கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர) முன்னோடிப் பரீட்சை - 2018
General Certificate of Education (Adv. Level) Pilot Examination - 2018

பௌதிகவியல் I Physics I	01 E I	இரண்டு மணித்தியாலம் *Two hours*

Instructions:

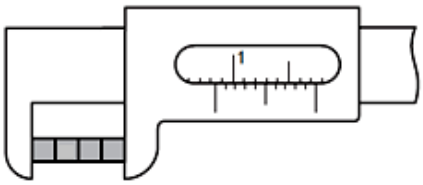
- Answer all the questions.
- This paper contains 50 MCQs in 12 pages.
- Write your index number in the space provided in the answer sheet.
- In each of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X) in accordance with the instructions given on the back of the answer sheet.

Do not use Calculator.
(g = 10 N kg^{-1})

1. Which of the following gives the dimention of the rate of change of momentum

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

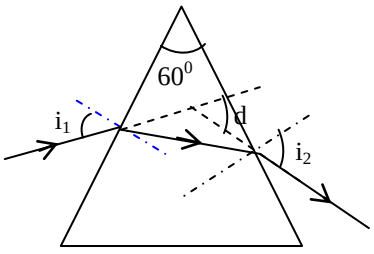
2. There are 4 identical rods with the crossection of square. All four of the rods were arranged in a row and their widths were measured all together by a vernier caliber as shown in the figure. The reading obtained was (84± 0.1) mm and the zero reading was (0.0± 0.1) mm what would be the width of a single rod.



(1) (2.10 ± 0.025) mm (2) (2.10 ± 0.05) mm (3) (2.1 ± 0.1) mm
(4) (2.1 ± 0.2) mm (5) (2.1 ± 0.0) mm

3. The Figure below shows the path of a light ray which travels through a glass prism. Which of the following could be the possible values for i_1, i_2 and d?

	i_1	i_2	d
(1)	50^0	30^0	40^0
(2)	50^0	20^0	90^0
(3)	40^0	48^0	42^0
(4)	50^0	35^0	25^0
(5)	60^0	60^0	40^0



4. When the teacher is absent the sound intensity level created by 5 students alone was 50dB. Then 45 students entered the class room additionally. If the sound intensity created by each of the students were considerd to be averagely similar find the increase in sound intensity level.

(1) 50dB (2) 25dB (3) 10dB (4) 3dB (5) 5dB

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5. Consider the following statements regarding the appearance size of the virtual image formed by a hand lense.

   (A) Depend on the position of object

   (B) Depend on the position of eye

   (C) Depend on the power of the lense.

   The true statement is/are.

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

   (4) All (A), (B), (C) (5) Non of the above

6. A 30cm long violin string with $0.5gm^{-1}$ mass per unit length is kept in tension. Then it vibrated by a viberator. The frequency of the viberator was increased form 500Hz to 1000Hz. For the Frequencys of 800Hz and 1200Hz the string shows a fixed wave patterns. Tension in that string is.

   (1) 2.88N (2) 5.67N (3) 28.8N (4) 57.6N (5) 100N

7. For a specific period of time which one of the following could be deduced from the area of an acceleration time graph for the motion of a particle.

   (1) Average velocity for a specific time interval of motion.

   (2) Speed of object at the end of the time interval.

   (3) Average speed for a specific time interval of motion.

   (4) Change in velocity for a specific time interval of motion.

   (5) Velocity of object at the middle of time interval of motion.

8. Consider the following statements about stationary waves.

   (A) Stationary waves can be formed by overlapping of incident and reflected waves.

   (B) Water waves can't form standing waves.

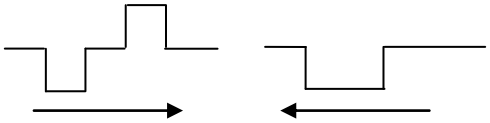
   (C) Increasing tension in a sonometer string with a standing wave could reduce its amplitude.

   Among them the true statement is/are

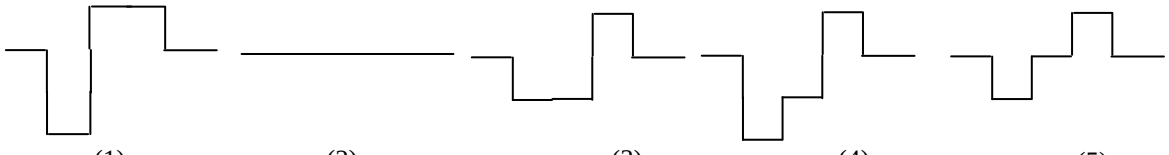
   (1) (A) and (B) only (2) (A) and (C) only (3) (B) and (C) only

   (4) All (A), (B) and (C) (5) None of the above

9. Two signals are approaching as shown in the figure.



   On a particular moment both signals overlap completely. According to the principal superposition the resultant signal at that moment is.



