Provincial Department of Education , Northern Province

General Certificate of Education (Adv. Level) Pilot Examination - December 2023

Physics I		01	E	I		Two Hours

Instructions

- This paper has 14 pages and 50 questions
- Answer all the questions
- Write your index number in the given space
- Read the instructions carefully given on the back side of the answer sheet. Follow them carefully
- In each of the question 1 to 50 , pick one of the alternative (1), (2), (3), (4) and (5) which is correct or most appropriate
- Mark a cross (X) in pencil in the cage corresponding to the number of your choice in the answer sheet

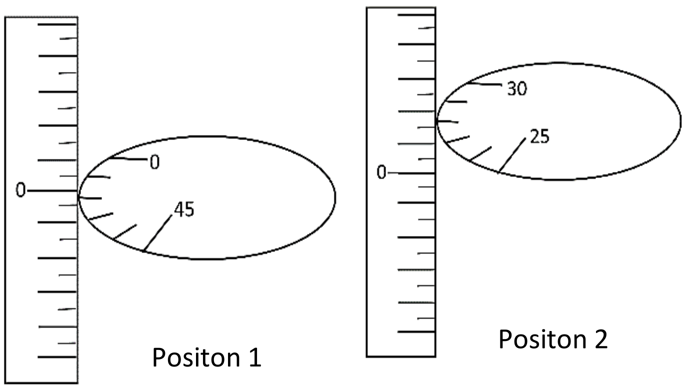
Use of calculator is not allowed

($g = 10\ ms^{-2}$)

1. The dimension of the pressure gradient is,
   (1) $ML^{-2}T^{-2}$ (2) MT^{-2} (3) $ML^{-2}T^{-1}$ (4) $ML^{-1}T^{-2}$ (5) MLT^{-2}

2. Two positions (position 1 and position 2) of a spherometer that involve a measurement of thickness of a disc , are shown in the figure . The thickness of the disc is,

   (1) 2.26 mm (2) 1.30 mm (3) 1.78 mm
   (4) 1.76 mm (5) 1.80 mm



3. The least percentage error that involved in a measurement taken with a laboratory micrometer screw gauge is,

   (1) 0.01 % (2) 0.02 % (3) 0.03 % (4) 0.04 % (5) 0.05 %

4. The threshold intensity of pain of ear of a healthy person is $1\ W\ m^{-2}$ .Threshold intensity of hearing is $10^{-12}\ W\ m^{-2}$. What is the difference in the intensity levels that corresponds to these intensities

   (1) 0.12 dB (2) 1.2 dB (3) 12 dB (4) 120 dB (5) 1200 dB

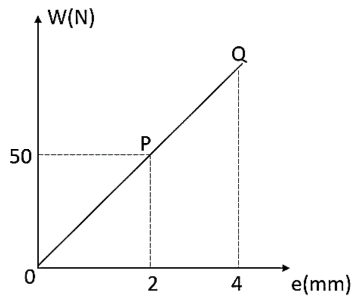
5. An ideal gas consists of N molecules per unit volume at pressure P and absolute temperature T. If the pressure and the absolute temperature of this gas is changed to 0.5 P and 2T respectively, then the number of molecules per unit volume becomes equals to

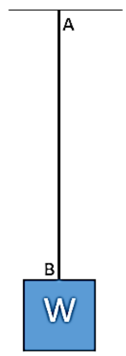
   (1) 0.25 N (2) 0.5 N (3) N (4) 2 N (5) 4 N

6. A wire AB is hung from roof at A and a load W is tied at B as shown in the figure. Graph shows the variation of extension with load . The ratio of

$$\frac{\text{The work done to extend the wire from O to P}}{\text{The work done to extend the wire from P to Q}}$$

Would be equal to

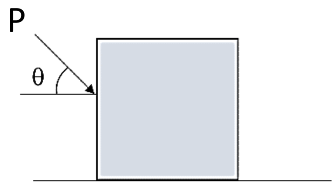


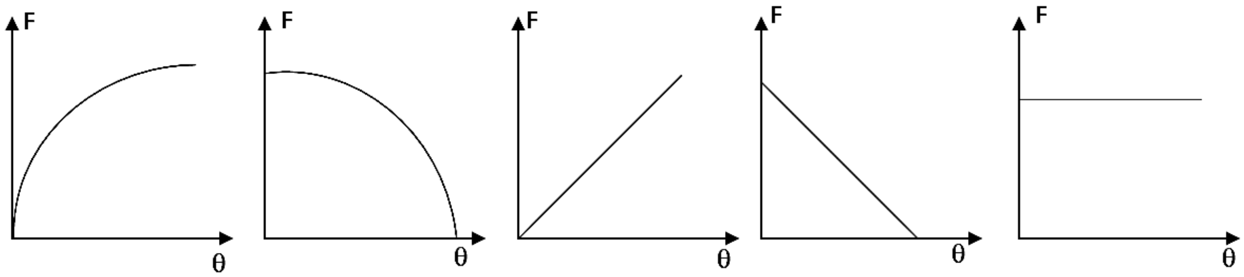


(1) $\frac{1}{4}$ (2) $\frac{1}{3}$ (3) 1

(4) 3 (5) 4

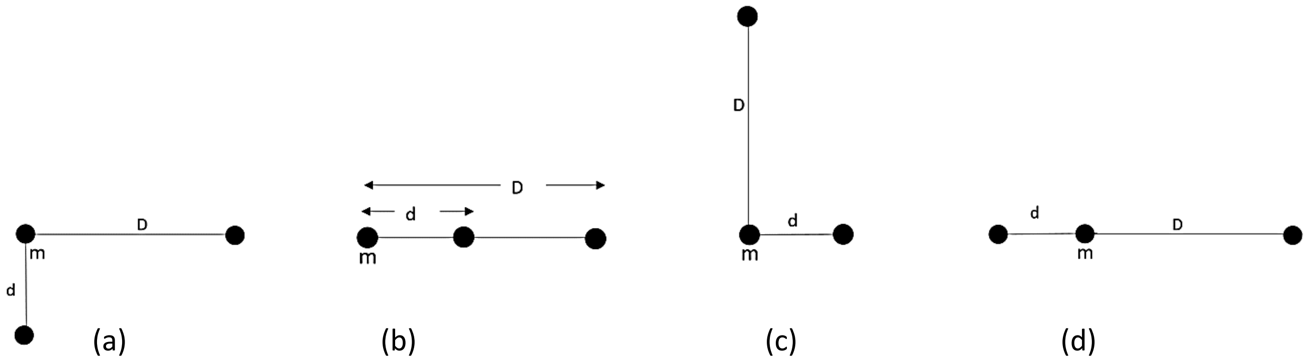
7. A block is kept on a horizontal rough floor. A constant force P acts on it at an angle θ to the horizontal as shown in the figure. The angle θ is varied from 0^0 to 90^0 while the block is at rest. Which of the following graphs shows the variation of frictional Force F with the angle θ ?





