G.C.E. A/L Examination November - 2015

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Zonal Department of Education Jaffna.

FWC

Grade :- 13 (2016)	Physics - I	Time :- Two hours

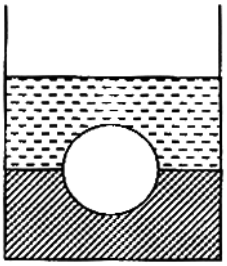
1. Dimension of heat conductivity is
   (1) $MLT^{-2}\theta^{-1}$ (2) $MLT^{-3}\theta^{-2}$ (3) $MLT^{-1}\theta^{-1}$ (4) $MLT^{-3}\theta^{-1}$ (5) $MLT^{-2}\theta^{-2}$

2. The physical quantities related to ampere hour and kilowatt hour are respectively
   (1) current, power (2) electric field strength, energy
   (3) electric charge, energy (4) electric charge, power
   (4) voltage, energy

3. Wrong statement in the following statements about laser
   (1) have same wavelength
   (2) these are high intense rays
   (3) they travel as a narrow beam
   (4) they are reflective, refractive, diffractive
   (5) each single wave have different phase

4. A stretched string vibrates in four loops. What will be the number of loops when the vibrating frequency is increased to three times?
   (1) 3 (2) 6 (3) 8 (4) 12 (5) 24

5. A beaker contains two immiscible liquids with the density of $900kgm^{-3}$, $3400kgm^{-3}$. A solid metal ball is fully immersed into the beaker such that same amount of volume is immersed in each liquid. What is the density of the metal ball in kgm^{-3}?
   (1) 1100 (2) 1800 (3) 2500
   (4) 2150 (5) 4300



6. In a measuring instrument $(n-1)$ main scale divisions is divided into n mail scale divisions. Find the least count of the instrument.
   (1) 1 (2) $\frac{1}{n}$ (3) $\frac{n}{n-1}$ (4) $\frac{n-1}{n}$ (5) $\frac{1}{n-1}$

7. The difference between the distances travelled by a free falling body in t_2 and t_1 is 55m. $t_1:t_2 = 5:6$ Find the distance travelled by the body in t_2 second.
   (1) 125m (2) 180m (3) 720m (4) 1125m (5) 1620m

8. An astronomical telescope have a convex lens of focal length 6cm. Separation between two lens in normal adjustment is 102cm. Find the angular magnification of the telescope at this adjustment.

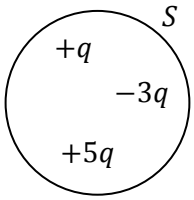
(1) 112 (2) 96 (3) 118 (4) 6 (5) 16

9. The lower fixed point and a upper fixed point of a false thermometer is marked as -10^{0}C and 90^{0}C respectively. What will be the real temperature when this thermometer reads 40^{0}C

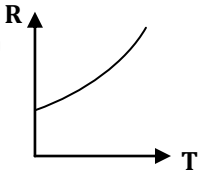
(1) 30^{0}C (2) 40^{0}C (3) 50^{0}C (4) 55^{0}C (5) 60^{0}C

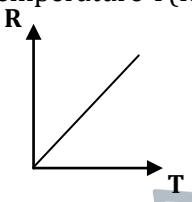
10. To reverse the net electric flux through the closed surface S shown in the figure

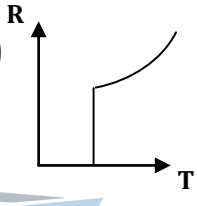
(1) change charge +q as charge +3q
(2) change charge +5q as charge +3q
(3) change charge -3q as charge -5q
(4) change charge -3q as charge –q
(5) change charge +q as charge -5q

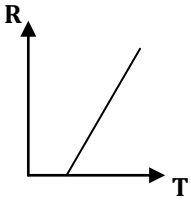


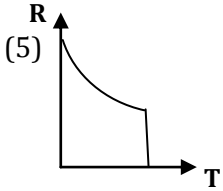
11. Which of the following graph correctly represents the variation of resistance R of a superconductor with temperature T(K)

(1) 

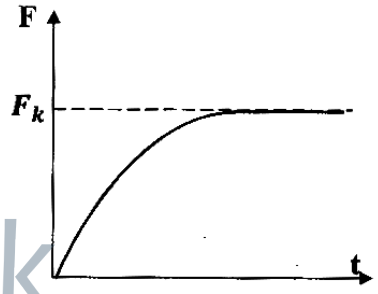
(2) 

(3) 

(4) 

(5) 

12. A horizontal force P is applied on a body on a rough surface. The figure shows the variation of frictional force F acting on the body with time. Out of the following statements which is / are true.



(A) initially a force P is applied to the body
(B) the kinetic frictional force acting between the body and surface is F_k
(C) the box doesn't move due to the force P

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

13. A balloon is moving upwards with a constant speed of 30m/s. An object is released from the balloon when the balloon is at a height of 800m from ground. Find the time taken by the object to reach the ground. (neglect air resistance)

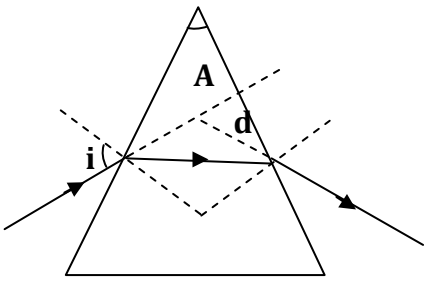
(1) $4\sqrt{10}\ Sec$ (2) $8\ Sec$ (3) $10\ Sec$ (4) $16\ Sec$ (5) $22\ Sec$

14. The distance between an eye lens and retina is 2cm. The least distance of distinct vision of the eye is 25cm. The maximum and the minimum power of the lens when the eye see objects from least distance of distinct vision upto infinity

(1) $+50D\ ,+46D$ (2) $-54D\ ,-50D$ (3) $+54D\ ,+50D$
(4) $+54D\ ,25D$ (5) $-27D\ ,-25D$

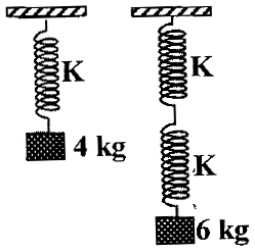
15. A laser ray shown in the figure emerges from a prism of prism angle A. which of the statement(s) is/ are true?