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

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10. Two spheres were heated to same temperature and exposed to similar Environments to radiate. Each of the spheres has similar radiating ability but one has the radius twice the other one. If the initial rate of radiation of small sphere is P, the initial rate of radiation of other sphere is.

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

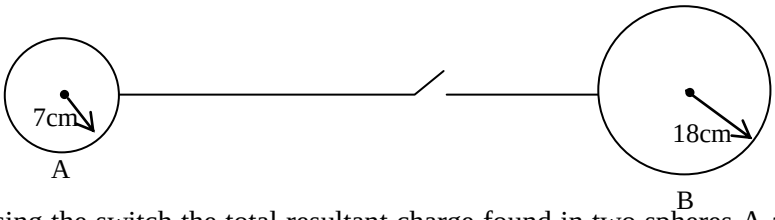
11. A vessel with 360g of water at 0^0C is poured into a vessel with unknown volume of water at 100^0C. The resultant temperature of the system was found to be at 40^0C. The total mass of water present in that vessel now is.

(1) 360g (2) 376g (3) 420g (4) 480g (5) 600g

12. In a cylinder, dry gas is traped with a pressure 760mmHg. The volume and temperature of the cylinder was 80cm^3 and 7^0C respectively. when the cylinder is compressed by a piston till the volume of gas become 38cm^3 the temperature got rised up to 28^0C.Now the pressure of the cylinder is

(1) 385 (2) 760 (3) 1520 (4) 380 (5) 1720

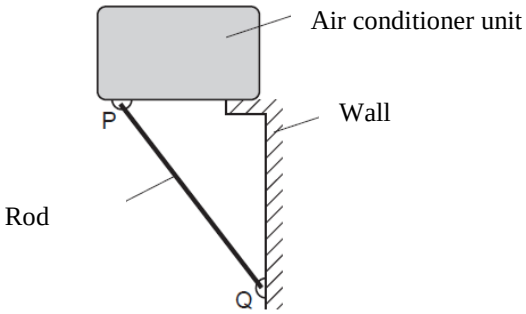
13.



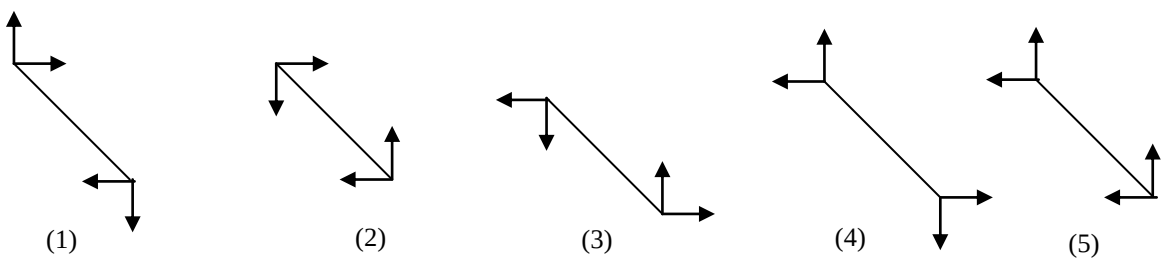
Before closing the switch the total resultant charge found in two spheres A and B is Q. when the switch is closed the percentage of charge found in A is.

(1) 18% (2) 28% (3) 38% (4) 72 % (5) 82%

14. Figure shows an air conditioner unit which is fixed to the wall by a solid rod.



The correct representation of forces, acting on the edges of the rods is.



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15. A piece of iron is heated in a Flame. It first becomes dull red and then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using.

(1) Newton's law of cooling (2) Stefan's Law

(3) Weirs displacement law. (4) Kirchhoff's law

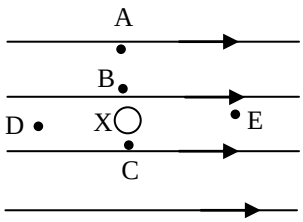
(5) Planks' law

16. When $3x10^{-4}$J of work was required to change the area of a soap layer from 10cmx6cm to 10cmx11cm. The surface tension of the soap layer will be.

(1) $1.5\ x10^{-2}Nm^{-1}$ (2) $3.0\ x10^{-3}Nm^{-1}$ (3) $6.0\ x10^{-2}\ Nm^{-1}$