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

8. The Figure shows four arrangements (a), (b), (c) and (d) of three particles of equal masses. Rank the arrangements descending in the magnitude of the net gravitational force on the particle labelled m



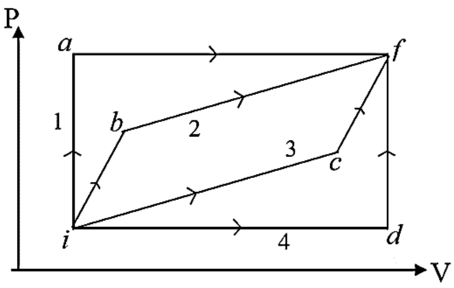
(1) b > d > c > a (2) b > a = c > d (3) b > a > c > d

(4) b > c > a > d (5) b > d > c = a

9. The lower (ice point) and upper fixed (steam point) point of a falsely graduated thermometer corresponds to -0.2 ^{0} C and 99.6 ^{0} C respectively. What will be the true temperature when this thermometer reads 30 ^{0} C ?

(1) 29. 74 ^{0} C (2) 29.94 ^{0} C (3) 30.06 ^{0} C (4) 30.26 ^{0} C (5) 30.38 ^{0} C

10. Four thermodynamic processes 1,2,3 and 4 (*iaf* , *ibf*, *icf* and *idf*) of a closed system of an ideal gas are shown in the figure. Q, W and U are the heat absorbed by the system , work done by the system , and the change in internal energy respectively. Consider the following statement



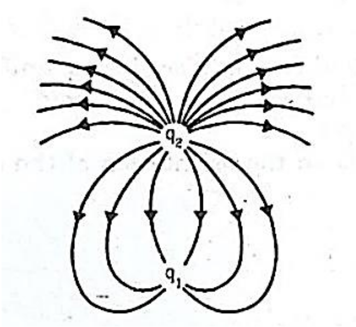
(A) $Q_2 - W_2 > Q_3 - W_3$ (B) $Q_1 - Q_4 = W_1 - W_4$
(C) $W_1 < W_2 < W_3 < W_4$ (D) $Q_1 > Q_2 > Q_3 > Q_4$

Which of the above statement(s) is / are true

(1) C only (2) D only (3) B and D only

(4) B and C only (5) A and D only

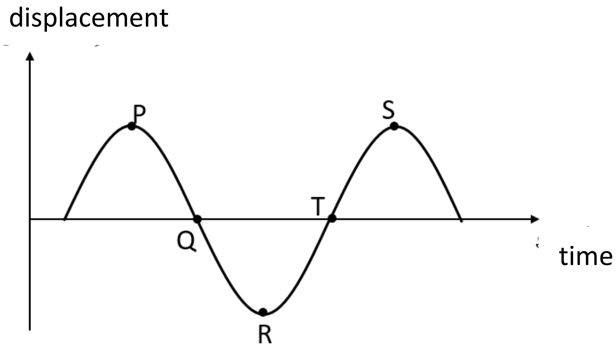
11. The electric field lines due to the point charges q_1 and q_2 , placed in a same medium, are shown in the figure. The possible values of q_1 and q_2 are, respectively



(1) +3 C, +1 C (2) -5 C, +15 C (3) + 2 C , + 6 C

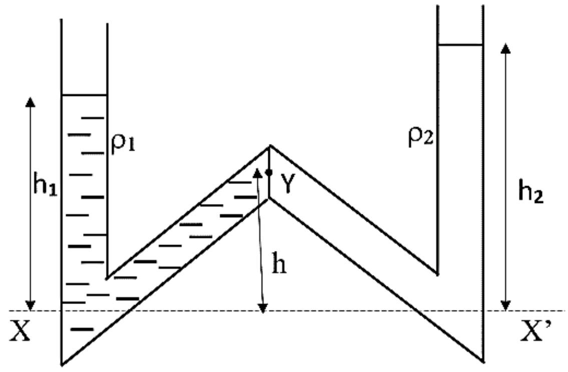
(4) + 18 C , - 6 C (5) data is not enough

12. The diagram illustrates the instantaneous position of a transverse wave travelling on a string .The points P, Q, R ,T and S represent elements on the string. At this instant ,



(1) The speed of the element P is maximum
(2) The speed of the element Q is minimum
(3) The acceleration of the element S is maximum.
(4) The elements S and R move in the same direction
(5) Depending on the direction of propagation of the wave the elements Q and T move either in the same direction or in the opposite direction

13. The diagram shows two immiscible liquids of densities ρ_1 and ρ_2 filled in a "W" shaped tube. The height of point Y above the horizontal level XX' is

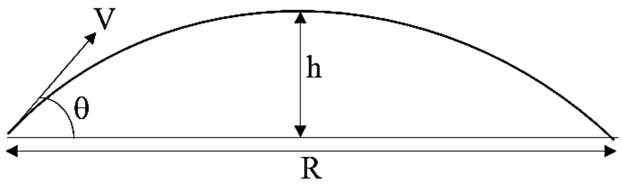


(1) h = $\frac{h_1\rho_1+h_2\rho_2}{(\rho_{1+}\rho_2)}$ (2) h = $\frac{h_1\rho_1-h_2\rho_2}{(\rho_{1+}\rho_2)}$

(3) h = $\frac{h_1\rho_1-h_2\rho_2}{(\rho_{1-}\rho_2)}$ (4) h = $\frac{h_1\rho_1+h_2\rho_2}{\rho_{1-}\rho_2)}$

