

INSTITUT UCAC-ICAM
Entrance Examination – August 2021

To be filled by the candidate:

Name: Surname:
Examination center: Seat N°:
Subject:

Reserved for the
Institut
Anonymous N°:
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Reserved for the Institut

Score:



1ST CYCLE OF TRAINING

Physics Test Questions

Reserved for the Institut

Anonymous N°:
.....

TIME ALLOWED: 1 hour 30 minutes

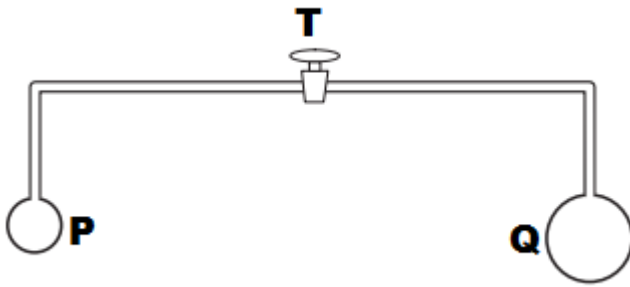
INSTRUCTIONS: This paper is made up of 50 questions. Each question carries 4 suggested answers. Select the most appropriate answer and mark it on the answer sheet provided.

-
- Which of the following is most correct about optical fibres and copper wires as used in communication?
 - Optical fibres are secured than copper wires but offers much attenuation
 - Optical fibres are less prone to noise than copper wires but offers much attenuation
 - Optical fibres are more secured, less prone to noise and offer less attenuation compared to copper wires
 - Copper wires are more secured, less prone to noise and offer less attenuation compared to optical fibres.
 - A player kicked a ball vertically upward with an acceleration of 1.25 m/s^2 . After 8.0 seconds, a tiny stone is released from the ball. The stone will
 - cover a distance of 40 m
 - have a displacement of 50 m
 - reach the ground in 4 s
 - begin to move down after being released
 - The dimensions of magnetic permeability of free μ_0 is
 - $M^{-1}L^{-3}I^2T^4$
 - $M^{-1}L^3T^{-2}$
 - $ML^2T^{-2}I^{-2}$
 - $MLT^{-2}I^{-2}$
 - The distances travelled by a body falling freely from rest in the first, second and third seconds are in the ratio

- A. 1:2:3 B. 1:3:5 C. 1:4:9 D. 1:3:4

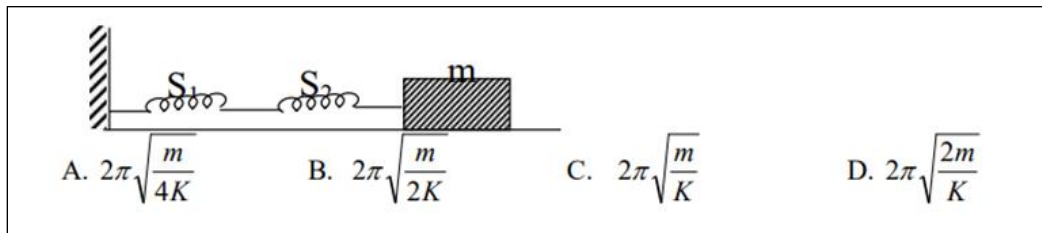
5. Assuming the earth is spherical, the mass of uniform density and radius R , the gravitational field strength in Nkg^{-1} at a height $R/4$ above the earth's surface in newton is
A. 9.8 B. 2.5 C. 6.3 D. 7.8
6. A surveillance drone of mass 10.21 kg hovers when its propellers move through air sweeping an area of 10.0 m^2 and giving the neighboring air molecules an average speed of v . Given that the density of the air molecules is about 1.2 kgm^{-3} , an estimated value of v in ms^{-1} could be:
A. 2.9
B. 100.1
C. 11.0
D. 85.1
7. A converging lens is used to form an image on the screen. When the upper half is covered by an opaque screen,
A. Half of the image will disappear
B. The intensity of the image will increase
C. The intensity of the image will decrease
D. There is no change in the image.
8. The temperature of a fixed mass of an ideal gas is doubled from 70°C to 140°C . The root-mean square speed of the molecules of the gas will therefore increase by a factor of:
A. 1.41 B. 1.20 C. 2.00 D. 1.10
9. A spinning object in space can change its moment of inertia (I) by changing its shape. This process is only possible if the object:
A. expends some energy to increase I
B. expends some energy to decrease I
C. does not have to expend any energy to change I
D. this can only be possible if we know the value of I
10. In an ac circuit, V (in V) = $100 \sin 100\pi t$, I (in mA) = $100 \cos 100\pi t$, the power dissipated is
A. 100 W B. 5 W C. 0 D. $5\sqrt{2}$ W

