot be zero as it is a capillary tube. Also, there should be a straight-line graph between H and h. When H is increased, h is also increased. The only relevant graph is graph (1). Graph (2) and (5) can be omitted as h cannot be zero when H=0. As there should be a variation between H and h, graph (3) can be omitted. There cannot be a curve as pressure differences vary linearly always.

24. A uniformly charged large metal plate is kept at zero potential. An equipotential surface of -1V is observed at a distance of 1 cm, as shown in the figure. The potential of the equipotential surface at a distance of 2 cm above the metal plate is

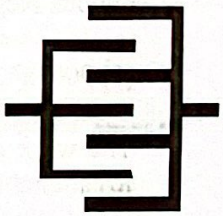


(1) –2V. (2) –1V. (3) 0.5 V.
(4) 1V. (5) 2V.

It is stupid to do a calculation for this question. Electric field strength due to a big charged sheet is uniform and acting perpendicular to the sheet. Therefore, if -1 V equipotential surface is there in 1 cm distance, the potential of the equipotential surface should be -2 V in 2 cm distance above. The potential difference across a unit distance should be the same as there is a uniform field. The correct answer is (1).

Gauss Theorem 06

25. Cross-sectional view of a variable capacitor with parallel plates is shown in the figure. The separation between adjacent plates is 0.5 cm, and the effective area of overlap of adjacent plates is 5 cm^2. If $\epsilon_0 = 9 \times 10^{-12}$ F m^{-1}, the capacitance of the variable capacitor at this position is



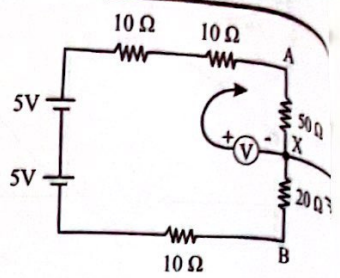
(1) 0.15 pF. (2) 0.3 pF. (3) 0.9 pF.
(4) 2.7 pF. (5) 5.4 pF.

This question needs a simple calculation. One should identify that the system is in parallel arrangement of six capacitors. If left hand side plates are connected to positive(or negative) potential and the righthand plates are connected to negative (or positive) potential,each subsequent platehas the same potential difference. Therefore, it is a parallel arrangement.

Capacitance of a capacitor $= \frac{A\epsilon_0}{d}$ Answer $= \frac{6 \times 9 \times 10^{-12} \times 5 \times 10^{-4}}{0.5 \times 10^{-2}}$

After this, a student from year 9 (who knows mathematics) can get the answer without writing further steps. Therefore, it should be very easy for you as you are in the advanced level class. If not, then it is your fault or the fault of our mathematics educational system. Number 5 is given as the denominator and numerator, to simplify very quickly. 54 X 10^{-13} F. Answers are given in pF. 1 pF = 10^{-12} F. Therefore, the correct answer is 5.4 pF in choice (5).

26. All the components shown in the circuit are ideal, and the point X is grounded. If a centre-zero voltmeter V is used to measure the voltages at A and B by connecting its free end to A and B respectively, then the corresponding readings will be

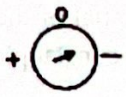


(1) 5 V, 2V. (2) 5 V, –2V. (3) 7 V, 1 V

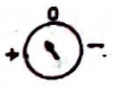
(4) 7 V, –1 V (5) 8 V, 1 V.

08 Resistor systems

This can be done using memory. Do not you get 100 Ω once all the resistors are added together Therefore, is not the current in the circuit 10/100 = 0.1 A? Then the potential across AX is 5 Potential across XB = 2V. As X is being earthed, the potential of A is +5 V and the potenti of B is -2 V. The deflection of the indicator is to the right as the free end of the centre ze voltmeter is connected to A. It is a positive reading.



Once it is connected to B, the deflection is to the left. It is a minus reading.



The correct answer is (2). Even though it has been written this much for the description, it a 15 s time consuming question of for a clever child. Total summation of resistors has bee given as 100 Ω to aid the question to solve from memory.

27. A flywheel of moment of inertia 9 kg m^2 about its perpendicular axis through the centre, connected to a motor. The motor accelerates the flywheel from rest to 600 revolutions p minute. Neglecting friction the work done on the flywheel is

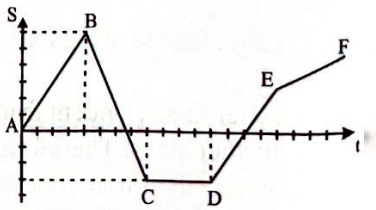
(1) 900 π^2 J. (2) 1800 π^2 J. (3) 3600 π^2 J. (4) 4000 π^2 J. (5) 6000 π^2 J.

02 Rotational Motion

The work done on the power wheel is equal to the rotational kinetic energy it acquire Rotational kinetic energy = $\frac{1}{2} \times 9 \times (2\pi \times 10)^2 = 1800\,\pi^2$J

600 revolution per minute is given to obtain 10 revolution per second. Then 102 =100. Do n waste time to simplify each step by writing. All the numbers are given to simplify from or step. This is a mathematical skill that you need to practice. If not, then you will not be able t save time for such question paper. It is fair to give more marks to such children. The corre answer is (2).

28 . Displacement (S) of a particle measured along the x-axis with time (t) is shown in the figure. The magnitude of the velocity of the particle is largest when it travels from



(1) A to B (2) B to C (3) C to D

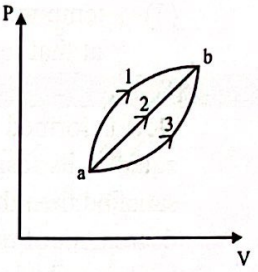
(4) D to E (5) E to F

02 Linear Motion

This is a very easy question. Velocity can be obtained from the gradient of a displacement- time graph. Therefore, the magnitude of velocity is highest at the highest gradient of s-t

graph section. Out of the drawn lines, anybody can see that BC has the maximum gradient. Therefore, the correct answer is (2). Is not it a foolish act to find the gradient in each section of straight line by counting squares? Some children are scared even when the answer can be obtained in such an easy way. Even there is no confidence in the easily obtained answers of this nature. Even though the answer can be seen easily, they even try the long methods to clarify their doubts. I do not agree with that method. Sections AB and DE are drawn parallel to each other. It can be clearly seen that the gradient of section EF is less than sections of AB and DE. Section CD can be removed directly. It represents the particle at rest.

29. An ideal gas is taken from state 'a' to state 'b' separately along the three paths shown in the P–V diagram. If $U_b > U_a$, consider the following statements.



(A) The work done by the gas is same for all three processes.

(B) Heat is absorbed when the gas is taken along path 1 whereas heat is liberated when taken along path 3.

(C) The temperature of the gas at state B is higher than that at state a.

Of the above statements,

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

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

Thermodynamics 04

If you correctly understood the 59th question of paper 1999, then the answer is in your hand. It can be directly seen that statement (A) is wrong because the areas of each curve are different with V axis. (B) is also false. Heat is absorbed even when going in path3. The direction of the arrow in each path is from a to b. ΔW is positive for all three instances. As $\Delta U=\Delta Q-\Delta W$, heat should be absorbed to increase ΔU. Statement (C) is clearly correct as it is given that $U_b>U_a$. The correct answer is (3).

30. At the atmospheric pressure the specific latent heat of fusion of ice and vaporization of water 3×10^5 J kg^{-1} and 20×10^5 J kg^{-1} respectively. If the specific heat capacity of water is 4×10^3 J kg^{-1} ^{0}C^{-1}, the minimum amount of energy required to convert 1 kg of ice at ^{0}C to steam at 100 ^{0}C under the atmospheric pressure is

(1) 27×10^5J. (2) 24×10^5J. (3) 23×10^5J (4) 20×10^5J. (5) 7×10^3J.

Energy 02

Cannot this question be done from memory? Heat that should be supplied to 1 kg of 0 ^{0}C water to convert 100 ^{0}C water is $4\times10^3 \times10^2=4\times10^5$. Now cannot you get the answer when you add $3\times10^5$and 20×10^5? Answer is 27×10^5 J. How much time will you waste on this question? All the numbers are being collected to aid the solving usingthe memory. The correct answer is (1).

31. Dew cannot appear if

(1) temperature is high, and relative humidity is 100%.

(2) temperature is low, and absolute humidity is equal to its corresponding value at de point.