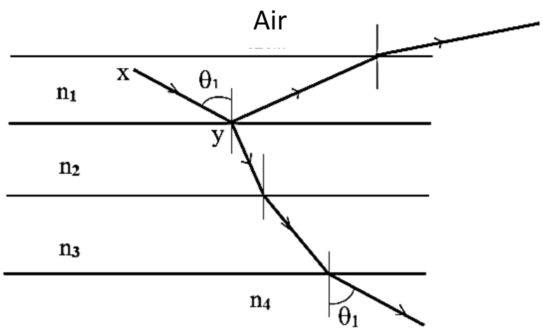
(5) h= $\frac{h_1+h_2}{2}$

14. An object of mass m is projected with an initial velocity V at an angle of elevation θ. Its horizontal range is R. The angular momentum about the point of projection when the object is at its maximum height is,



(1) $\frac{\mathrm{mVR}\cos\theta}{4}$ (2) $\frac{mVR}{2}$ (3) mVR (4) $\frac{\mathrm{mVR}\sin\theta}{4}$ (5) 2mVR

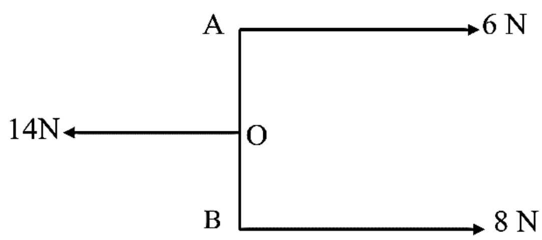
15. The figure shows the path of a light ray XY through four parallel sided media with refractive indices n_1, n_2, n_3 and n_4 according to the figure which of the following inequality is incorrect.



(1) $n_4 < n_3$ (2) $n_1 > n_2$ (3) $n_2 > n_4$

(4) $n_2 > n_3$ (5) $n_3 > n_1$

16. Consider the statements A, B and C made about a system of three forces shown in the figure. The point of action of the forces are such that AO = BO



A : The resultant of three forces is zero

B : The net effect of these forces is a couple

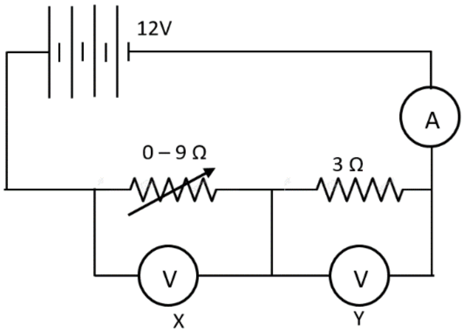
C : The system will be in equilibrium

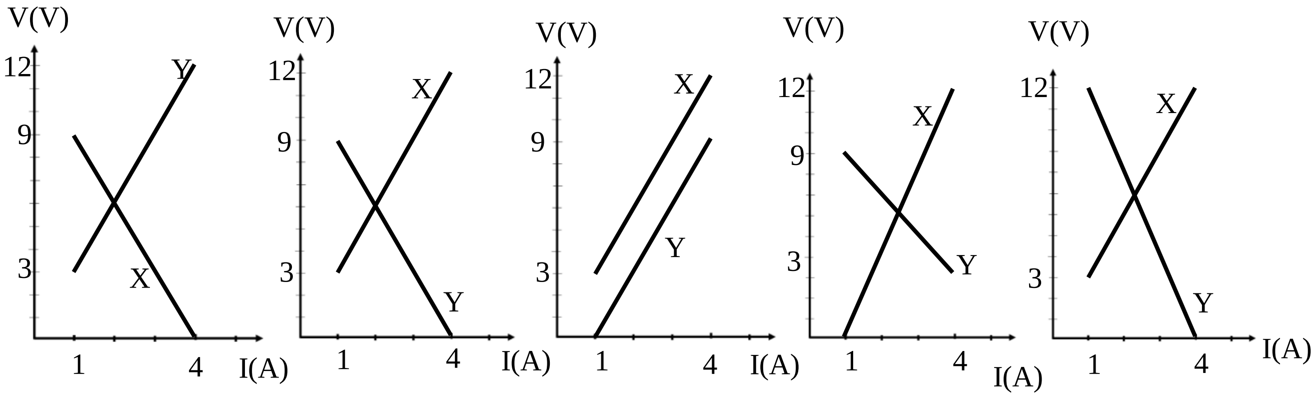
The correct statement/s is /are

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

(4) A and C only (5) A, B and C all

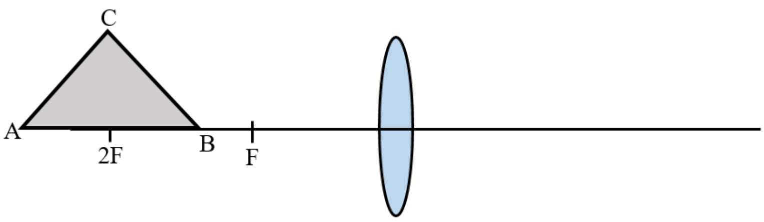
17. A cell with EMF 12 V and negligible internal resistance is connected in series with an ideal ammeter, 3 Ω resistor and variable resistor (0 – 9 Ω). Two high resistance voltmeters X and Y are connected as shown. The value of variable resistance is decreased from the highest to zero. Which graph best represents the readings of the voltmeters with the ammeter reading

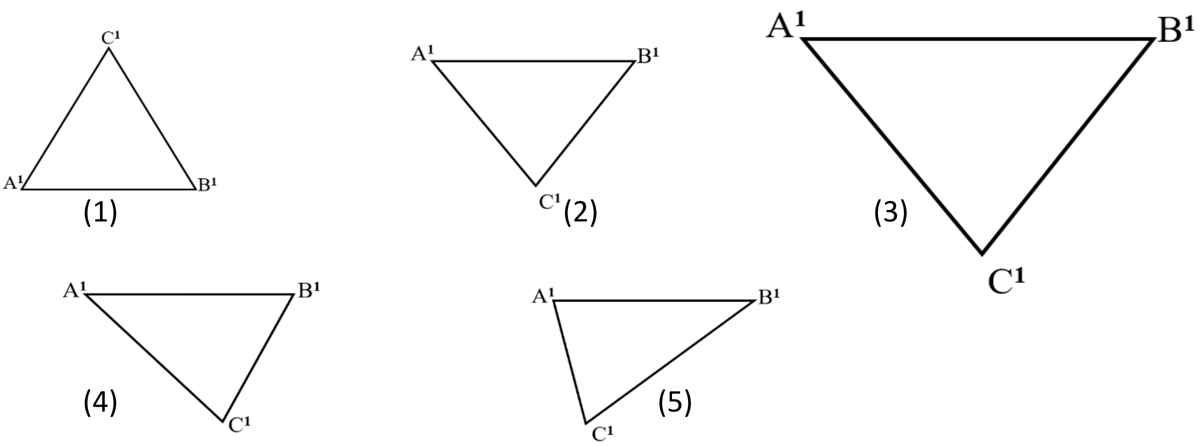




(1) (2) (3) (4) (5)

18. An equilateral triangular shaped object ABC is kept on the principal axis of a convex lens as shown in the figure. Which of the following figures best shows the shape of the image A'B'C' ?