11. The figure below shows a double-head tap in a locality in the East region. When the tap initially is closed, two bubbles P(smaller) and Q (larger) are formed at the end of the pipe.



T is now opened so that air can flow freely between the bubbles. Which of the following statements is true?

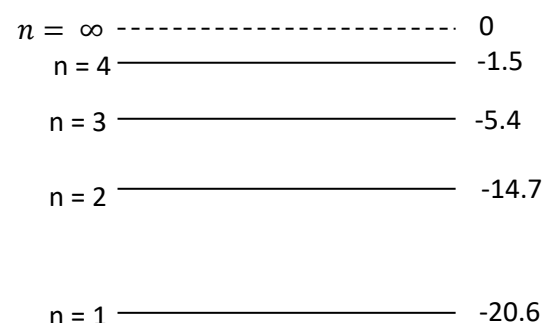
- A. There will be no change in the sizes of the bubbles.
 - B. The bubbles will become of equal size.
 - C. P will become smaller and Q will become larger.
 - D. The sizes of the two bubbles will become interchanged.
12. A block of mass m is attached to two identical springs S_1 and S_2 as shown in the figure below. The force constant of the springs is K . If the block is made to execute simple harmonic motion, the period will be



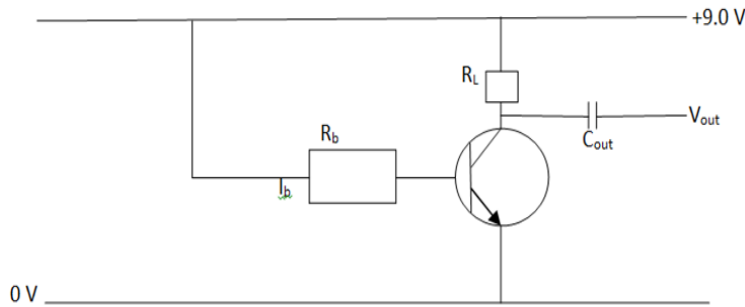
13. Which of the following is true about the young modulus of a material
- A. It is the ratio of the tensile strain to the tensile stress of a material
 - B. It is dependent on the stress, strain and dimensions of a material
 - C. A material with a smaller Young Modulus will resist elastic deformation strongly than one with larger Young Modulus.
 - D. It is dependent on the nature of the material

14. The figure beside shows the energy level of an atom in eV.

- A. The ionization energy for an electron transiting from the ground state to infinity is -20.6 eV
- B. As an electron de-excites from infinity to $n=2$, it gives out exactly 14.7 eV of energy
- C. The wavelength λ , of the transition from -5.4 eV to the ground state is 1.22×10^{-7} m
- D. Zero energy is needed to completely move an electron from $n=1$ to infinity..

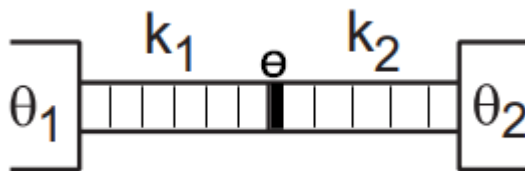


15. The figure below is an amplification circuit using an NPN transistor in the common emitter mode. The base current is $25\mu\text{A}$ when the output voltage V_0 is 6.0 V for a current gain of 60.