(3) temperature is high, and the absolute humidity is equal to its corresponding value dew point.

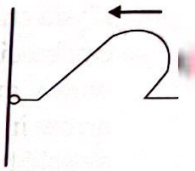
(4) temperature is below the dew point, and relative humidity is 100%.

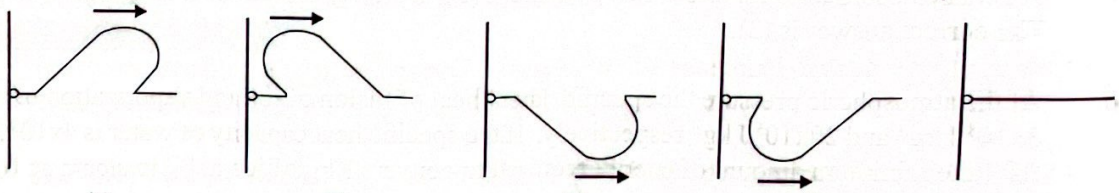
(5) temperature is low, and the absolute humidity is less than the maximum possible val at that temperature.

04 **Humidity**

Dew is formed when relative humidity is 100%. In fact, it is when the absolute humidity ge equal to its respective value in the dew point. Both indicate the same fact. If this instance satisfied,then there is no problem in temperature to form dew. Most of the time we think th decrement of temperature is essential to the formation of dew. Normally, temperature shou be reduced when reaching towards 100% in relative humidity. But if 100% relative humidi can be obtained, dew can be formed even in a higher temperature. Therefore, if that instan is satisfied, then the decrement or the increment of temperature is not a problem to from de Once the initially given temperature parts are neglected in the choices, you will note th choice 1 and 4, 2 and 3 are the same. Temperature part is added to make five choices. O of the choices, if you decide to forget the temperature part, you will instantly see (5) as t correct answer. It is true that you will not be tempted to decide instantly like that. But that the shortest method to reach the answer. If absolute humidity gets reduced from the maximu value of a certain temperature, dew will not form in that particular temperature.

32. A transverse pulse is travelling on a stretched string as shown in the figure. The left and of the string is tied to a light ring that could slides on a frictionless rod perpendicular to the string. The reflected pulse is best represented by





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

03 **Wave Properties**

This has been checked previously in different occasions. Look at 48th question of paper 1986 As there is a light loop in the reflective corner, soft reflection occurs.That means the pulse i reversed back again without a phase difference. The shape of the initial section in the puls should be given to the initial section of the reflected pulse. Therefore, the correct answer i (2). Another easy way to find the reflective pulse is to consider the rod as a mirror and draw the image of the incident pulse behind it.

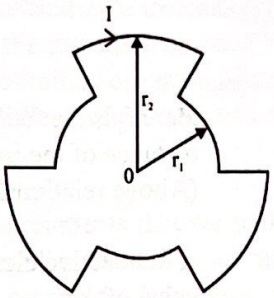
33. A geostationary satellite A moves in an orbit of radius R_A. Another geostationary satellite B has twice the mass of A. The orbital radius of the satellite B is

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

05 **Gravitational Field**

You can directly get the answer. Irrespective of the mass of the geo-stationary satellite, it should be placed at a certain height from the Earth as its orbit. Therefore, answer (1) should be chosen as soon as you see the question.If you attempt to derive the expressions, then it will take 3-4 minutes. Even if you derive the expression, you will note that the orbital radius of the geo-stationary satellite is independent from its mass. Only mechanically thinking children will try to derive the expressions. If it is geo-stationary, irrespective of the mass it is geo-stationary. That means distance from the Earth should be the same.

34. A current I flows around a closed loop as shown in the figure. The magnetic flux density produced at the centre o is given by



(1) $\frac{\mu_0 I}{6}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$ (2) $\frac{\mu_0 I}{3}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$

(3) $\frac{\mu_0 I}{2}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$ (4) $\frac{\mu_0 I}{2}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

(5) $\frac{\mu_0 I}{6}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

Magnetic effect of current 07

This is a very easy question. Such a question like this can be seen in every past paper. But unfortunately, there is no answer in this. It is a mistake from the examiners. As mentioned early in a previous occasion, it is true that the students face unfair treatment if a mistake occurs. Nothing can be done other than providing marks for everybody in such a situation. Therefore, do not waste more time on a question that you cannot find any answer. In here, the small and big curves make a half of a complete circle. Therefore, the correct answer should be,

$$\frac{1}{2}\frac{\mu_0 I}{2}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]=\frac{\mu_0 I}{4}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$$

35. Consider the following statements regarding an astronomical telescope and a compound microscope.

(A) To obtain a high magnification the telescope must have an objective lens of long focal length and an eyepiece of short focal length.

(B) To obtain a high magnification the microscope must have an objective lens of short focal length and an eyepiece of long focal length.

(C) At the normal adjustment of the telescope the separation between the lenses is equal to the sum of the focal lengths of the lenses.

Of the above statements

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

Optics 03

The statements in this question have been checked many times. Statement (A) is true. In a microscope, focal length of the objective should be smaller, whereas the focal length of the eyepiece should be bigger. But the magnification is not increased from it. (C) is being asked every time. It is true. The correct answer is (4).

The object is placed near the objective in the microscope. It is not kept far away like in the telescope. Therefore, if the focal length of the objective gets bigger, the object will be situated in between the optical centre and the focal length. There will be an unreal image of the object from this placement. If that is so, there will not be a produced real image of the object for the eyepiece. Therefore, the focal length of the objective should be shorter. When considering magnification, if the focal lengths of objective and eyepiece are smaller, a bigger magnification can be obtained in the compound microscope. For example, the magnification of a compound microscope in normal adjustment is given by,

$$\left[\frac{v}{f_o} - 1\right] + \left[\frac{D}{f_e} + 1\right]$$

Here f_o is the focal length of the objective, fe is the focal length of the eyepiece, V is the image distance of the image created by the object due to objective and D is the least distinct vision. (Above relationship is not a standard expression.)

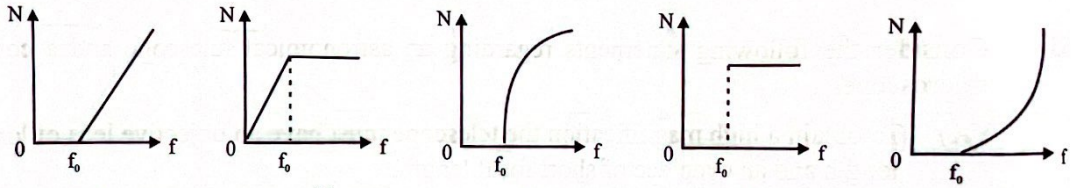
36. A radioactive element ${}_{86}{}^{A}X$ decays to a stable element ${}_{82}{}^{206}Y$ after several α – emissions. The value of A is

(1) 206. (2) 208. (3) 210. (4) 212. (5) 214.

11 Radioactivity

Z value of X is 86. Z value of Y is 82. Therefore, Z value has been reduced by 4. From that it can be concluded that two alpha particles have been emitted. So, the value of A should be 214 (206+8). No need to do any calculation in a piece of paper. Answer can be obtained by looking at the question. The correct answer is (5).

37. A light beam is incident on a photosensitive surface. If the intensity of the incident beam is not charged which of the following graphs best represents the variation of number (N) of electrons emitted per second with the frequency (f) of the incident light. (f_0 represents the threshold frequency of the photosensitive material.)



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

11 Photoelectric effect

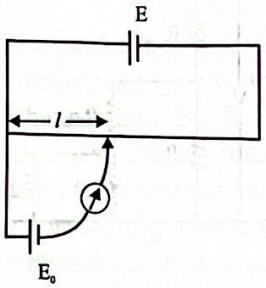
If the intensity of the incident light beamisunchanged, then the rate of electron emission is unchanged with the frequency. But it should be greater than the frequency of the electron emission, f_0. Therefore, if $f < f_0$, then N should be zero. Then once f is increased, N should remain as a constant. When the frequency is kept increasing, there is an increment in the kinetic energy of the emitted electrons. But as the intensity is constant, the rate of electron emission remains unchanged. Therefore, the correct answer is (4). There is no need to write equations for this question. The basic principles of photoelectric effect are being tested.