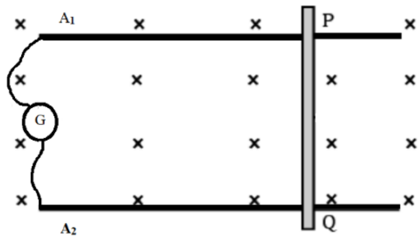




19. The energy levels in a three level laser are E_1= - 6.5 eV , E_2 = - 4.3 eV, E_3 = - 3.2 eV. The frequency of the pumping radiation used to produce this laser light is (in Hz)
(1 eV = 1. 6 x 10^{-19} J, h = 6.6 x 10^{-34} J s)

(1) 2.7 x 10^{14} (2) 5.3 x 10^{14} (3) 6.4 x 10^{14} (4) 8.0 x 10^{14} (5) data is insufficient

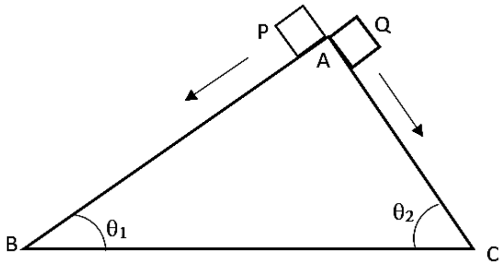
20. A conducting rod PQ of length l and cross sectional area A is placed on two parallel , horizontal conducting rails A_1 and A_2 as shown. A uniform magnetic field of flux density B is directed into the plane of paper as shown. A centre zero galvanometer is connected across A_1 and A_2. Neglect the resistance of all the components except PQ shown in the figure. PQ is dragged on the rails with speed V . which of the factors does not affect the deflection of the galvanometer.



(1) Length l (2) The cross sectional area A (3) Speed V

(4) Magnetic flux density B (5) the resistance of the rod PQ

21. Two blocks P and Q with equal masses are allowed to slide down from rest simultaneously along two smooth inclined planes AB and AC respectively from the top of the planes as shown in the figure. Consider the following statements.



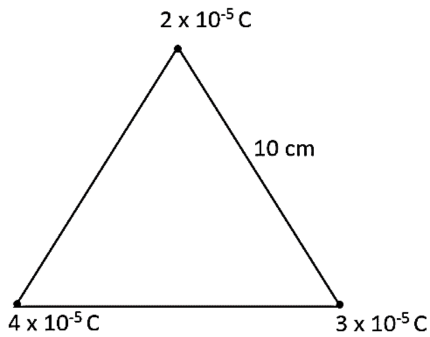
(A) Blocks reach the bottom of the inclined planes B and C with equal speeds.
(B) The acceleration of block P is greater than the acceleration of block Q.
(c) The block Q reaches the bottom C earlier than the block P

Correct statement(s) is / are

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

(4) A and C only (5) A, B and C all

22. Three point charges 2×10^{-5} C , 4×10^{-5} C and 3×10^{-5} C are brought to the vertices of a equilateral triangle of side length 10 cm as shown in the figure. The work that has to be done to bring these is,
($\frac{1}{4\pi\varepsilon_0} = 9x\ 10^9$ N m² C⁻²)



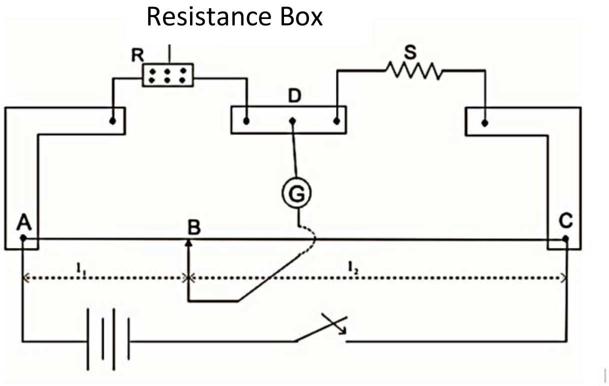
(1) 180 J (2) 108 J (3) 72 J

(4) 54 J (5) 234 J

23. A firefighter slides down along a vertical pipe with an acceleration of 2 ms^{-2} under mandatory training. If the mass of the fighter is 60 kg then the work done against the friction in sliding 1 m is ,

(1) 120 J (2) 300 J (3) 480 J (4) 600 J (5) 720 J

24. The figure shows meter bridge in its balanced state. S is a fixed resistance. Which of the following statements is not correct ?



(1) If the value of R is increased, the sliding key should be moved to the right to obtain new balance point.
(2) The rise in temperature, after long time usage , will not alter the balance point.
(3) The purpose of using wide conducting strip is to reduce the resistance of the connection
(4) This setup is not appropriate to compare small resistances
(5) The sensitivity of the galvanometer is high when the balance point is obtained at the middle point of the meter bridge

25. A uniform ring of mass M and radius R is shown in the figure (a). The ring is now folded along a diameter as shown in the figure (B) . If the moment of inertia of the ring and the folded ring about the axes through the center O , normal to the plane of the paper , are I_a and I_b respectively then

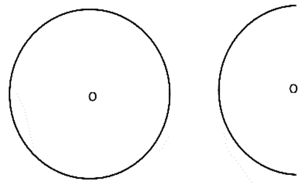
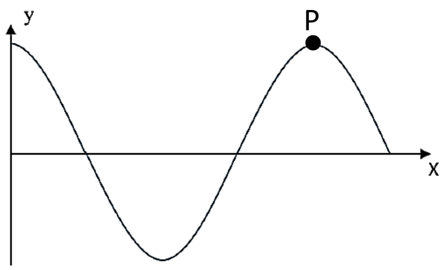


Figure (a) Figure (b)

(1) $I_a > I_b > MR^2$ (2) $I_b > I_a > MR^2$ (3) $I_a = MR^2 > I_b$

(4) $I_a = MR^2$, $I_b = \frac{MR^2}{2}$ (5) $I_a = I_b = MR^2$

26. Figure shows the variation of the displacement (y) with distance (x) when a sound wave travel through air to the right. The displacement to the right is taken as positive. Consider the following statements made regarding a point P .