(A) at minimum deviation position ray will travel parallel to the base of the prism
(B) the value of d will pass through a minimum when incident angle i increases from zero
(C) when the light disperses red ray will deviate lesser



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

16. When a spring of spring constant k is loaded with a weight of 4kg, it extends by 1cm. now two springs with spring constant k is connected in series and a weight of 6kg is loaded at the end of the combined string. What will be the extension?

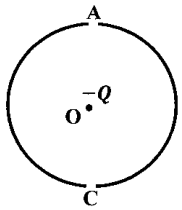


(1) 1.5 cm (2) 3 cm (3) 4.5 cm
(4) 6 cm (5) 7.5 cm

17. Which of the following statement(s) about absolute zero is / are true
(A) absolute zero temperature is -273.15^{0}C
(B) at this temperature the molecules of substance doesn't vibrate
(C) at this temperature semi-conductors doesn't conduct electrictity
(1) A only (2) C Only (3) A, B only (4) B, C only (5) A, B, C all

18. Parallel plate capacitor in air has a capacitance of 1X10^{-12}F. when the separation between the plates is tripled, area of the plates is halved and a medium A is inserted, the capacitance doesn't change. Find the dielectric constant of A.
(1) 2 (2) 4 (3) 6 (4) 5 (5) 12

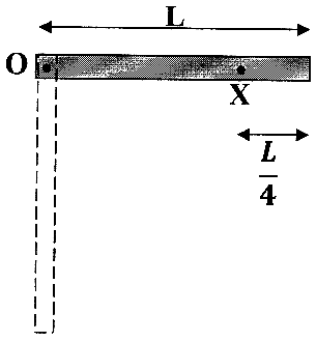
19. Charge +q is distributed uniformly on an insulator ring of radius R, a charge –Q is placed at the centre of the ring. Now as shown in figure a small charge Δq is removed from A and C. find the force acting on –Q at the centre.



(1) O (2) Along OA $\frac{Q(q-2\Delta q)}{4\pi\varepsilon_o R^2}$ (3) Along OC $\frac{Q(q-2\Delta q)}{4\pi\varepsilon_o R^2}$
(4) Along OA $\frac{Q.(2\Delta q)}{4\pi\varepsilon_o R^2}$ (5) Along OC $\frac{Q.(2\Delta q)}{4\pi\varepsilon_o R^2}$

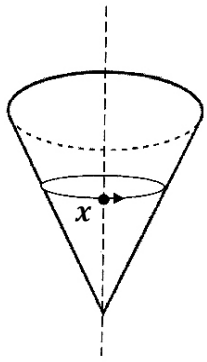
20. Mass of A is three times that of B. specific heat capacity of A is two times that of B. two times of heat that is supplied to A is supplied to B. if the temperature change in A is Δt what will be the temperature change in B
(1) $\frac{\Delta T}{6}$ (2) $\frac{\Delta T}{12}$ (3) 6 ΔT (4) 8 ΔT (5) 12 ΔT

21. A rod of mass M and length L is drilled at one end and fixed to frictionless pin. Rod can rotate about O on the horizontal axis. The rod is held horizontally and released. What will be the velocity of point X when the rod comes to its lower position?



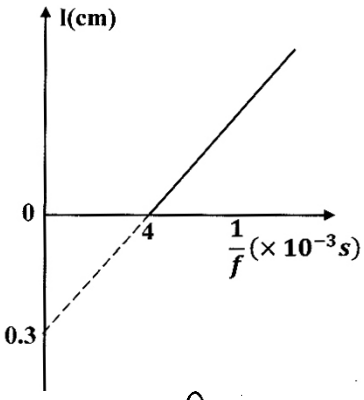
(1) $\sqrt{\frac{3g}{L}}$ (2) $\frac{3\sqrt{3gL}}{4}$ (3) $\frac{\sqrt{3gl}}{2}$
(4) $\frac{3L}{4}\sqrt{\frac{L}{3g}}$ (5) $\frac{L}{2}\sqrt{\frac{L}{3g}}$

22. An object moves on the smooth inner surface of a cone shaped vessel as shown in the figure. The forces acting on the object according to a non-moving observer



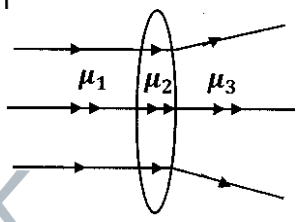
(1) only its weight
(2) object's weight and centripetal force only
(3) reaction force acting normal to the surface and centripetal force only
(4) centripetal force only
(5) reaction force acting normal to the surface and the weight of the object only

23. The figure shows the variation of 1/f with length l for the resonance tube experiment of fundamental mode f is the frequency of resonance tube . Speed of sound in air and end correction are respectively.



(1) $330ms^{-1}$, $4\ cm$ (2) $330ms^{-1}$, $0.3\ cm$
(3) $300ms^{-1}$, $4\ cm$ (4) $300ms^{-1}$, $0.2\ cm$
(5) $300ms^{-1}$, $0.3\ cm$

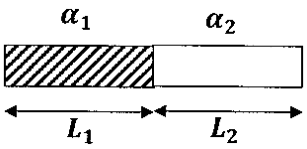
24. Correct relation between the refractive indices of the medium on the basis of the given diagram is



(1) $\mu_1 > \mu_2 > \mu_3$ (2) $\mu_1 < \mu_2 < \mu_3$
(3) $\mu_1 = \mu_2 = \mu_3$ (4) $\mu_1 = \mu_2 < \mu_3$
(5) $\mu_1 = \mu_2 > \mu_3$

25. Consider the following statements about thermistor. Which of the following is / are correct
(A) thermistor is made out of the oxides of semiconductors
(B) resistance of thermistor reduces with the increase of temperature
(C) heat capacity of thermistor is very small
(1) A only (2) B Only (3) C only (4) A, B only (5) A, B, C all

26. Two rod of length L_1, L_2 and coefficient linear expansion α_1, α_2 are combined as shown in the figure. What will be the coefficient of linear expansion of the combined rod?