We explain the photoelectric effect by the photon argument of light. According to the photon argument, the intensity of a beam of light beam means number of photons that travels across a unit area in a unit time. It is not the energy that travels across a unit area in a unit time. The unit of the intensity of the light beam is not Wm^{-2}according to the photon argument. The unit of intensity is Wm^{-2} according to the wave model. These two concepts should not be confused

together. The photon argumentis a discrete argument (like throwing pebbles). Wave argument is a continuous argument (like flowing a liquid).

If we use wave argument to explain photon argument, we become helpless. Even these two arguments cannot be mixed with each other. For example, energy (E) of n number of photons is E = nhf. This expression belongs to the concept of photon. Conclusions of E is constant when the intensity of the light beam is unchanged and n should be reduced once f is increased are not correct.According to the photon argument, intensity is not E. It is connected to n. Therefore, if the intensity is constant, the energy of the photon is increased with increasing f. Therefore, the total energy in number of photons gets increased. But the travelling number of electrons across a certain area in a unit time is constant. That means the emitted electrons (from a certain area) in a unit time is unchanged even the kinetic energy of the emitted electrons is being increased.

Do not worry about such contradictions. Science is a collection of arguments that we built upon by thinking that they are correct to be used in the explanation of natural phenomena. These are correct until the discovery of faults and limitations by ourselves. Argument of photon is not needed in the future. New concepts can be introduced by mentioning that it can be explained by modifying the wave argument. If such things are being convinced by the scientific community, then they will be welcomed on that day.

38. 

In the potentiometer circuit shown the internal resistance of the cell E is negligible. The balanced length l obtained for the cell E_0 is doubled when a resistance R is connected in series with E. The resistance of the potentiometer wire is

(1) R/2 (2) R (3) 2R (4) 3R
(5) 4R

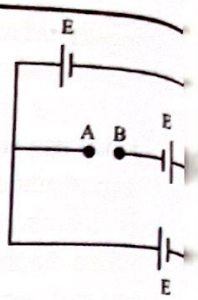
Potentiometer 08

Cannot this question be solved using a similar logic that was used to solve the 56th question of paper 1998? In that it contains the connection of resistor R to the cell E_0. Here it has been asked about the connection of resistor R to E. Avoid writing equations to this question. Time is not adequate for the children who write equations to such questions.

What can we conclude when the balanced length is doubled? Balanced potential difference has not changed (e.m.f of the cell is E_0). Therefore, voltage drop per unit length in the potentiometer wire has been halved, if the balanced length has been doubled. The length of the potentiometer wire is also not changed. That means if resistor R is connected to E in series, thene.m.f of cell E should be dropped by half across R. Then the other half is dropped through the wire of the potentiometer. If that is so, the resistance of the wire should be equal to R.

We can look from another way. If the voltage drop per unit length has been reduced by a half, then the current that is flowing across the wire also has been reduced by a half. If that is so, the resistance value that has been connected series should be equal to the resistance of the wire. The correct answer is (2).

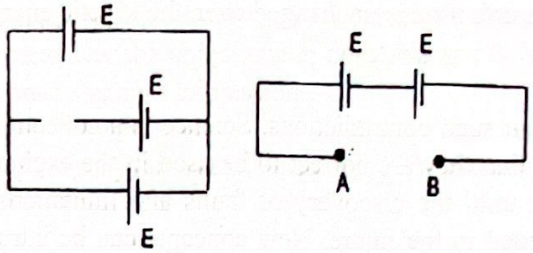
39. Three identical cells having e.m.f. E and negligible internal resistance are connected in a circuit as shown in the figure. The potential drop across AB is



(1) 0. (2) E/2 (3) E 4) 2E (5) 3E

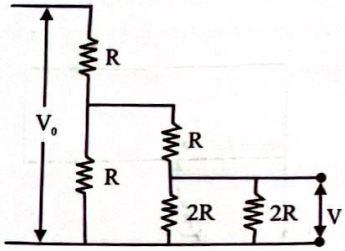
08 cell systems

This is a very easy question that you can get the answer at a glance. No calculation is needed to this question too. Look at the 34th question of 1988. When the cells with equal internal resistances (here the internal resistances are neglected) a the cells with equal e.m.f (E) are connected parallelly, their equivalente.m.fvalue is also E.



Therefore, the drop of voltage or the e.m.f valueacross AB is 2E. How simple is that? Tl correct answer is (4).

40. $\frac{V}{V_0}$ of the voltage divider shown is



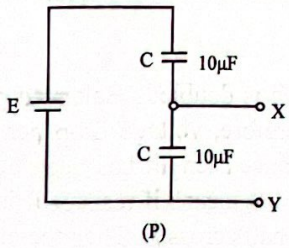
(1) $\frac{2}{3}$ (2) $\frac{3}{4}$ (3) $\frac{4}{5}$

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

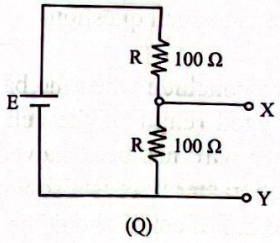
08 Potential Divider

Is not this the same question as the 40th question of 1999? Same voltage divider is given As resistors 2R are connected parallelly, the equivalent resistance of two resistors is R. Fo solution, look at how the 40th question of 1999 has been solved.

41.



(P)



(Q)

Consider the following statements made about the potential difference across XY of the circuits (P) and (Q) shown in figure. Both cells have e.m.f. E and negligible internal resistance.

(A) potential differences across XY in both circuits are equal.

(B) If a voltmeter with finite internal resistance is connected across XY it will read a steady non-zero voltage only in Q.

(C) If the colmeter is ideal both circuits will provide a same voltage reading across XY.

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

Capacitors 06

In both of the circuits, there are two identical capacitors and two identical resistors that have been connected to two identical cells with a same e.m.f value of negligible internal circuit resistances.

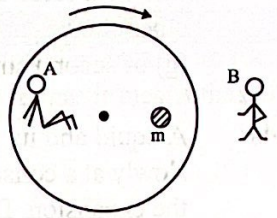
There should not be a problem in the statement (A). Electromotive force E is divided equally between the capacitors and resistors. There is no need to write equations for this. Therefore, statement (A) is true.

When a voltmeter with finite internal resistance is connected to a capacitor, the charges inside the capacitor starts to discharge or leak across the resistor. Therefore, the reading is not steady. But such a thing does not happen across a resistor.When a voltmeter with finite internal resistance is connected to 100 Ω resistor, the reading shown is stable even though it is not the real potential difference across XY. Therefore, statement (B) is true.

An ideal voltmeter means that it has an infinite internal resistance. If that is so, equal voltage reading can be obtained across XY in both of the circuits. As the resistance is infinite in the voltmeter, there is no room for discharging of charges. Therefore, statement (C) is also true. The correct answer is (5).

We consider that, there is no current flow across an ideal voltmeter. Specially, in a moving coil galvanometer type voltmeter, it is true that there should be a current flow to see a deflection in the indicator. But in Physics, 'ideal' is related to reminding aboutextreme conditions. There is no current across ideal voltmeters. In an ideal ammeter, the resistance is zero. An ideal gas has all the characteristics that we think of. Therefore, you should look at the statement (C) by considering ideal conditions. Above ideal condition is very much satisfied by the digital voltmeter. As it does not have moving indicators, it does not have rotational inertia like in moving coil equipment.

42. A horizontal table is rotating with a uniform angular velocity about the vertical axis passing through its centre. A mass m is rest on the table without slipping. Observer A is sitting on the table while the observer B is standing on the floor, as shown in the figure. The total horizontal force on m



(1) according to A is zero and according B is towards the centre.

(2) according to A is zero and according B is away from the centre.

(3) according to both A and B is zero.

(4) according to both A and B is towards the centre.

(5) according to both A and B is away from the centre.

Circular Motion 02

This is not a problem of dilemma. A is in a frame of acceleration or in a non-inertial frame. Therefore, to describe the motion of such a frame, centrifugal force is needed to take into consideration. But B is an inertial observer.According to him, previously mentioned centrifugal force is not needed to describe the motion. Actually, an observer in an inertial frame does not experience inertial forces such as centrifugal force.