(A) P represent a middle point of a compression
(B) The kinetic energy of an air molecule at P is maximum.
(C) At this instant the particle at P is displaced to the right.

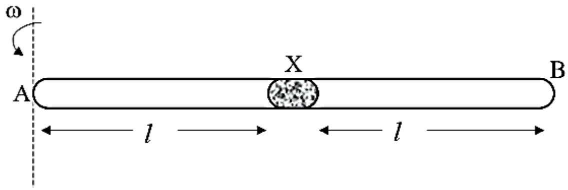
The correct statement (s) is / are

(1) A only (2) C only (3) A and B only
(4) B and C only (5) A, B and C all

27. A freshly prepared sample of radioactive element has half life two hours . It has the activity 64 times of its permissible safe level. The minimum time after which it would be possible to work safely with the sample is ,

(1) 3 h (2) 6 h (3) 12 h (4) 42 h (5) 128 h

28. A glass tube AB of uniform cross sectional area A and length 2 l contains a small thread of mercury at its middle. Two air columns , AX and XB , at the same temperature and pressure are thus formed by this mercury thread . The tube is now rotated with gradually increasing angular speed ω about the axis passing through A and perpendicular to AB
The incorrect statement is ,



(1) The pressure in the tube AX will decrease while that in XB will increase.
(2) The mercury thread will move towards B
(3) When the angular speed becomes equal to ω the additional force that acts on the mercury thread is greater than $ml\omega^2$
(4) The mercury thread executes simple harmonic motion If the tube continues its rotation with uniform angular acceleration followed by uniform angular deceleration of the same magnitude periodically.
(5) The mercury thread will move to X again when the rotation is stopped.

29. A uniform rod AB is made to oscillate freely about a pivot A in vertical plane as shown in figure 1. The period of oscillation of the oscillating rod is T. Now the free end B is connected to a string which goes over the smooth pulleys P_1 and P_2 , and carries a mass m as shown in the figure 2. The string is burnt out when the system is in equilibrium. The mass starts to fall vertically under gravity while the rod AB starts to oscillate. The mass hits the rod at the point C when it falls as shown in the figure 3. The gravitational acceleration would be equal to

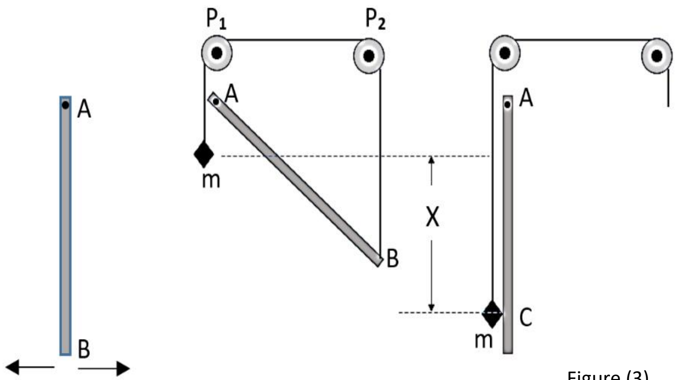
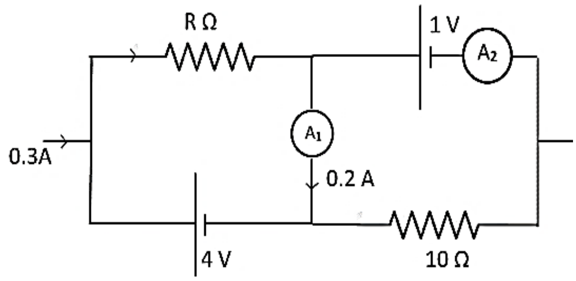


Figure (1) Figure (2) Figure (3)

(1) $\frac{32x}{T^2}$ (2) $\frac{16x}{T^2}$ (3) $\frac{8x}{T^2}$ (4) $\frac{2x}{T^2}$ (5) $\frac{x}{T^2}$

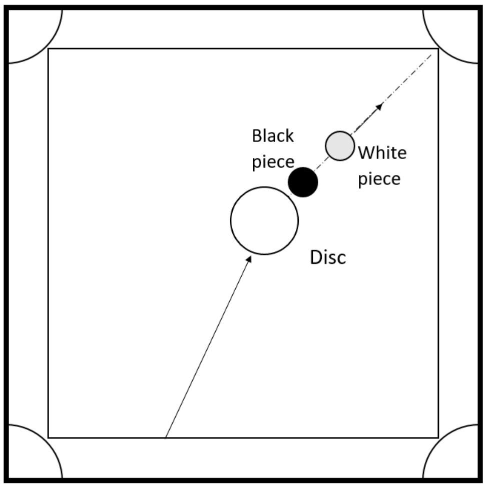
30. The ammeters A_1 and A_2 shown in the circuit are ideal . The internal resistance of the cells can be neglected . If A_1 reads 0.2 A then the value of R and the reading of A_2 are, respectively



(1) 40 Ω, 0.2 A (2) 6.67 Ω, 0.3 A (3) 6.67 Ω, 0.4 A

(4) 10 Ω, 0.3 A (5) 10 Ω, 0.2 A

31. In a tricky shot, a carom player strikes the black piece by disc instead of striking the white piece directly. White piece falls into the hole and black piece also follows the white piece and falls into the hole. All the collisions are elastic. Ignore the friction.