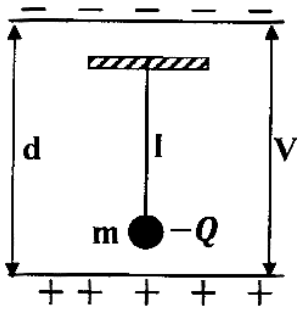


(1) $\frac{\alpha_1+\alpha_2}{2}$ (2) $\alpha_1+\alpha_2$ (3) $L_1\ \alpha_1 + L_2\ \alpha_2$
(4) $\frac{L_1\alpha_1+L_2\alpha_2}{L_1+L_2}$ (5) $\frac{L_2\alpha_1+L_1\alpha_2}{L_1+L_2}$

27. Three spherical drops made out of same liquid have capacitance C_1, C_2, C_3 respectively. If the three drops makes another drop by combining them into one, what will be the capacitance of the drop formed?
(1) $C_1 + C_2 + C_3$ (2) $\frac{C_1C_2C_3}{C_1+C_2+C_3}$ (3) $(C_1^3 + C_2^3 + C_3^3)^{1/3}$

(4) $(C_1^2 + C_2^2 + C_3^2)^{1/3}$ (5) $(C_1C_2C_3)^{1/3}$

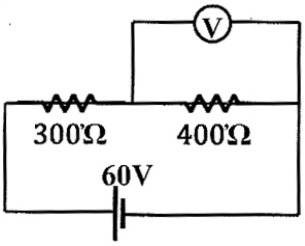
28. The conducting sphere of mass m shown in the figure has a charge –Q. The sphere is hung between two plates with V voltage difference and at a separation d, by using an insulator string of length R. What is the period of oscillation of this S.H.M?



(1) $T = 2\pi\sqrt{\frac{\ell}{g}}$ (2) $T = 2\pi\sqrt{\frac{\ell}{g+\frac{V}{d}}}$ (3) $T = 2\pi\sqrt{\frac{\ell}{g+\frac{QV}{d}}}$

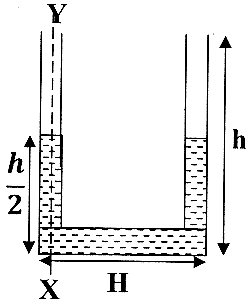
(4) $T = 2\pi\sqrt{\frac{\ell}{g-\frac{QV}{d}}}$ (5) $T = 2\pi\sqrt{\frac{\ell}{g+\frac{QV}{md}}}$

29. 300Ω, 400Ω resistance are connect in series to a cell of 60V and negligible internal resistance. When voltmeter connect across 400Ω resistance as shown in figure, the voltmeter reads30V. Find the resistance of voltmeter.



(1) 300 Ω (2) 400 Ω (3) 600 Ω
(4) 1200 Ω (5) 2400 Ω

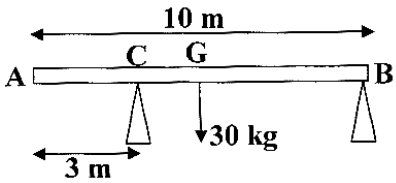
30. Water is filled upto half of the arms of a u tube held vertically as shown in the figure. What will be the least height h of tube such that water doesn't spill out when the tube is rotated about xy axis at an angular velocity 15rads^{-1}? Consider H = 10cm, density of water = 1000kgm^{-3}.



(1) 2.25 cm (2) 10 cm (3) 22.5 cm
(4) 25 cm (5) 30 cm

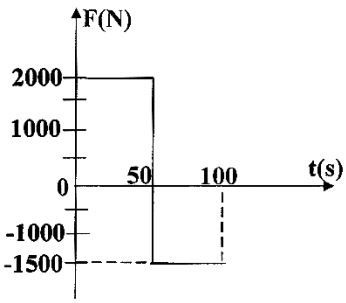
31. Which of the following is / are correct
(A) if the momentum of an object is constant with time, then kinetic energy of that body must be constant with time
(B) if the momentum of an object changes uniformly with time then kinetic energy must also linear changes with time
(C) if the kinetic energy of an object is constant with time, then momentum of that body change uniformly with time
(1) A only (2) B Only (3) C only (4) A, B only (5) A, C only

32. A uniform rod of length 10m and mass 30kg is placed at two supports B, C such that AC = 3m. What is the maximum load that can be placed at A without disturbing the equilibrium of the rod?



(1) 10 kg (2) 15 kg (3) 20 kg (4) 30 kg (5) 22.5 kg

33. A force changing with time according the graph is acted upon a vehicle of mass 1000kg placed on a smooth surface. What will be the speed of the vehicle after 100s in m/s?



(1) 25 (2) 50 (3) 75
(4) 100 (5) 175

34. In a one end closed tube the difference of frequency between two consecutive overtones is 300Hz. What is the length of an open end tube having the same fundamental frequency with the one end closed tube? Consider the speed of sound in air is 300m/s.

(1) 10 cm (2) 25 cm (3) 50 cm (4) 75 cm (5) 100 cm

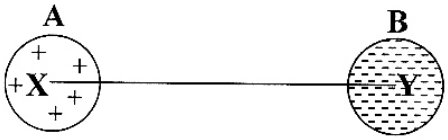
35. At what temperature the of oxygen will be equal to the speed of hydrogen H_2 at 200 K

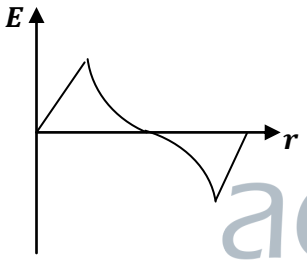
(1) 400 K (2) 800 K (3) 1000 K (4) 3200 K (5) 6400 K

36. For a planet of radius R, there is satellite of mass m at its surface. What will be the increase in the potential energy of the satellite when it is moved to a distance of 4R? along radially

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

37. A, B are two similar non-conducting spheres with same amount of positive charge uniformly distributed in one and same amount of negative charge uniformly distributed in the other. The distance between them is much greater than their radius. Which of the following graph correctly represent the variation of electric field intensity(E) with r. r is the distance from x to y along xy



(1)


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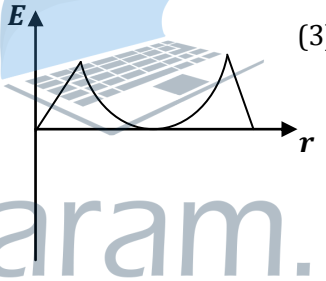