If this is simply explained, then m is at rest only relative to A. Relative to B, there is a fo which is directed to the centre of m(frictional force). As m is at rest relative to A,to descr the motion according to him, there should be a force on m which should be substituted av from the centre of m. Therefore, the correct answer is (1). Though we do not need to w equations, for clarification we will write equations of motions relative to A and B. Relat to B, m is accelerating towards the centre. Therefore, according to B, $F = mr\omega^2$ Here F is frictional force acting on m towards the centre (centripetal force). The radius of the ci that m travels is r. The angular velocity of the table is given by ω. Here $r\omega^2$ is centrip acceleration.

If m is at rest relative to A, then how does he write the equation of motion?$F - mr\omega^2 = 0$

Even though this and the above-mentioned equation is similar, the logics are different. this equation, $mr\omega^2$ is the centrifugal force. F is centripetal force. As these forces are eq in magnitude but opposite in direction, m is at rest according to that frame. But they are i action and reaction.

43. In an experiment to measure the thermal conductivity of a good conductor a long bar of material is normally used. This is to

(1) obtain the steady-state condition.

(2) achieve a higher heat flow rate.

(3) obtain a practically measurable temperature difference along the bar.

(4) make lagging easy.

(5) ensure a parallel flow of heat along the bar.

04 **Heat conduction**

The correct answer is (3). If a short rod of a good heat conductor is taken, then there will n be a temperature difference that can be practically measured. The temperature gradient small in a good heat conductor. There is no such temperature difference across a metal sh with good heat conducting ability of less thickness. If it is a heat insulating material, then the will be a clear temperature difference across the two surfaces even it is a short rod. All t other choices are irrelevant and useless statements. The relevant answer is in the final secti (g) of second structured question in paper 1987.

44. A liquid and its vapour are enclosed in a closed vessel. The volume of the vessel is expand slowly at a constant temperature ensuring that some liquid is retained inside the vessel duri the expansion. During the expansion

(1) thevapour pressure increases linearly with the volume.

(2) thevapour pressure decreases linearly with the volume.

(3) thevapour pressure retains constant.

(4) the number of vapour molecules per unit volume increases.

(5) the kinetic energy of vapour molecules decreases.

04 **Gases**

This is a very famous question. This has been checked in many past papers (38th questio of paper 1998 and 3rd question of paper 1990). If the temperature is constant, the saturated vapourpressure is constant. I have no idea that how many times this sentence has bee recited in numerous ways. Certain amount of liquid is left during the total time period means that the vapour is remaining throughout in its saturated vapour state. Therefore, it can be

easily understood that the correct answer is (3). Choices (1) and (2) can be directly rejected. Even though the vapour molecules are increased in the total volume, vapour molecules in a unit volume should be a constant. As the temperature is constant, the kinetic energy of the molecules also should be constant.

45. Ten identical machines produce a certain sound intensity level at a given point. In order to decrease the sound intensity level by 10 dB, the number of machines that has to be turned off is

(1) 1. (2) 2. (3) 5. (4) 8. (5) 9.

Sound Intensity **03**

It is a surprise to know that this is a difficult one if you have attempted the multiple-choice questions of decibels in past papers with a proper understanding. If the intensity is changed in multiple powers (powers of 10), then the changed amount in decibels has been asked in those questions. This time it has been asked on the other way around. Will not the changing factor of the intensity be 10 if we need to reduce the sound intensity level by 10 dB? ($\log_{10}10=1$). If we think in another way as the sound intensity from one machine is I, then intensity from 10 identical machines will be 10 I. If the intensity should be ten times reduced, 10 I should be reduced to I. Then the number of machines that should be stopped is 9. Is not it? Actually, do not you believe that this question is very close to the question in 1999? What is the answer if that question was asked like this? A sound source of intensity I is removed and another sound source of 10 I is kept. What is the change of intensity level at a given point? Answer is 10 dB.

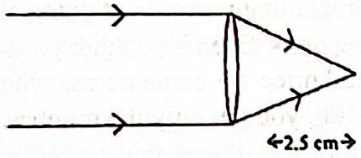
Has not the contradictionbeen asked in year 2000? If 10 dB is needed to be reduced, then 10 I should be reduced to I. Therefore, 9 machines have to be stopped. The correct answer is (5). If the question in 1999 is asked in other way round, then 99 sound sources should be removed.

46. The maximum focal length of the lens of a normal eye is 2.5 cm. If the point is 25 cm, the minimum focal length of the eye lens is about

(1) 1.5 cm. (2) 1.8 cm. (3) 2.0 cm. (4) 2.3 cm. (5) 2.5 cm.

Optics **03**

All you need is to do a simple calculation if you understand this question. The maximum focal length of eye lens occurs when an object at infinity is focused in the retina. It means that the distance from the eye lens to the retina is 2.5 cm.



The minimum focal length of eye lens can be obtained when an image of an object in the near point is focused in the retina. The image of an object in 25 cm distance is formed behind the eye lens at a distance of 2.5 cm in the retina. That means it should be $-\frac{1}{2.5}-\frac{1}{25}=\frac{1}{f}$

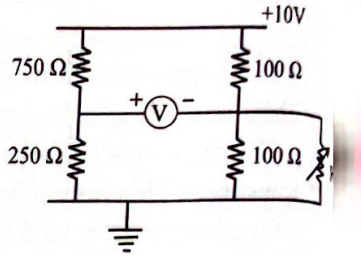
As there is 2.5 and 25, the easiest way to solve is converting 2.5 into 25. $-\frac{10}{25}-\frac{1}{25}=\frac{1}{f}$

Now you can directly write f= -25/11.

If you cannot write this directly, that means you do not know the mathematics in year 8 and 9. Even though as others think as questions of PhD level, such questions are not suitable for A/L

and not even for O/L. All the answers are given to first decimal place. Even the approx value is asked for the answer. It means the answer is not simplified properly as a normal M The value of 25/11 to the first decimal is 2.3. Is not it? However, the answer should be than 2.0 but it cannot be 2.5 as the maximum focal point is 2.5 cm. Therefore, least should be less than 2.5 cm. The only answer between 2.0 and 2.5 is 2.3. Examiners have given answers such as 2.2 cm. The correct answer is (4).

47. In the circuit shown V represents an ideal centre-zero voltmeter. R is a variable resistor, of which can be varied from 0 to 10,000 Ω. As R decreases from 10,000 Ω to zero the voltm reading will approximately vary from



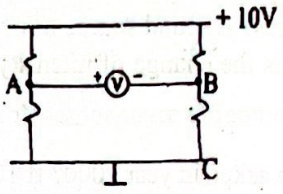
(1) –7.5 V to 2.5 V. (2) 7.5 V to 10 V.

(3) –2.5 V to 2.5 V. (4) –2.5 to 7.5 V.

(5) 2.5 V to 0.

08 Resistor systems

Most of you will scold me if I say that this question can be done from the memory. But w I say is the truth. I will show the circuit for the convenience.



You need to find the potentials of A and B if you need a voltmeter reading. The potential of does not change whatever happens to R. If the potential of A is found, then half of the questi has been solved. Cannot you get the potential of A from memory? The drop of voltage is V between the resistors 750 Ω and 250 Ω. If that is so, do you have to go to four classes electricity to identify that 7.5 V is the drop across 750 Ω? If you can understand this instant you are a child with general knowledge rather than of Physics. According to that, the potenti of A is +2.5 V. Now if the potential of B is found in both occasions, then the answer is your hand. Now again your general knowledge should be tested. R and 100Ω are connect parallelly. Will not the equivalent resistance be practically 100 once the resistors of 100 and 10,000 Ω are parallelly connected? If you are going to find the equivalent resistance 100 Ω and 10,000 Ω, then remember that you are not doing a short question. You lose time attempting such unnecessary questions. Even if you did, you will get 99.01 Ω as the equivale resistance. This is equal to 'Bata' price we come across when we buy pair of slippers. Aft paying Rs. 99 to a price of Rs. 100, you get only the number satisfaction.

Some children are so fearful to look at a short question in this manner. To get away the fea look at how the 35th question of paper 1998 has been solved. If a small resistor is connected a big resistor parallelly, then the equivalent resistance is very nearly equal to the small resistor Even though you studied this, seems that you do not use it. Even the approximate answer is asked due to this reason. On the other hand, these are challenging questions.

Therefore, when R is 10,000 Ω, the equivalent resistance can be considered as 100 Ω. Then the potential of B is 5 V. Divide 10 V among 100 Ω and 100 Ω. When R= 0 Ω the potential of B is zero. When R= 0 Ω B and C ends get short circuited. Potential of B is zero as C has been earthed. Now A = + 2.5V → B = 5 V/0 V

+2.5 +5 Voltmeter reading is - 2.5 V (when deflected to the left, the reading is minus.)