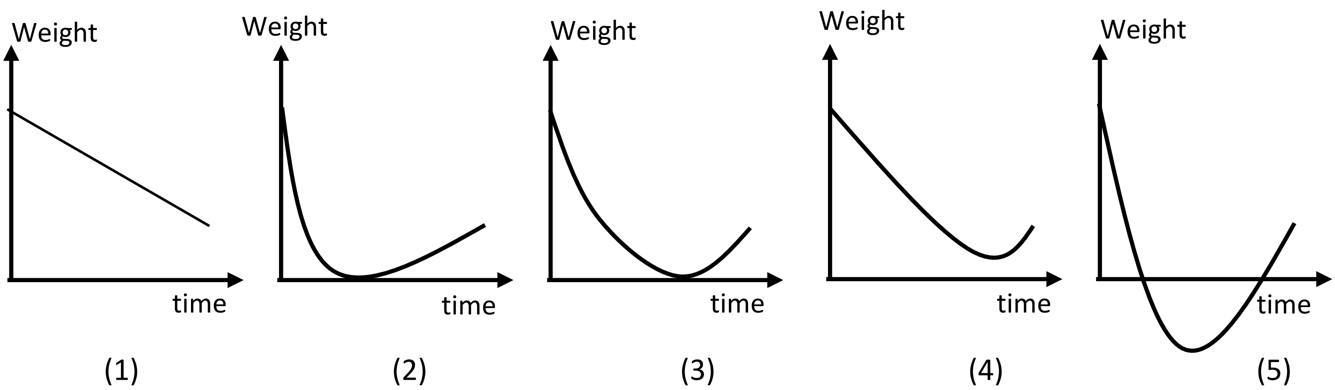


(A) The mass of black piece is more than the mass of white piece
(B) The linear momentum of black piece is more than the linear momentum of white piece
(C) The change in linear momentum of black piece is equal to the change in linear momentum of white piece .

The possible reason for this shot is ,

(1) A only (2) B only (3) A and B only
(4) A and C only (5) A, B and C all

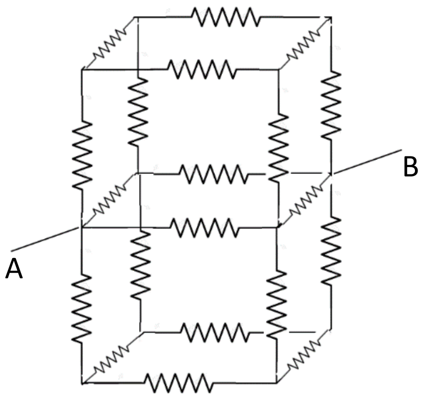
32. The gravitational acceleration on the surface of the earth is two and a half times of the gravitational acceleration on the surface of the mars. A man travels from the earth to the mars with constant speed directly. The variation of magnitude of the gravitational attractive force (weight) on the man with time t is correctly represented by (ignore any other attractive forces)



33. A student of mass 40 kg accidently fell from a building of 10 m high. After having fallen 5m distance, he collided with the telephone cable which crosses his falling path and momentarily comes to rest and then fell to the ground. The time of collision with the cable is negligible. Which of the following statements is wrong . ($\sqrt{2} = 1.414$)

(1) If the telephone cable is not there , he will reach the ground with lesser time.
(2) He will reach the ground with the same kinetic energy whether the cable is present or not .
(3) He would collide the ground with the speed of 10 m s^{-1}
(4) He would have lost 2 kJ energy by the collision with the cable.
(5) He would hit the ground with 0. 586 s delay due to the collision with the cable.

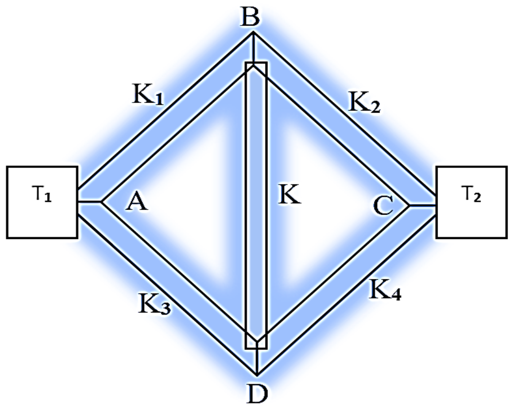
34. The value of the resistance of each of the resistor shown in the network is R. The equivalent resistance between points A and B is,



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

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

35. Figure shows a frame work made with five identical uniform rods (dimentionally) AB, BC, AD, DC and BD of thermal conductivities k_1, k_2, k_3, k_4 and k respectively. The junctions A and C of this framework are in contacts with two reservoirs of temperatures T_1 and T_2 ($T_1 > T_2$). The sides of the frame work are thermally insulated except at the junction A and C. The rods have attained the steady state. Consider the following statements made regarding these rods.



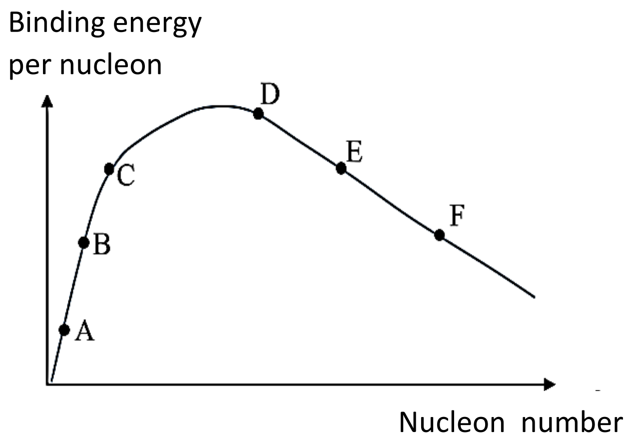
(A) The temperature gradient across the rod BD will be zero if k_1, k_2, k_3 and k_4 are all equal.
(B) Heat will not flow through BD if $k_1 k_4 = k_2 k_3$
(C) The temperature of the junction B will greater than that at junction D if $k_1 k_4 > k_2 k_3$

Which of the above statement(s) is / are correct

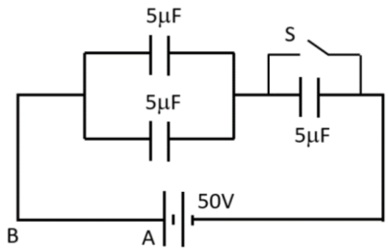
(1) A only (2) A and B only (3) A and C only (4) B and C only (5) A, B and C all

36. The diagram shows the variation of binding energy per nucleon with nucleon number. A, B, C, D, E and F are six different nuclei. Which of the statements given below is incorrect?

(1) Of these six nuclei D is the most stable one.
(2) A and B may fuse to form C .
(3) D may split to form B and C.
(4) F may split to form D and E
(5) The fusion reaction of A and B requires initial supply of energy to overcome coulombic repulsion .

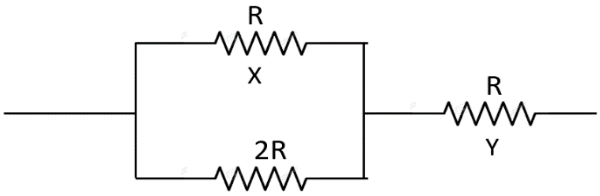


37. Each of the capacitor shown in the figure has capacitance of 5 μF. The EMF of the cell is 50 V. Initially the switch S is open. How much electric charge would flow through AB when the switch S is closed ?