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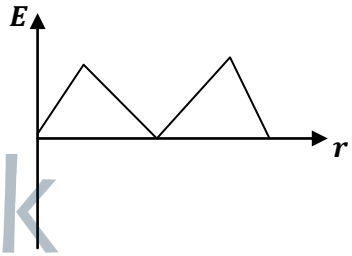

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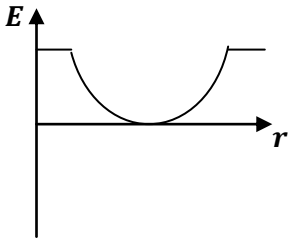

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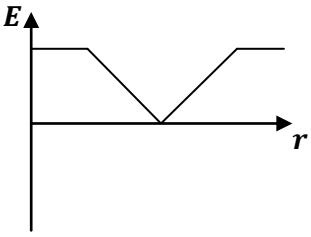
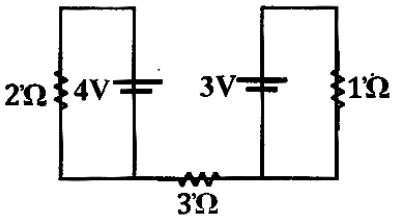


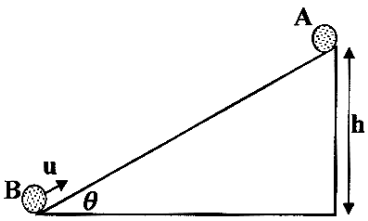
38. In the figure shown the cell have negligible internal resistance. What is the voltage difference across 3Ω resistance?



(1) 0 (2) 1 V (3) 2 V

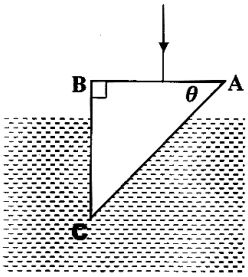
(3) 3.5 V (5) 7 V

39. An object A is released from the top of a smooth inclined plane of height h. At the same time another particle B is thrown from the bottom of the inclined plane along the inclined plane. If the both particles meet at the middle of the inclined plane what will be the initial velocity of B. l is the distance between A and B initially.



(1) $2g\ell \sin\theta$ (2) $\frac{g\ell \sin\theta}{2}$ (3) $\sqrt{\frac{gh}{2}}$ (4) $\sqrt{gh}$ (5) $g\ell \cos\theta$

40. A glass prism ABC is immersed in water as shown in figure. What will be the correct statement if a ray incident normal to AB on AB is totally reflected on face AC. Refractive index of water and glass are 3/2, 4/3 respectively.



(1) $Sin\,\theta \geq {}^{8}/_{9}$ (2) $Sin\,\theta \geq {}^{2}/_{3}$

(3) $Sin\,\theta = {}^{\sqrt{3}}/_{2}$ (4) $Sin\,\theta = {}^{2}/_{\sqrt{3}}$

(5) ${}^{2}/_{3} < Sin\,\theta < {}^{8}/_{3}$

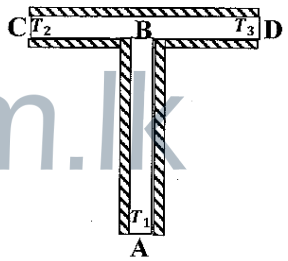
41. A person standing 1m from a source hears a sound of 90dB. The person move 99m away from the source. What is the new intensity level of the sound he hears?

(1) 10 dB (2) 30 dB (3) 50 dB (4) 70 dB (5) 130 dB

42. A van emitting a signal of frequency 700Hz, is moving at a speed of 2m/s towards a rock that can reflect signals back. How many beats per second will be observed by the driver? Speed of sound in air is 350m/s.

(1) 1 Hz (2) 4 Hz (4) 5 Hz (4) 8 Hz (5) 10 Hz

43. As shown in figure two identical rods are connected symmetrically. The combination is fully lagged except the faces A, C and D. faces A, C and D are placed at constant temperatures T_1, T_2 and T_3.($T_1<T_2=T_3$). Temperature at junction B



(1) $\frac{T_1+T_2+T_3}{3}$ (2) $\frac{T_1+2T_2+2T_3}{5}$

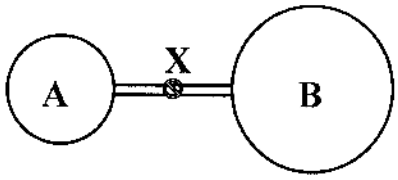
(3) $\frac{2T_1+T_2+T_3}{5}$ (4) $\frac{2T_2+2T_3-T_1}{5}$

(5) $\frac{T_2+T_3-2T_1}{5}$

44. A satellite situated 4r distance from center of a planet revolves around it with a speed of 3v. What will be the speed of a satellite revolving at a distance of r from the center of same planet?

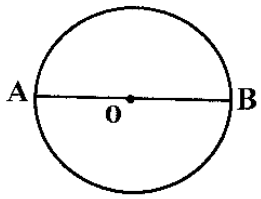
(1) V (2) 2 V (3) 3 V (4) 6 V (5) 12 V

45. Bulb A consist of an ideal gas at pressure $5X10^5$Pa and temperature 300K. Bulb B consist the same ideal gas at temperature 400K and pressure $1X10^5$Pa. screw x is opened and the gas system is allowed to attain equilibrium by keeping the initial temperature of bulbs constant. If the volume of B is four times that of A find the final pressure in Pa.



(1) 1×10^5 (2) 1.8×10^5 (3) 2×10^5 (4) 2.6×10^5 (5) 3.2×10^5

46. The structure shown in figure, the circle with radius R and the diameter AB is made of substance having $\propto$ as the resistance per unit length. Equivalent Resistance across A and O is.