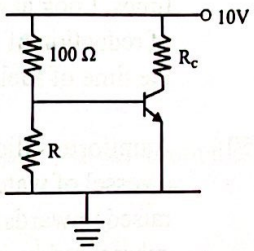
+2.5 0 Voltmeter reading is + 2.5 V However, the answer is not mentioned as from +2.5 to -2.5. Even though there is a problem regarding the sign, it is not affecting to find the answer. The correct answer is (3). All you need to write ∴ 2.5 5. 0 to find the answer. Otherwise,

if you write all the known equations using i1, i2.... It will take 10 min to get the answer.

48. A suitable value for R to bias the silicon transistor in the active mode would be

(1) 100 kΩ. (2) 251 kΩ. (3) 75 kΩ.

(4) 7.5 kΩ. (5) 100 Ω.



Transistors 09

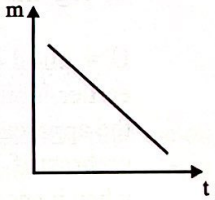
After solving 47th question, you may scold me in obscene words if I say that this also can be done from memory. But need to say that it is true again. If you want to bias a silicon transistor in the operational mode, then there should be a voltage drop of 0.7 V across the base and the emitter. Therefore, there should be a voltage drop of 0.7 V across R in the given circuit. So, what is the resistor that you should select for R? If R= 100 kΩ, 10 V is divided equally among the two 100 kΩ resistors. It means 5 V is the drop of voltage across R. It is not suitable. You can directly omit 251 kΩ. Why? Then there will be a voltage drop more than 5 V across 251 kΩ. If you select 75 kΩ, then a voltage drop (10/7) X3 V occurs across 75 kΩ resistor.

Because 10 V is divided into 4:3 ratio (100:75). Therefore, it is also not suitable. Last answer has 100 Ω. If it is used, then 0.7 V voltage drop cannot be obtained across that. Most of 10 V gets dropped across 100 kΩ. Therefore, suitable answer is 7.5 kΩ. By removing the unnecessary choice from each other is the shortest way to find the answer to this question. If calculation is done without following this method, then simply it can be done. My simple intelligence does not understand that why the following expression cannot be written directly.

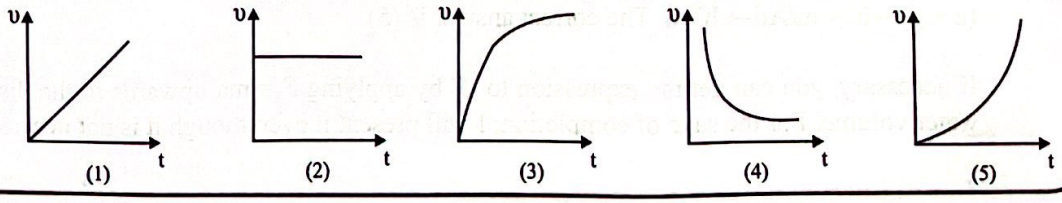
$\frac{10}{100+R} \times R = 0.7$ $10R = 70 + 0.7R$ If 0.7 R is removed, you get R = 7kΩ. Therefore, you

need to take choice (4) as the correct answer. Any other choice is not going near to 7kΩ. The correct value should be slightly higher than 7kΩ (if 0.7 R is considered). Therefore, the correct answer is clearly seen as (4). How much time will it take for this?

49. Figure shown how the mass (m) of fuel in a rocket decreases with time (t) when it moves away from the earth perpendicular to the earth surface. If the atmospheric resistance is disregarded and the thrust produced by the fuel is constant throughout, which of the following graphs best represents the variation of the velocity (v) of the rocket with time (t)?



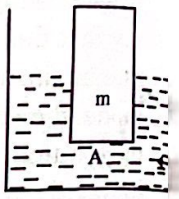
Newton's Law and Momentum 02



This is an easy question even it is the 49th question. If the total mass of the rocket gets red over the time even the thrust from the fuel is kept constant, then the acceleration of the ro is not constant and its value should get increased (as long as M gets reduced). To get th you need equations? If the fuel inside the rocket gets reduced, then that means total ma the rocket M gets reduced. Therefore, if M is reduced then acceleration should increase w F is constant. Does not velocity- time graph (5) show the gradually increasing accelera Graph (1) represents a constant acceleration. Graph (2) shows zero acceleration. Graph shows a v-t curve that represents an acceleration of gradual decrease numerically. At point, the gradient of the tangent gives acceleration. Graph (4) represents a deceleration.

Even though such a question is not connected, velocity-time graphs have been tested numer times. Look at 47th question of paper 1994. The v-t graph is drawn only during the time pe of reduction of fuel mass. Practically this reduction is not happening continuously. But du the time of fuel burn, the effective mass of rocket is reduced.

50. A uniform solid cylinder of cross-sectional area A and mass m floats in a vessel of water of density d as shown in the figure. When the vessel is raised upwards with a constant acceleration α, the height of the cylinder submerged in water will



(1) increase by a distance of $\frac{ma}{Adg}$.

(2) decrease by a distance of $\frac{ma}{Adg}$.

(3) increase by a distance of $\frac{m(g-a)}{Adg}$.

(4) decrease by a distance of $\frac{m(g-a)}{Adg}$.

(5) remain unchanged.

02 **Hydrostatics**

This is a similar question even though it is not directly related to 47th question of paper I regarding an air bubble. The total system here is moving upwards in a constant acceleral Then the apparent weight of cylinder is increased as well as the upthrust. Actually, the upth is obtained from the weight of the displaced water volume. It should also increase as the upward acceleration. I will describe using equations.

If the sinking height is h at rest, Ahdg=mg → h=m/Ad

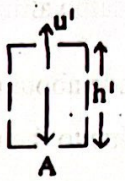
If the upthrust is U' acting on the cylinder when moving upwards with an acceleration, th

U'-mg=ma U'=m (a + g) Now what is U'? If we consider sinking height as h', U' should

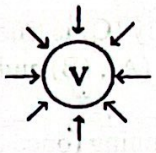
U'= Ah' d (a + g). Here is where the mistake occurs.U' is not U'= Ah' d g. As mentic earlier, upthrust is the weight of the displaced water volume. When accelerating upwa the apparent weight of the water volume is not Ah' d g. It is Ah' d (a + g). Good. What is upthrust if it accelerates downwards?It is Ah' d (g - a). That means the upthrust is redu when it accelerates downwards. When a=g the upthrust is zero. The upthrust of a liquid is z due to its zero apparent weight when it is freely falling. Now substitute for U'. Ah'd(a + g) = (a + g)→h' = m/Ad→ h'=h. The correct answer is (5).

If necessary, you can get the expression to U' by applying F = ma upwards to the displac water volume. For the sake of completion, I will present it even though it is not necessary.

U' is acting upwards from the outer water of the water volume.

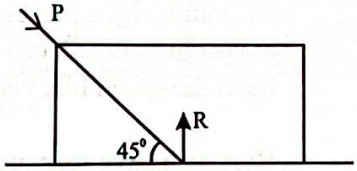


There is no change in the upthrust from the surrounding water, even if the water volume is equivalent to Ah' volume or any other volume. For example, if any material (metal, piece of cork or else a part of the liquid) of volume V is immersed on a liquid, then the upthrust from the liquid is the same. Therefore, the upthrust acting on the volume V does not change.



Now consider the water volume Ah' . When F = ma is applied, U' - Ah' dg = Ah' da. From that you get, U' = Ah' d (a + g).

51. As shown in figure a force P is applied on an object of mass 2 kg lying on a horizontal surface. The coefficient of kinetic friction between the two surfaces is 0.5. If the object moves with uniform velocity the normal force R acting on the object is



(1) 10 N. (2) $10\sqrt{2}$ N. (3) 20 N. (4) $20\sqrt{2}$ N. (5) 40 N.

You need to write two equations for this question. This cannot be done from the memory. There is no need to think differently. This is a familiar question.