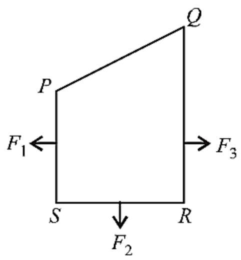
(1) $\frac{250}{3}$ μC (2) $\frac{500}{3}$ μC (3) 250 μC
(4) $\frac{1000}{3}$ μC (5) 500 μC

38. If P is the total power that could be dissipated in the circuit shown , the respective power dissipation in the resistors X and Y are



(1) $\frac{4P}{15}, \frac{4P}{5}$ (2) $\frac{4P}{15}, \frac{3P}{5}$ (3) $\frac{P}{18}, \frac{P}{2}$ (4) $\frac{4P}{15}, \frac{4P}{15}$ (5) $\frac{P}{18}, \frac{P}{8}$

39. A current carrying loop PQRS is in a uniform magnetic field. The magnetic forces act on the sides PS, SR and RQ , on the plane of PQRS , are F_1, F_2 and F_3 respectively as shown in the figure. The magnitude of the magnetic force which act on PQ is ,



(1) $F_3-F_1+F_2$ (2) $\sqrt{(F_3-F_1)^2-F_2^2}$ (3) $\sqrt{(F_1-F_3)^2-F_2^2}$

(4) $\sqrt{(F_3-F_1)^2+F_2^2}$ (5) $F_3-F_1-F_2$

40. The initial lengths and the Young's moduli of three rods X , Y and Z of the same cross sectional area are depicted in the table. The effective Young's modulus of the combined rod when these rods are connected in series is,

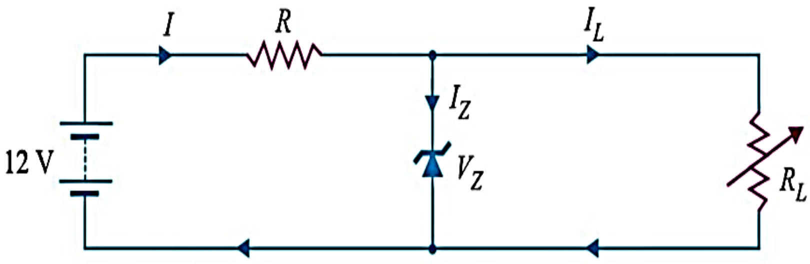
Rod	Initial length	Young's Modulus
X	l	2E
Y	l	E
Z	$2l$	E

(1) $\frac{E}{8}$ (2) $\frac{4E}{7}$ (3) $\frac{8E}{7}$
(4) E (5) 14 E

41. A spherical oil drop rises in water contained in a deep vessel. After attaining the terminal speed V_0 it splits into three identical drops. The terminal velocity attained by each of the small drop will be

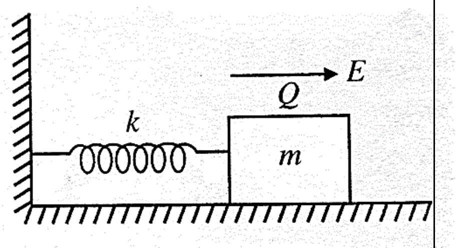
(1) $V_0\left(\frac{1}{3}\right)^{\frac{2}{3}}$ (2) $V_0(3)^{\frac{2}{3}}$ (3) $V_0(3)^{\frac{1}{3}}$ (4) $V_0(3)^{\frac{-1}{3}}$ (5) V_0

42. Zener breakdown voltage of the zener diode shown in the circuit is 7.2 V. The current through the load (I_L) will vary between 12 mA and 100 mA . The input voltage is constant at 12 V and the minimum zener current is 10 mA. The required value of the resistance R in order to maintain a voltage of 7. 2 V across the load is,



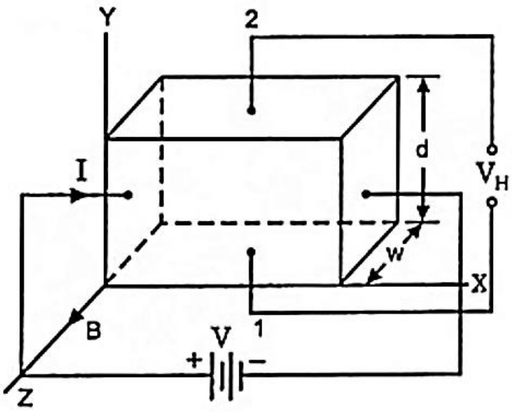
(1) $\frac{4.8\,V}{110\,mA}$ (2) $\frac{4.8\,V}{22\,mA}$ (3) $\frac{12V}{110\,mA}$ (4) $\frac{12V}{22\,mA}$ (5) $\frac{7.2\ V}{10\,mA}$

43. A block of mass m having charge Q is placed on a smooth horizontal table and is connected to a wall through an initially unstretched spring of spring constant k as shown in the figure . A horizontal electric field E , directed to the right is now switched on. If the block starts to execute simple harmonic motion, the amplitude and the angular velocity are given by ,



(1) $\frac{EQ}{k}, \sqrt{\frac{k}{m}}$ (2) $\frac{2EQ}{k}, \sqrt{\frac{k}{m}}$ (3) $\frac{EQ}{k}, \sqrt{\frac{2k}{m}}$ (4) $\frac{EQ}{k}, \sqrt{\frac{m}{k}}$ (5) $\frac{k}{EQ}, \sqrt{\frac{k}{m}}$

44. In a study of Hall effect , a conducting cuboid of thickness d and breadth w is placed as shown in the figure. The charge careers are electron with carrier density of n . A uniform magnetic field of magnetic flux density B acts along the z axis. A current I flows as shown in the figure. Which of the following is correct.



(1) An electric field is established in the positive direction of Y axis

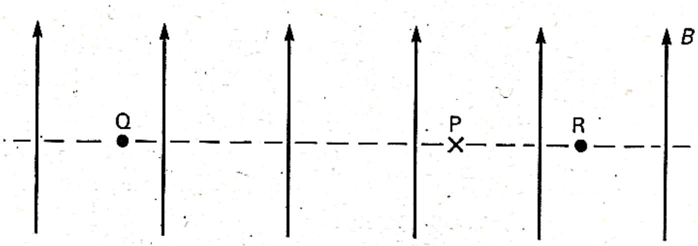
(2) Established hall voltage is $V_H = \frac{Be}{nIw}$

(3) Whenever a current flows through the cuboid, the charge carriers always move up or down due to the magnetic force.