The values of R_b and R_L in $k\Omega$ are respectively:

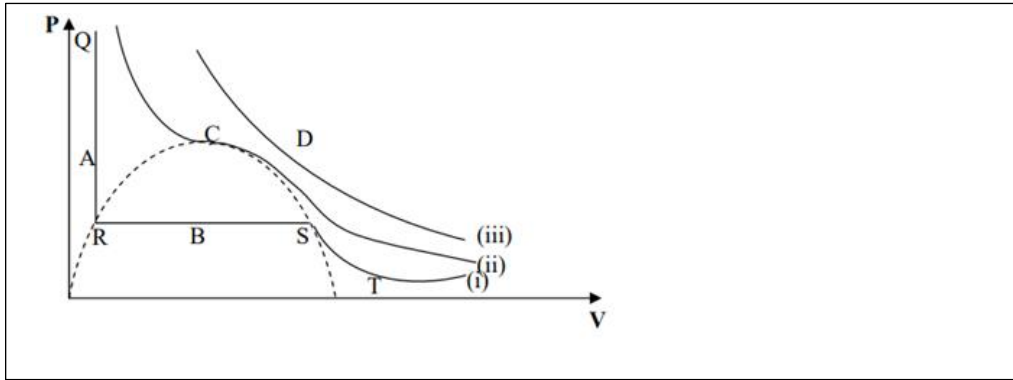
- A. 2 and 30
 B. 1.5 and 2
 C. 28 and 2
 D. 28 and 1
16. A potentiometer wire of length 80.0 cm is correctly connected to a driver cell of e.m.f. 2.0 V . A student tries to balance the e.m.f. of a thermocouple directly on the potentiometer wire and finds that it is impossible to do so. This could be because
- A. the p.d. across the wire is too high.
 B. the emf of the thermocouple is too high.
 C. the balance length is too small to be measurable.
 D. D, the positive terminal of driver cell is connected to the negative terminal of the test cell.
17. Two similar conductors made of different materials of conductivities k_1 and k_2 are placed end to end between two heat sources at temperatures θ_1 and θ_2 respectively.



The junction temperature (θ) of the conductors is:

- A. $\frac{\theta_1 + \theta_2}{2}$
 B. $\frac{k_1\theta_1 + k_2\theta_2}{k_1 + k_2}$
 C. $\frac{k_1\theta_2 + k_2\theta_1}{k_1 + k_2}$
 D. $\frac{|k_1\theta_1 + k_2\theta_2|}{|k_1 + k_2|}$

18.

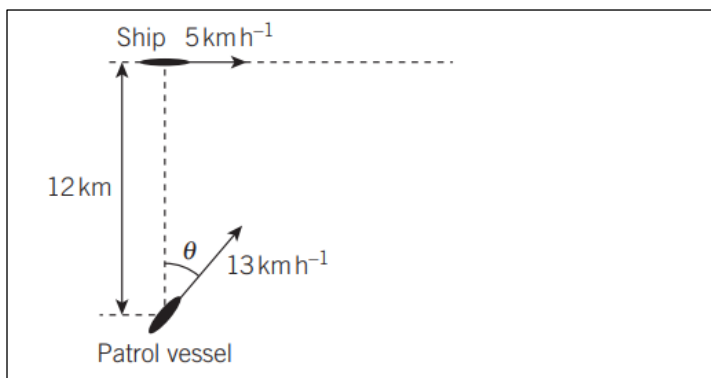


In which part of the diagram in the figure above (ABCD) can saturated vapour exist in equilibrium with its liquid?

19. A $22.0 \mu\text{F}$ capacitor charged to 10.0 V is connected in parallel with a $47.0 \mu\text{F}$ capacitor charged to 20.0 V . The final potential difference across both capacitors will be
 A. 15.0V B. 38.7V C. 30.0V D. 16.8V

20. In Einstein's explanation of the photoelectric effect:
 A. There is a small time lag between illumination of a metal surface and photoemission of electrons
 B. The number of electrons emitted per second does not depend on the frequency but on intensity of light only
 C. Few electrons are emitted below the threshold frequency and more above it.
 D. The maximum kinetic energy of the emitted photoelectrons depend on the energy of the incident photons, frequency of light and the work function of the metal.