$\rightarrow P \cos 45^0 = 0.5\ R$ $\uparrow R = P \sin 45^0 + 20$

You should be able to write these two equations directly. There is no doubt that you may have solved many questions that are more difficult than this question at school or tuition class. Remember to consider P Sin 45^0 in the second equation. R should be found from those two equations. There is an easy way to find R. Once you understand that Sin 45^0 and Cos 45^0 values are the same, it is very easy to find R by solving these two equations. That means P Sin 45^0 and P Cos 45^0 are equal. Therefore, the second equation can be written like this. R = 0.5 R + 20 Now cannot you find R? If you can find R from memory after this step, then you can remember how you had solved problems in year 8 and 9.

0.5 R = 20 R= 40 The correct answer is (5).

Finding P from the above equations is a stupid action. You need the mathematical practice on these occasions. If you have, then you can solve the problem of 5 min in 2 min. The examiners have given the angle as 45^0 to simplify easily.

52. Two airmen with different weights falling freely after being jumped together from a plane, open their identical parachutes at the same altitude at the time and start to descend.

Consider the following statements made about the motion of the two airmen.

(A) Initially their speed are reduced due to the upthrust acting on the parachutes.

(B) The terminal velocity of the heavier airman is greater than that of the other.

(C) Both airmen reach the ground together.

Of the above statements

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

Statement A is not correct. At the beginning (once the parachute is unfolded), it is true that the speed of air force officials is reduced.This happens not because of the upthrust that acts on the parachute. Actually, the upthrust acting on the parachute is negligibly small. The displaced air volume by a parachute is negligibly small. We have a wrong conclusion that the speed of a parachute is reduced due to the upthrust. Air drag is affecting on the parachute. It depends upon the speed like viscous force.

Hope you have seen on the television about the vehicles that participate in horizontally moving super speed competitionsemit a parachute to stop the vehicle. You can directly argue that in that instance, the speed of the vehicle is reduced not to the upthrust. If the speed of the vehicle gets reduced due to upthrust, then it cannot occur like that as the upthrust is a force that is acting vertically upwards. Therefore, it cannot create a horizontal force. (A) is wrong.

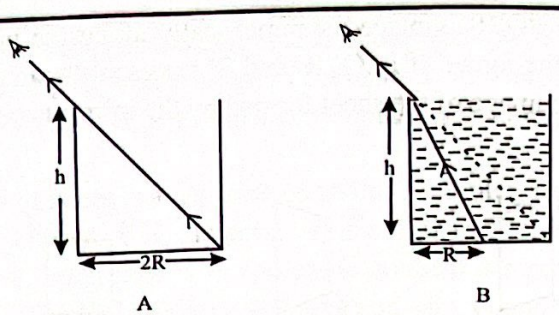
No need to write equations for statement (B) and (C). As the parachutes are identical, the critical speed of the heavier soldier is greater than the other. Before unfolding the parachutes both of them fall under g acceleration (if the upthrust acting upon them and air drag have been neglected).

Once they unfold, their rate of speed increment is reducing continuously. Once the soldier's weight is equal to the air drag acting upon the parachute, the soldier is gaining the critical speed. Therefore, the light soldier attains critical speed quickly whereas the heavy soldier attains a little bit later. Therefore, the heavier soldier's critical speed is greater than the other.

When two iron masses with same volume but different mass are released in water, the heavier one gets the greater critical speed. Does not it? Less heavy sphere equalizes its weight to the viscous force very quickly. But the heavier sphere takes more time to equalize its weight to the viscous force. Due to this reason its critical speed (velocity when weight = viscous force + upthrust) should be much higher.

Therefore, statement (B) is true. Actually statement (C) is not independent from (B). In such a question, the statements should be independent from each other. It is a weakness of the question. But I doubt whether you get that. You may conclude that it is better not to notify such issues of weaknesses. Therefore, if (B) is true, then (C) cannot be true. Clearly, the soldier with higher critical speed should come to the ground quickly. The correct answer is (1). Avoid writing equations in such situations.

53.



A B

A person can just see the opposite edge of the bottom of an empty vessel over its brim as shown in figure (A). While keeping the eye in the same position, the vessel is filled with a clear liquid up to its brim. Then he is able to see a small mark at the centre of the bottom of the vessel as shown in figure (B). The refractive index of the liquid is given by

(1) $\frac{\sqrt{h^2+R^2}}{\sqrt{h^2+4R^2}}$ (2) $\frac{2\sqrt{h^2+R^2}}{\sqrt{h^2+4R^2}}$ (3) $\frac{\sqrt{h^2+R^2}}{\sqrt{h^2+2R^2}}$ (4) $\frac{\sqrt{h^2+2R^2}}{\sqrt{h^2+R^2}}$ (5) $\frac{h+2R}{h+R}$

Think this is as a problem that you have solved (especially as an essay question). Drawn rays even with dash lines are provided in the diagram just because this is a short question. No need to give a diagram if this was an essay question. Sin i is obtained from figure A.Sin r is obtained from figure B. So, what do you need more to find refractive index?

$$Sin\, i = \frac{2R}{\sqrt{h^2+4R^2}} \quad Sin\, r = \frac{R}{\sqrt{h^2+R^2}}$$

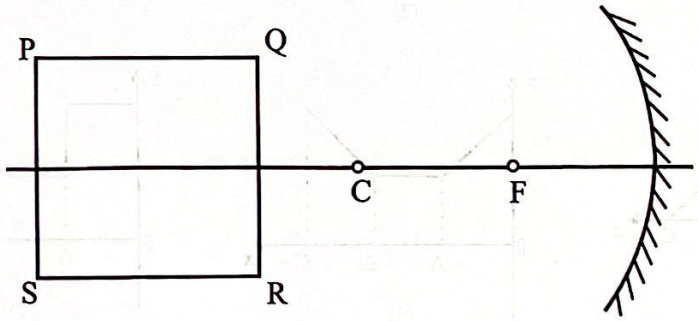
If you cannot write these two expressions directly, then you do not know simple trigonometry. Need to mention again that these are not A/L mathematics. Now cannot you get (Sin i/Sin r) from your mind? The correct answer is (2).

I heard a child saying "Oh no! It takes time as we need to put Pythagoras Theorem". It shows the massive destruction of (simple) mathematics. It will landslide more in the future. I do not know that who should be truly responsible for it.

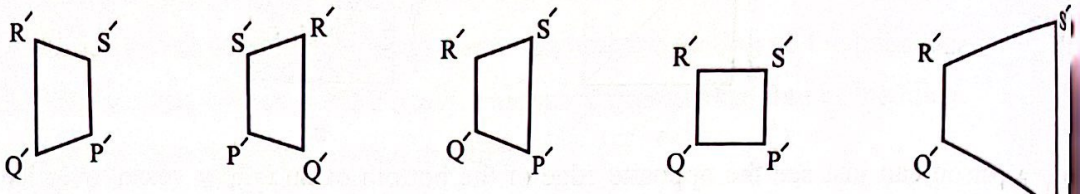
How much time do you need to apply Pythagoras Theorem? Poor Pythagoras might have taken some time to discover it. I do not know that for sure. But when somebody has found something correctly, how much time do you need to apply it after understanding properly? You think it for yourself.

Out of the persons who sat for the exam, how many of them might have made such comments? Does our entire nation is mentally retarded according to Soma Thero?

54.



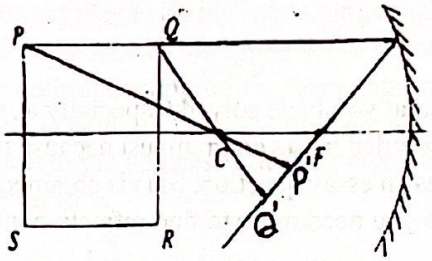
A thin square sheet PQRS is placed symmetrically along the principal axis of a concave mirror as shown in the figure. If P',Q',R' and S' represent the images of points P,Q,R and S respectively then the image of the sheet formed by the mirror is best represented by



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

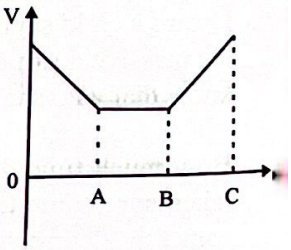
03 Optics

The answer can also be obtained from logic. I think the easiest way to solve the problem is drawing ray diagrams (three is enough) on the paper. Look at the following figure.