(1) $\left(\frac{\pi+2}{2\pi}\right) R \propto$ (2) $\left(\frac{\pi+4}{\pi-2}\right) R \propto$ (3) $\left(\frac{\pi+4}{2\pi}\right) R \propto$

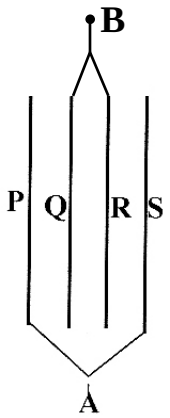
(4) $\left(\frac{\pi+2}{\pi+4}\right) R \propto$ (5) $\left(\frac{\pi+4}{\pi+2}\right) R \propto$

47. The initial temperature and initial relative humidity of a room is θ_1 and x_1% respectively. When the temperature of the room is reduced by using an air conditioner to θ_2, the relative humidity of the room is observed to be x_2%. At dew points θ_1 and θ_2 the absolute humidity of air is y_1 and y_2 respectively. Find the mass per unit volume of water vapour removed by the air conditioner from the room.

(1) $\frac{x_1y_1-x_2y_2}{100}$ (2) $100(x_1y_1 - x_2y_2)$ (3) $\left(\frac{x_1}{y_1} - \frac{x_2}{y_2}\right) \frac{1}{100}$

(4) $\left(\frac{x_1}{y_1} - \frac{x_2}{y_2}\right) \times 100$ (5) $\left(\frac{y_1}{x_1} - \frac{y_2}{x_2}\right) \times 100$

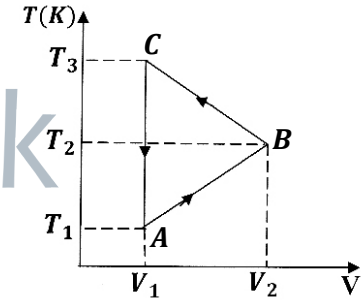
48. P, Q, R and S are identical rectangular metal pieces. They placed parallel to each other such that distance between two consecutive plates is d. area of each plate is A. P is joined with S and Q is joined with R using a thin metal wire as shown in the figure. What is the capacitance between A and B?



(1) $\frac{A\varepsilon_0}{d}$ (2) $\frac{2A\varepsilon_0}{d}$ (3) $\frac{3A\varepsilon_0}{d}$

(4) $\frac{2A\varepsilon_0}{3d}$ (5) $\frac{A\varepsilon_0}{3d}$

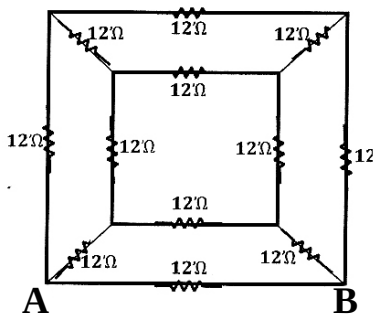
49. One mole ideal gas loses 70J of energy when undergone through a cyclic process ABCA. T_1=100K, T_2=200K R = 8.3Jmol^{1}K^{-1}. During process BC the work done by the gas is



(1) 305 J (2) 760 J (3) 830 J

(4) $-900\ J$ (5) 900 J

50. In the electric network structure shown in the figure all the resistance are 12Ω. Find the equivalent resistance between A and B.



(1) 4Ω (2) 6Ω (3) 7Ω

(4) 9Ω (5) 14Ω

G.C.E. A/L Examination November - 2015

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Zonal Department of Education Jaffna.

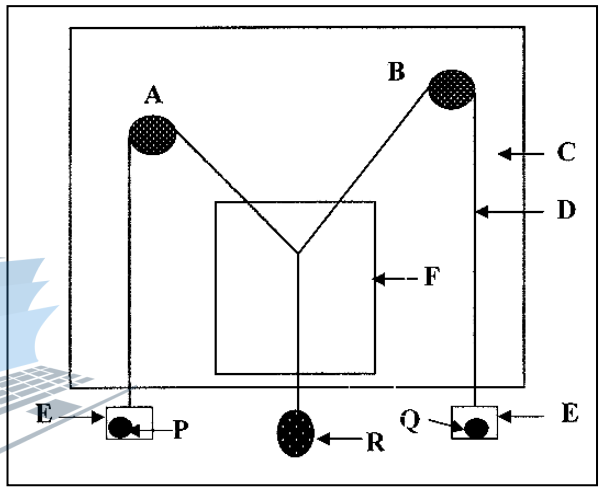
FWC

Grade :- 13 (2016)	Physics - II	Time :- Three hours

Part - II A - Structured Essay

01) The figure shows a setup used verify law of parallelogram in school laboratory

A, B – smooth pulleys
D – light inextensible string
C – vertical board
E – light balance pans
P, Q – weights
R – stone (density to be determined)



a) State the other instruments needed to complete this experiment

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b) The above setup done by the student is incorrect. How would you correct it?

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c) How would to test whether the friction in pulleys are negligible or not?

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d) Why light string are used in this experiment?

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e) The above setup is made for you. State the steps that you would do to verify parallelogram law. .....

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f) In this experiment student denotes the position of strings by using their shades. Do you agree with this procedure? Give reasons.

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g) If the weighing pans aren't light, what will you do to complete this experiment correctly?

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h) In this experiment if Q is larger than P and R, what will be the problem faced by you?

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i) From the above experiment student decided to determine the density of stone ρ and the density of liquid ρ_l. the length of diagonal of the force parallelogram is measured during the following instances stone in air, stone in water and stone fully immersed in liquid are l_1, $l_2$and l_3 respectively. Consider the density of water to be ρ_w

i) define the average density of a body

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ii) state an expression for the density of stone in relation to l_1, $l_2$andρ_w

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iii) l_1= 3.2cm l_2 =2.7cm, ρ_w = 1000kgm^{-3}. Find the density of stone

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iv) state an expression for the density of liquid in relation to l_1, $l_2$and l_3

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v) l_1= 3.2cm l_2 =2.7cm,l_3 =2.8cm, ρ_w = 1000kgm^{-3}. Find the density of liquid

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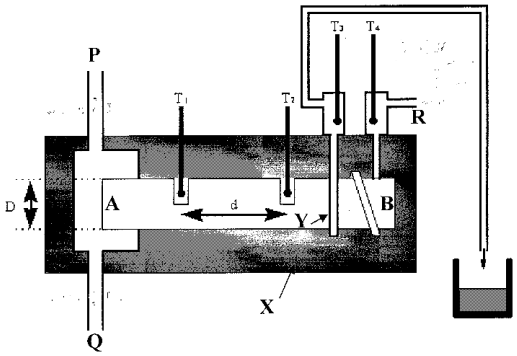
02) A part of the Searle's experiment to find the thermal conductivity of a metal is shown in the figure.



a) What are the other additional instruments needed to complete this experiment

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b) What is the name of the instrument to be connected to R? draw a sketch of that instrument in the correct place in the appropriate place and clearly show how it is connected to R.