(4) Hall effect cannot be used to determine the type of extrinsic semiconductor (p- type or n-type)

(5) Hall voltage of a semiconductor is greater than that of a conductor having same dimension. .

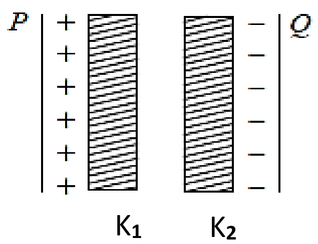
45. A uniform magnetic field of flux density $B = 4 \times 10^{-6}$ T is directed upward on the plane of the sheet. Q and R are two long , straight, parallel conductors placed normal to the paper. They carry currents in the same direction . X is a null point . If QX = 40 cm and RX = 20 cm the magnitude and the direction of the current are, ($\frac{\mu_0}{2\pi} = 2 \, x 10^{-7}$ H m^{-1})

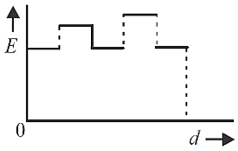


(1) 4 A inward (2) 4 A outward (3) 8 A inward

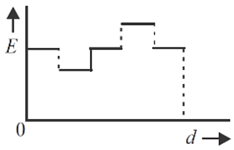
(4) 8 A outward (5) $\frac{8}{3}$ A outward

46. Two dielectric slabs with dielectric constant K_1 and K_2 ($K_1 < K_2$) are inserted between two plates of parallel plate capacitor as shown in the figure. Which of the following graphs best shows the variation of electric field intensity (E) with distance d , measured from P to Q

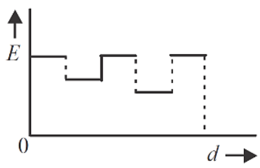




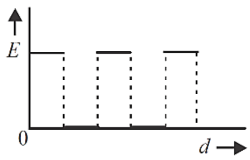
(1)



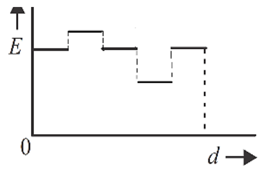
(2)



(3)



(4)



(5)

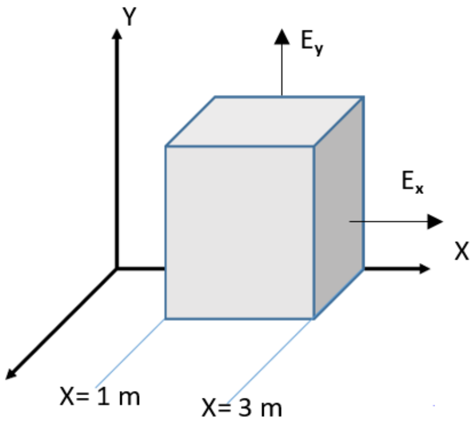
47. Two electric charges each of q circulate along circular paths of radius R which are perpendicular to each other and having the same centre with the same frequency f Hz. If any other effect is ignored the magnitude of net magnetic flux density at the centre is,

(1) $\frac{\mu_0 q f}{2R}$ (2) $\frac{\mu_0 q f}{2\pi R}$ (3) $\frac{\mu_0 q f \sqrt{2}}{2\pi R}$ (4) $\frac{\mu_0 q f \sqrt{2}}{2R}$ (5) $\frac{\mu_0 q f}{R}$

48. The speed of sound in a gas at 27 ^{0}C is 300 m s^{-1} . If the absolute temperature of the gas is increased by 21% the speed of sound at this new temperature will be,

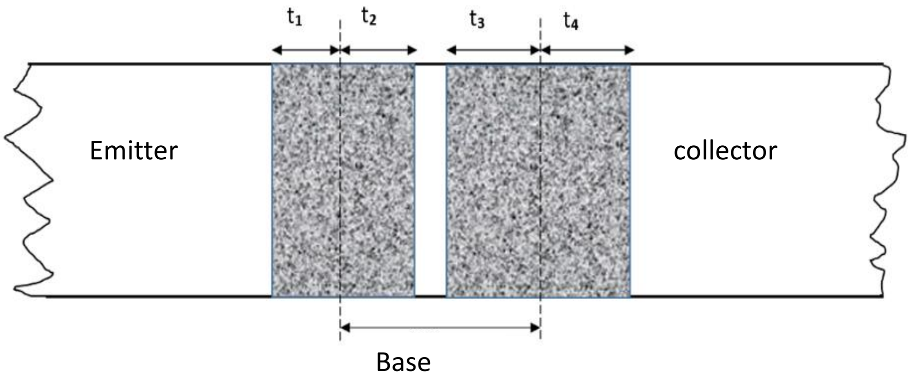
(1) 300 m s^{-1} (2) 311 m s^{-1} (3) 321 m s^{-1} (4) 330 m s^{-1} (5) 363 m s^{-1}

49. A non uniform electric field pierces the Gaussian cube shown in the figure. One side of the cube is along the x axis in between x=1 m and x= 3m. The component parallel to the y axis is uniform and its magnitude is $E_y = 4$ N C^{-1}. The component parallel to the X axis is non uniform and its magnitude varies such that $E_x = 3x$ (N C^{-1}) where x is the value of x coordinate. The component parallel to the z axis is zero. The net electric flux through the cube is



(1) 36 N m^2 C^{-1} (2) -12 N m^2 C^{-1} (3) 16 N m^2 C^{-1} (4) 40 N m^2 C^{-1} (5) 24 N m^2 C^{-1}

50. The thicknesses of the depletion layers extended in the emitter , base and the collector regions of an unbiased bipolar junction transistor are t_1, t_2, t_3 and t_4 are shown in the figure (not drawn to scale). The correct relationship among these thicknesses is,



(1) $t_3 > t_2 > t_4 > t_1$ (2) $t_4 > t_2 = t_3 > t_1$ (3) $t_2 = t_3 > t_4 > t_1$

(4) $t_2 = t_3 > t_1 > t_4$ (5) $t_1 = t_2 = t_3 = t_4$