21. A ship is travelling due east at a speed of 5kmh^{-1} . A police patrol vessel is 12km due south of the ship, moving at a speed of 13kmh^{-1} and wishes to intercept the ship.

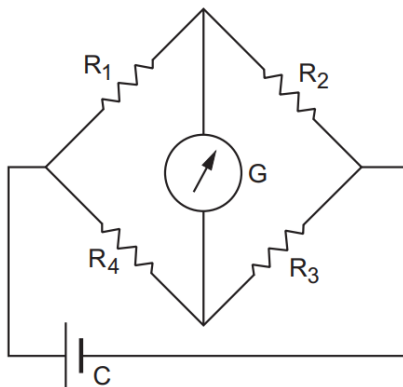


The time taken and the angle through which the patrol vessel must sail in order to intercept the ship is respectively:

- A. 2 hours and 30°
 B. 1 hour and 23°
 C. 1 hour and 25°
 D. 2 hours and 23°

22. A metal does not emit electrons when a parallel beam of light falls on it. Which of the following steps would make it emit electrons?
- Using light of longer wavelength
 - Polarizing the light
 - Increasing the intensity of the light
 - Using light of shorter wavelength
23. A neutron ($m_0 = 1.675 \times 10^{-27} \text{ kg}$) is traveling at $0.50 c$ with respect to a "stationary target." Its momentum with respect to the stationary target is
- $0.29 \times 10^{-19} \text{ kgms}^{-1}$
 - $1.15 \times 10^{-6} \text{ kgms}^{-1}$
 - $2.9 \times 10^{-19} \text{ kgms}^{-1}$
 - $2.9 \times 10^{-20} \text{ kgms}^{-1}$
24. The amount of thermal energy in joules that is required to convert 40 kg of pure water initially at 25°C , completely into steam at 100°C at standard atmospheric pressure is
- 1.03×10^5
 - 1.03×10^8
 - 9.05×10^7
 - 1.26×10^7
25. Which of the following is not true about dimensional analysis? It can be used to:
- Check the dimensional correctness or consistency of a physical equation.
 - Derive an equation containing two or more physical quantities with the same dimensions.
 - Derive expressions connecting different physical quantities
 - Convert units of a physical quantity from one system of units to another.
26. A charged particle is moving in a circular path in a magnetic field. If the velocity of the charged particle suddenly increases, which quantity remains unaltered?
- Kinetic energy
 - Momentum
 - Radius
 - Angular frequency
27. A conductor carrying a current I_1 is placed inside a long solenoid in which a steady current I_2 is flowing. The length of the conductor is perpendicular to the axis of the solenoid. The magnetic force on the conductor is independent of
- the number of turns per unit length of the solenoid
 - the magnitudes of the currents in the conductor and solenoid
 - the cross-sectional area of the solenoid
 - the length of the conductor
28. A radioactive sample has a mass m , decay constant K , molecular weight M and L as the Avogadro number of particles. What will the initial activity of the sample be?
- $\frac{Km}{M}$
 - Km
 - mLe^K
 - $\frac{KmL}{M}$
29. If the thermal conductivity of brick is $0.6 \text{ Wm}^{-1} \text{ K}^{-1}$. Then the thickness of brick which will conduct heat at the same rate as 10 cm of air of thermal conductivity $2.4 \times 10^{-3} \text{ W m}^{-1} \text{ K}^{-1}$ is
- 6 m
 - 24 m
 - 20 cm
 - 25 m

30. In the year 2013, a laboratory held a stock of 4.0 mg of a radioactive isotope which had a half-life of 2.0 years. The stock was originally purchased in the year 2005. The quantity of the isotope that was bought in the first place in mg is
- A. 32.0 B. 64.0 C. 16.0 D. 0.25
31. Nuclear forces are either strong nuclear, electromagnetic or weak nuclear. Which of the following is not true about these forces?
- A. Strong nuclear force acts over a very short range, holding the nucleus together
- B. Weak nuclear force is responsible for the stability and rigidity of the nucleus
- C. Electromagnetic force within an atom, has an infinite range and acts on charged particles in the nucleus.
- D. Weak nuclear force has a very short range and is responsible for beta decay.
32. The toughness of a material is a measure of
- A. its opposition to crack growth
- B. how difficult it is to scratch its surface
- C, the minimum stress required to break the material
- D. its ability to be drawn out into wires or thin sheets.
33. Below is a figure of a Wheatstone bridge that is balanced.