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c) Through which P or Q water steam is sent to heat the metal through end A. state two reasons for your choice.

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d) How would you know whether the system has attained it's stable state?

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e) How would you get a better contact between thermometer T_1, T_2 and the metal rod?

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f) What is function of X? what is the physical feature considered when selecting a substance for X? state one example of substance used as X.

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g) In which direction should water have to flow at constant rate through the metal pipe? State the reason.

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h) In this experiment, at stable state the reading of thermometers T_1, T_2, T_3 and T_4 are θ_1, θ_2, θ_3 and θ_4.the mass of water collected in t second is m kg, the distance between thermometers T_1 and T_2 is d and the diameter of the metal rod is D.

i) What instruments will you use to measure d, D in your laboratory?

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ii) Give an expression for the thermal conductivity of metal rod in relation to S_w, the specific heat capacity of water

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iii) $\theta_1 = 80^0C$ $\theta_2 = 66^0C$ $\theta_3 = 37^0C$ $\theta_4 = 28^0C$, mass of water collected in 3 minutes is 0.4kg, cross section area of metal rod is $1.2 \times 10^{-3} m^3$, d = 0.08m, $S_w = 4200 Jkg^{-1}K^{-1}$ .find the thermal conductivity of the metal rod.

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i) Can you determine the thermal conductivity of insulators using this experiment? State reasons.

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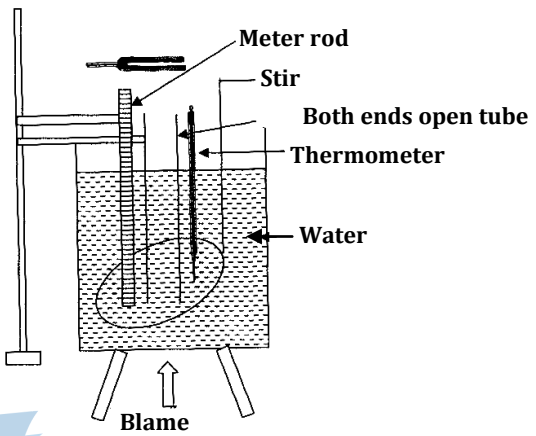
03) An experiment to find the molar mass (M) of gas in the tube and the end correction (e) of the tube is shown in the figure. Following instruments are used

- ✶ Tall water tank that can be heated
- ✶ Both end opened tube
- ✶ Standard tuning fork
- ✶ Bunsen burner
- ✶ Thermometer
- ✶ Meter rod



(a) Draw the pattern of wave that you will produce in order to carry out this experiment, in the tube shown in the figure. Clearly show the end correction

(b) Is there any reason for using this specific type of vibration? Explain your answer.

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(c) In the above condition write an expression for speed of sound in air v in relation to resonance length l, e and frequency of tuning fork f

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(d) In the above condition write an expression for speed of sound in air v in relation to absolute temperature of air, molar mass of air(M)

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(e) The variation of resonance length at deferent temperature of water is obtained. A straight line graph is drawn to obtain molar mass of air and end correction. State the expression of the graph.

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(f) Sketch the graph and label the axis

(g) Draw and label the graph as **x** that is obtained by using a tube with smaller diameter than the tube used here.

(h) State how would you find M and e from the above graph.

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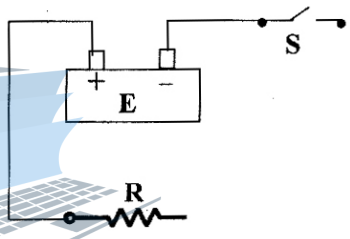
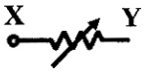
04) An incomplete circuit that is used to verify ohm's law in laboratory is shown in the figure.

- ✶ E – standard cell
- ✶ R – standard resistance(10Ω)
- ✶ S – switch
- ✶ V – voltmeter (resistance 2000Ω)
- ✶ A – Ammeter
  (scale of 10mA, maximum current 1A)
- ✶ Needed connecting wires





(a) Complete the above circuit to verify Ohm's law. Show the +, - end of voltmeter and ammeter in the circuit

(b) Write the relation between V, the voltage across the resistance R, I, the current through the resistance R.

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(c) How the value of the resistance of ammeter and voltmeter should be to make the experiment more accurate?

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(d) What physical quantity is chosen as dependent variable and what should be chosen as independent variable to verify Ohm's law using graphical method?

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(e) Draw the graph in axis given below and label the axis

(f) Would junction diode obey Ohm's law? Explain. Draw the graph for junction diode in the same graph and name it as X.

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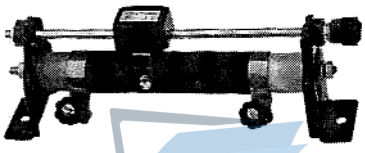
(g) The rheostat is given to use in this experiment. Mark the points X, Y in the circuit on the suitable place of the rheostat.



(h) Why you are not advised to use resistance box instead of a rheostat?

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(i) If the given standard resistance was 500Ω, how would you connect the voltmeter to carry out the experiment accurately? Give reasons

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(j) What is the minimum percentage of error that can be found when measuring current using the given ammeter?

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(k) A student says that it is better to do this experiment when small current passes through R. do you accept his statement? Give reasons.

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G.C.E. A/L Examination November - 2015

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Zonal Department of Education Jaffna.

FWC

Grade :- 13 (2016)	Part - II B	Physics - II

Essay

Answer any four Questions

01)

(a) Bernoulli's equation can be written as

$P + 1/2\rho v^2 + \rho gh = \text{constant}$

Here all notations have their general meaning

i) State the conditions where Bernoulli's equation will be valid.