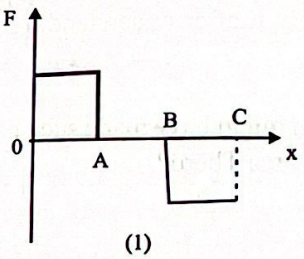


Now do you need the intelligence of God Sakra to understand that the answer is (1)? I a stupid thing to draw the points S' and R'. Only the figure in (1) has drawn P' and Q' above. The focus and centre of curvature are shown to make the question easy for you.. not two minutes enough?

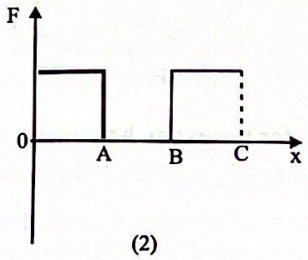
55. The variation of the electric potential V along the x-direction in a certain region of space is shown in the figure.



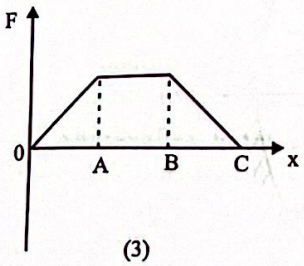
If a charge is taken from O to C along the x-direction, the variation of the electric force F acting charge is best represented by



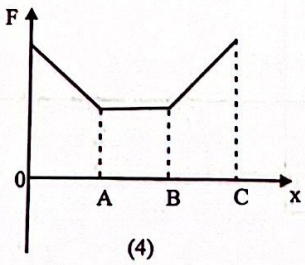
(1)



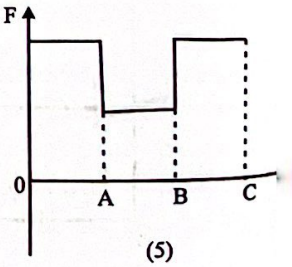
(2)



(3)



(4)



(5)

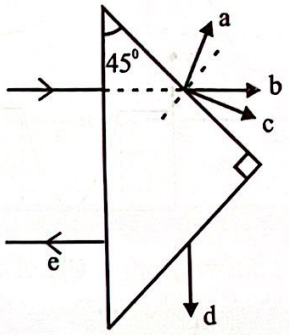
06 Electric Field

Is not this question the reciprocal of 47th question of paper 1995? The answer has gone to the question and the question has been asked in the answer. The force on the charge is dependent on the electric field strength (E). (F = qE) E = - potential gradient

Up to OA, potential gradient is a negative constant. Therefore, from O to A, the value of E is a positive constant. From A to B, the potential is constant. That means the potential gradient is zero. That is E = 0. From B to C, the potential gradient is a positive constant (numerically equal to OA value). Then E should be a negative constant. Graph (1) represents this variation. This is a very easy question if past papers are done. The sign of the charge is not given. If it is a negative charge, then the direction of the force is opposite to E. But the reciprocal of graph (1) is not included in the choices. So, there should not be a question regarding the direction of the force here. The correct choice is true for a positive charge.

56. As shown in the figure a ray of monochromatic light is incident normally on one face of a prism made of plastic of refractive index 1.40. The refracted ray emerging to air is best shown by

$$\left[\sin 45° = \frac{1}{1.42}\right]$$

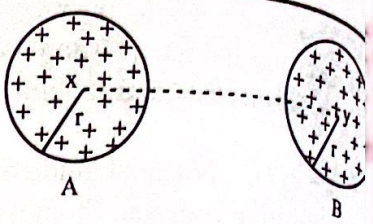


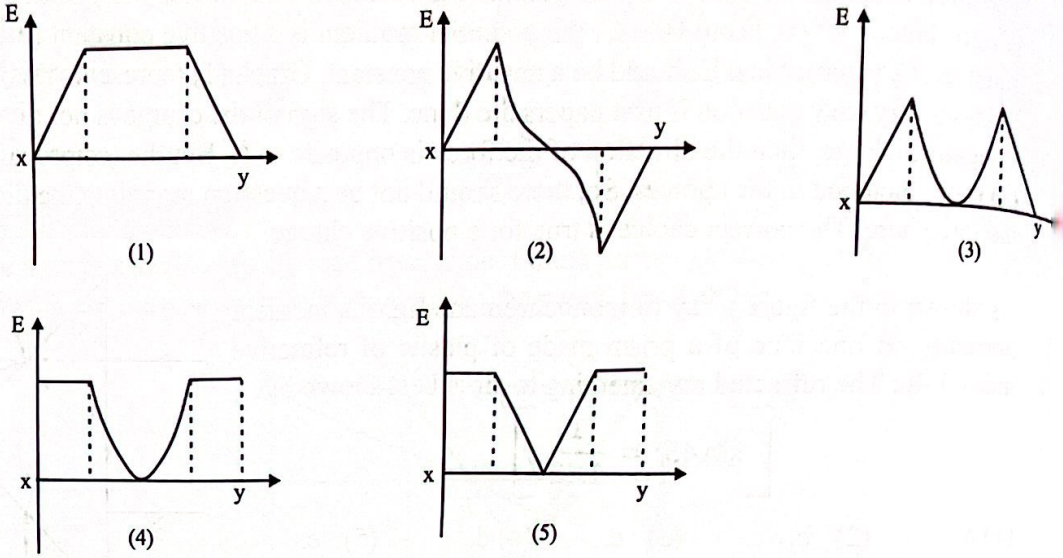
(1) a. (2) b. (3) c. (4) d. (5) e.

There is no need of calculation if you think correctly. The ray is incident on the second surface with an incident angle if 45°. First, you should see that. If this 45° is less than the critical angle of the medium, then the ray exits to the air.If this 45° is greater than the critical angle of the medium, then the ray undergoes total internal reflection. Now how to find whether 45° is greater or less compared to the critical angle value in plastic? A hint is given inside the bracket. It has been given to indicate that if refractive index is 1.42, then the critical angle is 45° and not for any calculation.

As the refractive index of the plastic which the prism was made is 1.4, does the corresponding critical angle is less or greater than 45°? 1.4 < 1.42 then, 1/1.4 > 1/1.42. Therefore, the respective critical angle for 1.4 should be greater than 45°. So, 45° is less than the respective critical angle. Hence the ray is exiting to the air from the second surface. Therefore, the correct answer is (3). If you chose (5) by treating as normal glass, then you have not understood the question. On the other hand, if it is so, then this question should have been asked in the first twenty questions. You can get the correct answer by finding the respective critical angle according to 1.4. But you need logarithmic tables. The relationship in the brackets is given to avoid that issue. Solving the problem will be hard if you do not see the reason that it has been given.

57. A and Bare two uniformly charged identical, non-conducting solid spheres carrying equal charges. The distance between the spheres is very much greater than their radii r. The variation of the electric field intensity, E, along xy from to x to y is best represented by

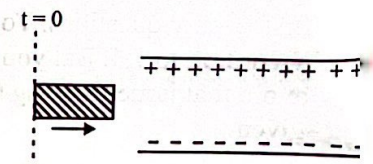


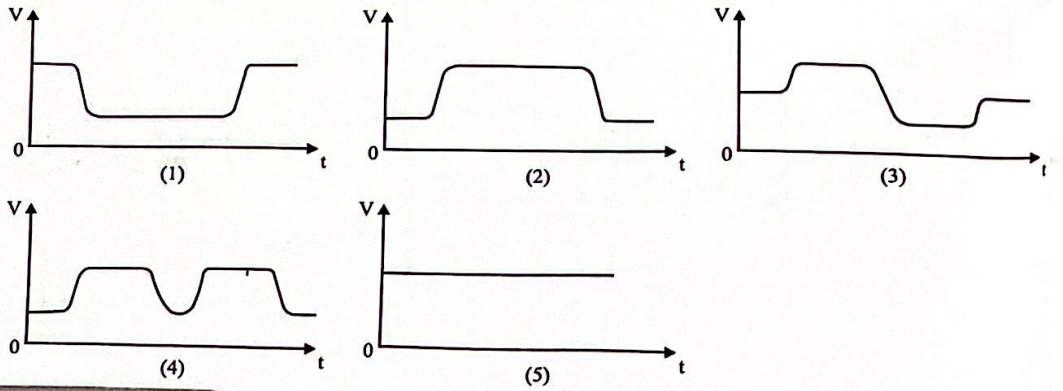


06 **Electric Field**

In the 56th question of paper 1994, there is a similar question about two-point charges. Anot similar question for two positive charges is in 60th question paper 1991. There is no need write any expression. I am not telling the rest of it if you cannot see that there can be a n point in the middle of two spheres (where the electric field intensity is zero). So, the direct of E from the left side of the null point should be in opposite direction to the direction of E the right side of the null point. Otherwise, how can there be a point where E = 0? Change o with direction (sign) is shown only in graph (2). If you look from that point, then you can the answer quickly. If you understand the question completely, then the electric field intens of an insulating sphere that is uniformly charged should gradually increase from zero (fr the centre). Electric field intensityoutside the sphere should decrease according to $1/r^2$. Th can be obtained easily from Gauss Theorem. If it is a conducting sphere, then the electric fi intensity is zero inside the sphere as the net charges come to outer surface.