Interchanging the positions of the cell C and the galvanometer G, the reading of G will be zero

- A. only if $R_1 = R_3$ and $R_2 = R_4$
- B. in all cases
- C. only if all the resistances are equal
- D. $R_1/R_3 = R_2/R_4$

34. Why is a stress-strain characteristic preferred to a force-extension graph in describing the mechanical behaviour of a material?
- A. A thin long wire gives a measurable extension for a small force.
 - B. A stress-strain curve gives more detail about the behaviour of the material.
 - C. With a stress-strain graph, the wire would not undergo plastic deformation.
 - D. It is easier to plot a stress-strain curve than a force extension graph
35. Two progressive waves travelling along the x-direction in the medium are described by the wave equations: $y_1 = a\sin(\alpha t - \beta x)$ and $y_2 = a\sin(\beta x + \alpha t)$ where α and β are constants
Which of the following is/are true about the waves?
- A. They both move at the same speed
 - B. Both waves move in the same direction
 - C. They both have the same amplitude of vibration
 - D. They have different wavelengths and frequencies.

SECTION 2

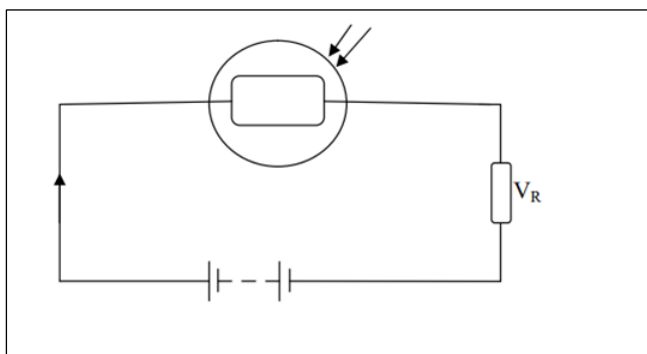
Directions:

For each group of questions below, ONE or TWO of the responses given is/are correct. CHOOSE:

- A. If 1 and 2 are correct
- B. If 2 and 3 are correct
- C. If 1 only is correct
- D. If 3 only is correct

| Directions summarised | | | |
|-----------------------|----------|--------|--------|
| A | B | C | D |
| 1, 2 only | 2,3 only | 1 only | 3 only |

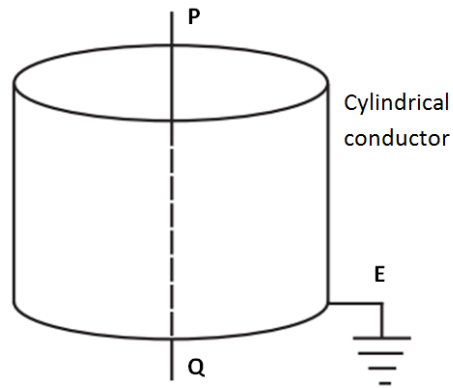
36.



When the light dependent resistor in the circuit above is illuminated there is an increase in