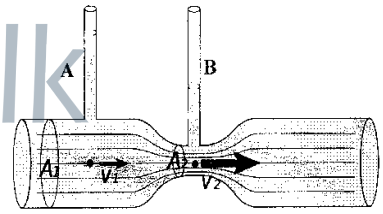
ii) by applying dimensional analysis only to $1/2\rho v^2$ and show that it has the dimension of pressure

iii) state two events that can explained by Bernoulli's equation but not mentioned in this question

iv) draw stream line flow diagram to explain one incident you mention in a(iii).

v) write the equation of continuity and explain the notions in it

(b) the figure shows a simple setup of venture meter. This is used to measure the speed of liquids flowing through pipes. A liquid flows steadily from X to Y in the tube. X, Y are two points in the stream line at the center of the tube.



The pressure and velocity at X and Y are V_1, V_2 and P_1, P_2 respectively. The cross sectional surface area perpendicular to stream line at X and Y are A_1 ,A_2 respectively.

i) draw the water column in tubes A and B, by copying the figure of the venturimeter to your answer sheet.

ii) write Bernoulli's equation at A and B with respect to V_1, V_2 , P_1, $P_2$and density of liquid ρ

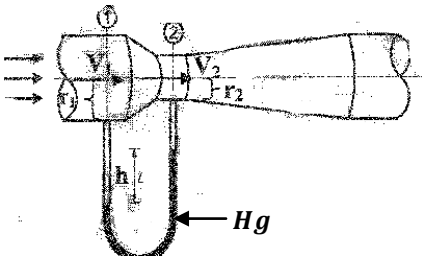
iii) the height of liquid column in tubes A and B are h_1, h_2 respectively. Atmospheric pressure is π cm Hg. State the expression for the pressure P_1, P_2 at points X and Y respectively.

iv) by applying equation of continuity to the cross sections at X, Y and using the equation from a(ii), a(iii), write an expression for the velocity of water flow V_1 with respect to h_1, h_2, A_1, A_2, ρ.

v) the venturimeter is fixed to a tube through which oil flows. The difference between oil level in A and B is 80cm. if the cross sectional area at Y is half of cross sectional area at X, find the velocity of oil flowing through the tube ($g = 10ms^{-2}$)

vi) in the above mentioned tube oil spills out at constant speed through a hole in tube and the speed of oil in the tube is reduced to 1m/s. find the speed of oil flowing through the hole? Consider the radius of cross section at X is 20cm

(c) in a venturimeter air flows from left to right as shown in the figure. Find the difference in the mercury level (h). r_1 = 1cm, r_2 = 0.5cm, v_1 = 15m/s , density of air = 1.3kgm^{-3}, density of mercury = 13.6X10^{3}kgm^{-3}, g =10ms^{-2}



02)

(a)

i) define the angular magnification of astronomical telescope.

ii) if the focal length of eye piece and objective of an astronomical telescope is f_o, f_e respectively, draw the ray diagram for this telescope at normal adjustment

iii) from the ray diagram you drawn derive an expression for angular magnification M in relation to f_o, f_e.

iv) if focal length of eye piece is 6cm and focal length of objective is 60cm, find the angular magnification of telescope?

v) what do you understand by eye ring of a telescope?

vi) in normal adjustment find the distance between eye ring and eye piece in relation to f_o, f_e

vii) by using the expression you obtained in a(vi), write an expression for the angular magnification M in relation to the diameter of objective (D) and diameter of eye ring(d).

viii) by considering that eye is situated very close to eye piece of a telescope at normal adjustment and the diameter of pupil is 3mm. if the light from objective fill the pupil find the diameter of the objective?

ix) when the moon is observed by the above telescope at same adjustment the angle made by the final image with eye is 10^0, find the angle made by moon with naked eye?

(b) Consider a situation where the distance between the objective and eye piece of the above mentioned telescope is 90cm and an object of height 11mm is placed 100cm infront of objective.

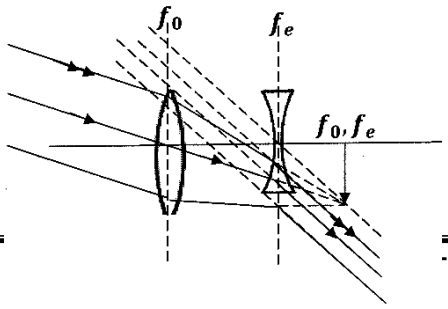
i) find the position of image formed by the objective

ii) find the distance between final image and eye piece?

iii) what is the height of final image?

(c) The figure shows an astronomical telescope made with a convex lens of focal length f_o as objective and a concave lens of focal length f_e as eye piece.

i) on the basis of the diagram derive an expression for the angular magnification of this telescope.



ii) state one advantage and one disadvantage of this telescope.

03)

(a)

i) what do you understand by Doppler's effect?

ii) state two application of Doppler's effect.

iii) when the sound source moving with a speed of V_s follows an observer moving with a speed of V_0, it emits a sound of frequency fHz. Find the apparent frequency heard by the observer in relation to V_s, V_o, f, c. c is the velocity of sound in air.

iv) a bird flying very low with a speed of 20m/s emits a sound of frequency 300Hz. The bird passes a stationary observer. If the speed of sound is 320m/s calculate the change in frequency observed by the observer?

(b) a boat moves towards a hill with speed of 18km/h emitting a sound of frequency 335Hz. Speed of sound in steady air is 340m/s.

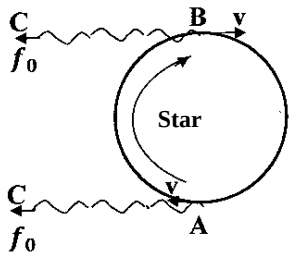
i) what is the apparent frequency heard by a man in the hill

ii) the sound was reflected by the hill. What is the frequency of sound heard by the man in the boat?

iii) if he hears the reflected sound and the direct sound, how many beats will he observe in a second?

iv) if air blows from boat towards the hill with the speed of 5m/s, , how many beats will the man observe in a second?

(c) the rotational speed of a star can be measured from the earth by using Doppler's effect. c – speed of light , v – speed of star's edge, f_o– real frequency of light emitted by star.



i) write an expression for the apparent frequency (f) of light emitted from A as seen from earth in relation to c, v, f_0

ii) write an expression for the apparent frequency (f^1) of light emitted from B as seen from earth in relation to c, v, f_0

iii) if $\Delta f = f - f^1$, show that $\frac{\Delta f}{f_o} = \frac{2V}{C}$, $C >> V$

iv) if $\Delta f/f = 4X10^{-8}$, $c = 3 X 10^8$, find the rotational speed of the star.