58. A small dielectric slab is passed through an isolated charged parallel plate capacitor, as shown in the figure. As the slab moves the variation of the potential difference V across the capacitor with time t is best represented by

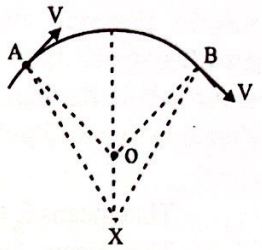


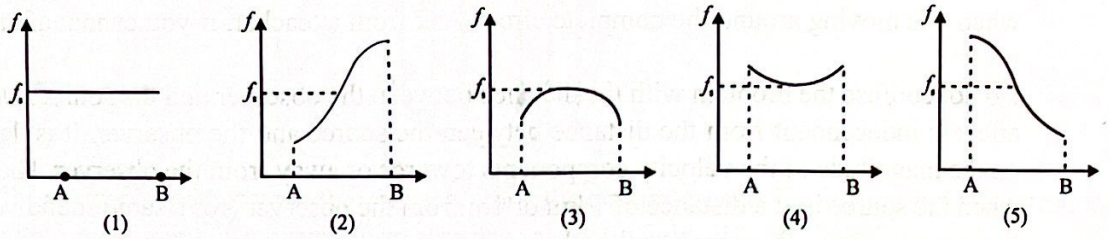


06 **Capacitors**

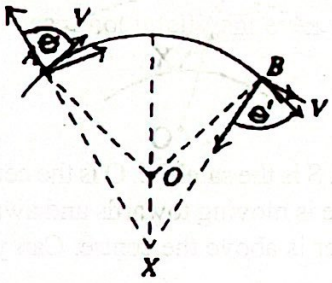
You should blame as this question is given as the 58th question. Is not this 56th question of paper 1996? I will not explain again. Look how it was solved in the 56th question of paper 1996. The correct answer is (1). The only difference here is that, t is measured only when the block is placed outside the plates.

59. A sound source emitting signals at a constant frequency f_s moves along an are of a circle with constant speed V as shown in the figure. A stationary observer is located at a point X. O is the centre of the circle. As the source moves from Ato B, the variation of the frequency (f) heard by the observer is best represented by





For this question also you can get the answer from general knowledge without writing an equation or expression. I think that all the dash lines are drawn to take you towards the answer. When the source is at A, it is noted that the source is moving away from the observer as its velocity is resolved perpendicularly to XA and through XA. If we do the same resolution at B, its velocity component is towards BX direction which is coming towards the observer.



When the source is vertically above the point X, we accept that the frequency heard by the observer is f_s. That is when the velocity component of the source through the observer or away from him is zero. Therefore, when the source is at point A, the velocity component is away from the observer and when the source is at point B, it is towards the observer. Therefore, f at A should be less than f_s and at B, f should be higher than f_s. When the source is moving away from the stationary observer, then the apparent frequency should be lesser than the actual frequency whereas when it is moving towards the observer, then the apparent frequency should be greater than the actual frequency. These points are satisfied only in (2). Do not try to get the shape of the curve by writing down equations with effort. All you need is to decide that at A, f is lesser than fs and at B, f is greater than f_s. Other than that, the shape of the curve is not checked. The only graph that is drawn such that f is lesser than f_s at A and f is greater than fsat B is graph (2). If you practice to look at the questions like this way, then you will not say that the paper is hard on that particular day. I will write down the following equation to those children who really cannot get the answers without writing an equation. But do not get addicted to these. V' is the velocity of the sound.

$$f_A = \frac{V' f_s}{V' + V \cos\theta}$$

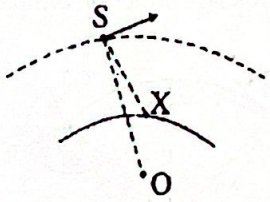
Even it is written, we can see that f_A is lesser than f_s. Now once the source is going to the θ gradually increases. That means cosθ decreases. Then the apparent frequency which w a lesser value gradually increases and once it has come to the top, $f = f_s$ ($\theta = 90^0$, cos 90
At a point like B,

$$f_B = \frac{V' f_s}{V' - V \cos \theta'}$$

That means $f_B > f_s$. Once it is coming from the top, θ gradually decreases. Then cos θ' increa That means (V'-V cos θ') gets reduced. Then f_B gets increased. Look at the variation o when it is moving around the complete circle. Ask from a teacher, if you cannot after a try

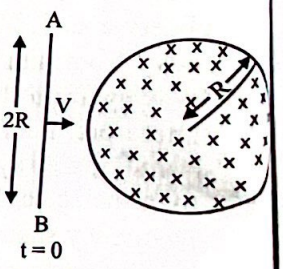
Do not confuse the problem with the distance between the observer and the source. Doppler effect is independent from the distance between the source and the observer. It is depende on the magnitude of the velocity components towards or away from the observer. That mea when the source is at a distance of 1 km or 1m from the observer (for a same sound velocity the same apparent frequency will be heard if the velocity component of the source is equa But the loudness is less when the source is 1 km away. Whether it is near or far, f is unchange due to the fact of distance.You will get this directly once you consider all the equations Doppler's effect.

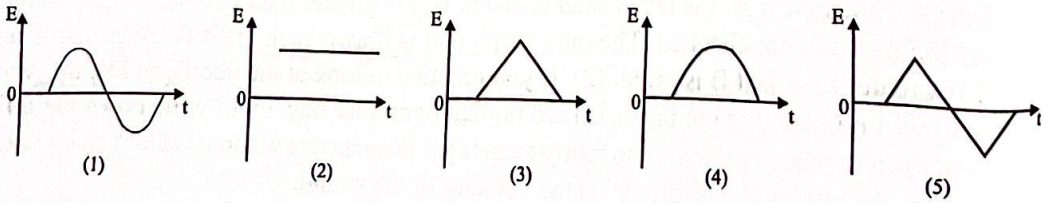
Obtaining signals from a satellite is a situation where the change of frequency is practical considered.



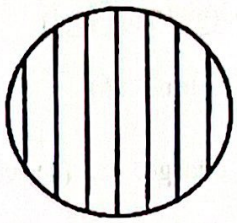
X is a hosting centre on Earth. S is the satellite. O is the centre of Earth. How will the frequenc signals vary when the satellite is moving towards and away from X? This is different from th given question as the observer is above the centre. Can you argue that this variation is give by graph (5)?

60. A metal rod AB of length 2R moving with a constant velocity V is passing over a uniform magnetic field confined to a circular region of radius R, as shown in figure. The variation of the e.m.f. (E) induced across the rod with time (t) is best represented by





This is a shameful work to give as the 60th question. Seems that the people who made the paper are not with a sound mind. How easy is this question compared to the 60th question of paper 1999? A rod is moved not a loop. Same V and B are there. Therefore, induced e.m.f is dependent only upon the length of the rod that is in the field. Do you need equations to decide this? Once the rod is entering the field, the length that is on the field gets increased. As soon as it comes to the centre of the circle, its total length (2R) is inside the field. Then the length inside the field gets reducedagain. Therefore, (3) and (4) are the guessed variations. But as the required length of the rod is obtained from the arc of a circle, the length cannot gradually increase or decrease. So, the correct answer is (4).



The answer is there if you take your eye along the circumference. Do not confuse this question with a movement of a closed loop across a magnetic field. When a loop is moved, you need to consider the rate of change of flux associated with. But there is a metal rod here. It is sufficient to consider only VlB. Therefore, the change of l should be considered (as V and B are constant). When a long rod is taken into a circle, how much from the rod will be cut from the circle? A child in year 9 can answer this.

The people who argue that last 10 questions of the paper are of degree level, are the educated ones who need to derive equations for every question, without thinking the question in a simple way. They are not intelligent even they are educated.