1. its electrical resistance
2. the potential difference V_R
3. the current I

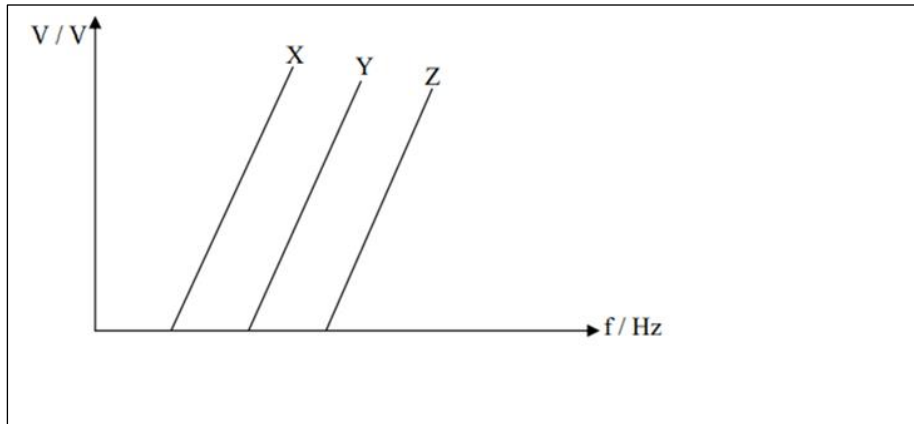
37. The figure below is that of a hollow cylindrical conductor connected to the earth at E. A copper wire PQ is placed along the axis of the cylindrical conductor. A quantity of charge will flow through E:



1. if PQ is removed, and a beam of electrons flows in its place
 2. if PQ is removed, and a beam of protons flows in its place
 3. if a current begins to flow through PQ
38. An object is released from an aeroplane traveling horizontally at a speed of 100 m s^{-1} at a height of 250 m above the ground
1. The horizontal velocity of the object will increase, and then decrease while its vertical velocity will increase at a constant rate.
 2. The initial velocity of the object relative to the plane is zero.
 3. The minimum time taken before the object hits the ground is 7.1s
39. When a monochromatic beam of light traveling in air enters a glass block along a path normal to the glass surface, there is no change in its
1. velocity
 2. Frequency
 3. Direction
40. Which of the following is/are common to electrostatic and gravitational forces?
- 1, They obey the inverse square law.
 2. They are non-contact forces.
 3. They can be shielded.
41. Using white light in a Young's double-slit experiment,
1. the first-order red fringes are closer to the centre of the screen than the first-order violet fringes
 2. the first-order violet fringes are closer to the centre of the screen than the first-order red fringes
 3. bright white fringe is formed at the centre of the screen
42. When two bodies X and Y are in thermal equilibrium with each other, it implies that
1. X and Y are at the same temperature
 2. If X and Y are in contact no thermal energy would flow between them
 3. Either X and Y can be used as a thermometer.
43. The height to which a liquid will rise in an open-ended capillary tube due to surface tension alone depends on:

1. the density of the liquid
2. the diameter of the capillary tube
3. the atmospheric pressure at the time of the rise

44. The figure below shows the result of stopping potential V_s , against frequency f for three different materials X, Y and Z



Which of the following statement(s) is/are true?

1. The three materials have different work functions
 2. Plank's constant can be found from any of the graphs X, Y and Z
 3. The three materials have the same threshold frequency.
45. A certain solid Y of specific heat capacity $1000 \text{ Jkg}^{-1}\text{K}^{-1}$ is heated in a well lagged container at a constant rate. Its temperature increases from 10 to 80 °C within 300 seconds as shown on the figure below;
1. Within AB, the energy supplied only goes to break intermolecular forces changing the state of substance.
 2. The specific latent heat of fusion of the solid is 84000 Jkg^{-1}
 3. The boiling point of this substance is 40 °C

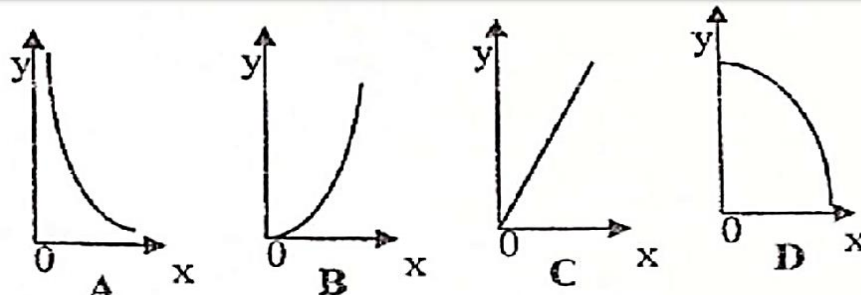
SECTION 3

Directions:

Each of the questions has four sets of graphs labeled A to D. Which of the graphs in each question best fits the relationship between x and y ?