04)

a) Consider a satellite of mass m that rotates the earth in a circle of radius of r.radius and mass of earth is R, M respectively. Consider satellite experience only an attraction from earth.

i) write an expression for the gravitation force acting on satellite and explain the notations used by you.

ii) write an expression for the kinetic energy of the satellite in relation to G, M, m, r

iii) write an expression for the potential energy of the satellite in relation to G, M, m, r

iv) write an expression for the total energy of the satellite in relation to gravitational field strength g, m, r.

v) find the total energy of a satellite of mass 1000kg rotating earth at a distance of 8000km. g =10ms^{-2}, radius of earth of = 6400km

vi) find the minimum energy needed to move the satellite to the orbit from the surface of earth.

b) Geo stationary satellites are those rotating with same time period as that of the plane passing through the equator, in an approximately circular orbit.

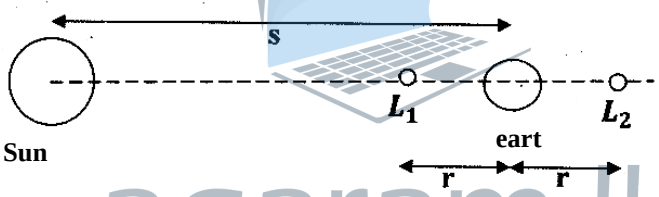
i) find the period of rotation of geo stationary satellite.

ii) if a geo stationary satellite rotates the earth in a radius of r, find an expression for r in relation to T – period of rotation of satellite, R – radius of earth, g – gravitational field strength

iii) can the geo stationary satellites be placed at different heights from the earth surface?

iv) at what distance a geo stationary satellite can placed from the surface of earth? g =10ms^{-2}, radius of earth of = 6400km

c) The places where satellite form earth are placed to examine the outer universe is known as L points. The satellites placed in these points appears to be stationary with respect to sun - earth system. Figure shows two L points L_1, L_2. A satellite is placed at L_2. Consider that satellite is only influenced by the earth and sun.

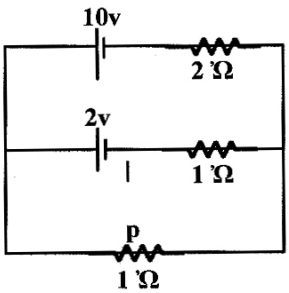


i) find the angular velocity of the satellite?

ii) though the distance to L_1, L_2 are in different distance from sun, how do they have same period of rotation? Write down the expression for the kinetic equations by considering M_s – mass of sun, M_e – mass of earth, mass of satellite placed at L_1 or L_2 is m, ω – angular velocity of the satellite

05)

a) In the figure shown a battery with e.m.f 10V and internal resistance 2Ω, another battery with e.m.f 2V and internal resistance 1Ω are connected parallel to each other. A resistance P of 1Ω is connected across the two cells.

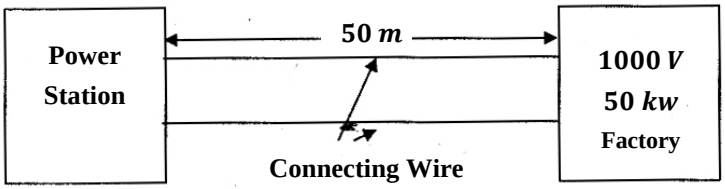


i) find the current through the cells

ii) find the current through the resistance P

iii) find the power wasted in P

b) As shown in figure current of 1000V is supplied to a factory from the direct current power station. The power consumed by the factory is 50kW. The distance between factory and power station is 50. The resistance of wire is 0.04Ω per meter.



i) what is the current passing when all the engines in the factory work with maximum power.

ii) what is the resistance of total wire?

iii) find the difference between voltage at the both ends of generator when the engines function? Neglect the internal resistance of generator

iv) find the power wasted in the carrying wires?

v) find the power generated by the generator?

vi) if the cost of production of 1 unit electricity is rs.20 find the total amount of cost of production of the current used by the factory in one day?

06)

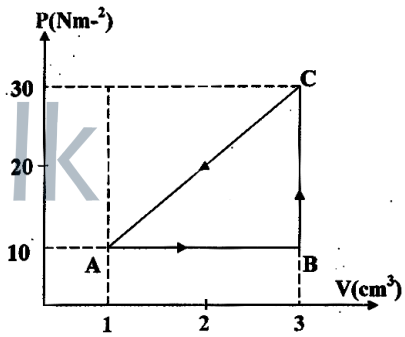
a)

i) write the first law of thermodynamics in mathematical form and identify it's terms.

ii) explain iso-thermal process and adiabatic process.

iii) state the conditions needed for iso – thermal process and adiabatic process

b) An ideal gas is undergone a cyclic procedure of ABCA as shown in the figure. Internal energy of gas at A, B are 20J and 50J respectively. Heat absorbed by gas during BC process is 90J.

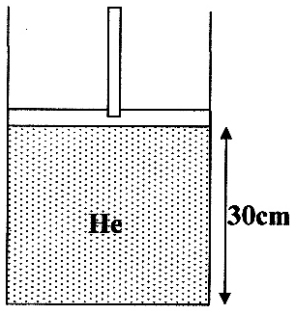


i) what is the internal energy of gas at position C?

ii) what is the amount of heat absorbed by the gas during process AB?

iii) does gas absorb or release heat during the process CA? what will be the amount of heat absorbed/ released?

c) In an insulated cylinder gas is filled and closed by a smooth piston as shown in the figure. Cross sectional area of cylinder is 8 X $10^{-3}m^2$, He gas is filled in the cylinder at a pressure 1 X 10^5Pa and temperature 27^0C. height of gas column is 30cm. heat capacity of cylinder and piston is negligible.



i) find the no. of moles of He in the cylinder? (Molar mass of He = 4g, R = $8.0K^{-1}mol^{-1}$)

ii) find the root mean square speed of molecules of He in cylinder

iii) what is the pressure inside the cylinder when a mass of 806g is placed above the piston?

iv) what is the distance moved by the piston due to the weight?