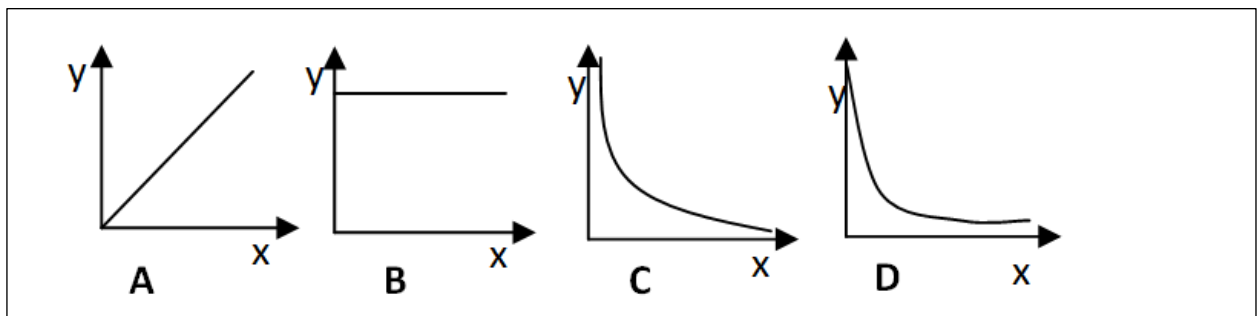
46.

| | |
|---|------------------------------------|
| y | x |
| Electrical conductance of a conducting wire | Square of the diameter of the wire |



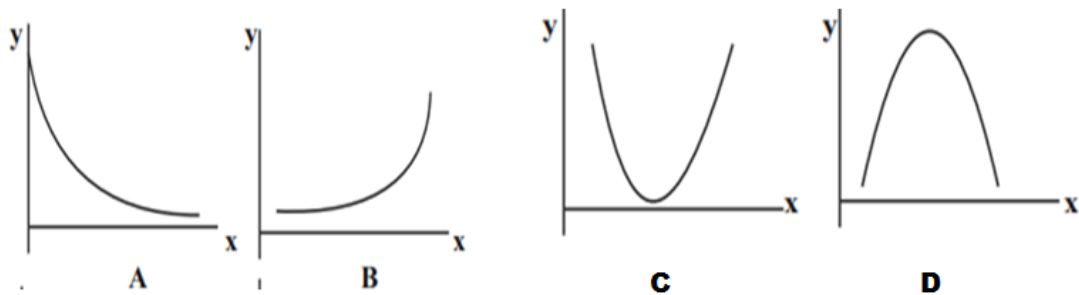
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| | |
|---------------------------------------|--|
| y | x |
| Temperature of a uniformly lagged bar | Heat flow from hot to cold end at steady state |



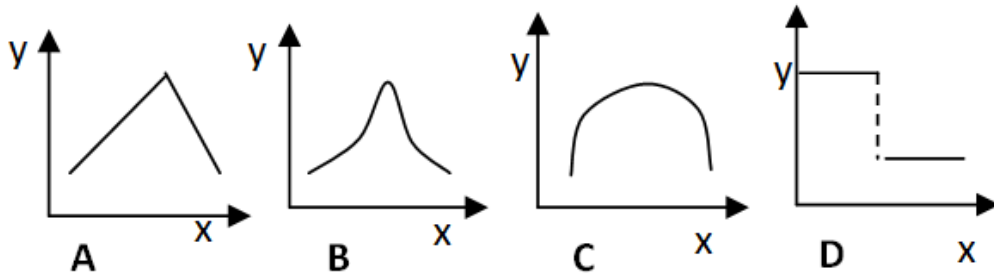
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| | |
|----------------------------------|-------------------------|
| y | x |
| Impedance of a RCL circuit where | Frequency of the system |



49.

| | |
|--|------|
| y | x |
| Frequency of sound heard by a stationary observer as a car driving at constant speed move past him producing a sound of constant frequency | time |



50.

| | |
|--------------------------------------|---------------|
| y | x |
| The activity of a radioactive source | Time of decay |