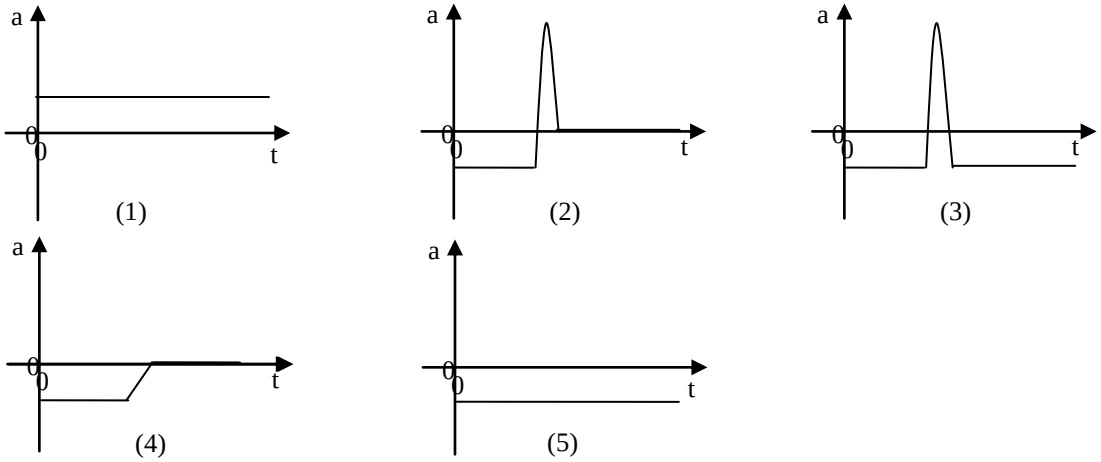
(4) $11.0\ x\ 10^{-2}Nm^{-1}$ (5) $3.0\ x10^{-2}Nm^{-1}$

17. A uniform magnetic field is passing through the plane of paper form left to right. A long straight conducting rod X is held perpendicular to the plane of magnetic field. When electric current is passed through the rod in inward direction, which of the following point have highest flux density.

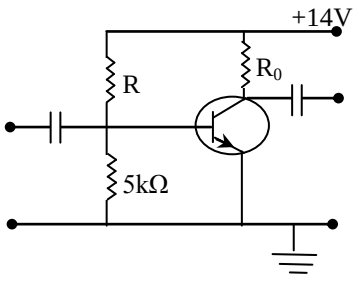


(1) A (2) B (3) C (4) D (5) E

18. A Huge clay ball is dropped from a height to reach the ground. The most appropriate graph that shows the variation of accteraction of center of mass of clay ball (a) with time (t) is.



19. In the circuit shown below what's the suitable value for R to make the silicon transitor biased in active mode.



(1) 50kΩ (2) 95 kΩ (3) 150 kΩ

(4) 200 kΩ (5) 250 kΩ

20. An ice cube of mass 30kg is about to be lifted to a hight 1.5m with the help of an inclind plane by using a force 75N. The minimum length of inclined plane required is.

(1) 3m (2) 6m (3) 12m (4) 4.5m (5) 9m

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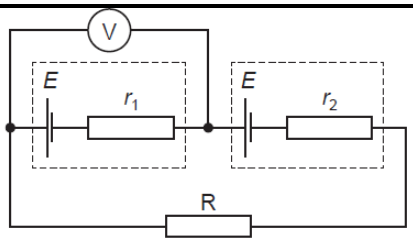
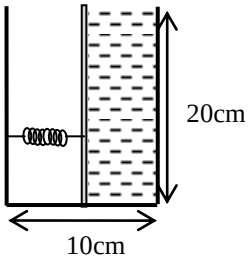
21. Two cells with same emf E and with different internal resistance r_1, r_2 are connected serially with a resistance R. If the voltmeter reading is 0V. The value of R is. .



(1) 0 (2) $r_1 - r_2$ (3) $r_1 + r_2$

(4) $\frac{r_1 r_2}{r_1 + r_2}$ (5) $\frac{r_1 + r_2}{2}$

22. A square based tank is filled with water to a height 20cm. By using a piston connected with a spring with spring constant 1500Nm^{-1}, the tank is separated into two equal parts as shown in the figure. The compression in the spring is (density of water is 1000kgm^{-3}, the friction between tank and pistons are negligible)

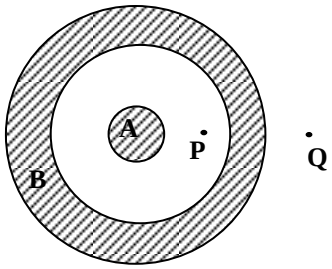


(1) 1cm (2) 1.1cm (3) 1.2cm (4) 1.3cm (5) 1.5cm

23. Disk of a computer hard disk reaches a certain speed from rest after completing 10 full rotations, but it takes 50 rotations to come to rest. If the disk executed a constant angular acceleration X_1 and a constant angular deceleration X_2 then X_1/X_2 is.

(1) $\frac{1}{5}$ (2) $\frac{1}{\sqrt{5}}$ (3) $\sqrt{5}$ (4) 5 (5) 25

24. A, B are same centered conducting sphere and thick conducting shell respectively. When A is positively charged while B is kept uncharged, which of the following statement is false regarding A and B.



(1) In the outer surface of B Positive charge is found

(2) The electric field strength, electrical potential at the point Q is independent of thickness of shell B

(3) Electric field strength at point P is independent of thickness of shell B

(4) Electric potential in the point P decrease with the increase of thickeners of sphere B

(5) When the shell B is earthed electric field strength at P increases.

25. Cooking vegetables and some other food items in pressure cooker helps to save time and fuel because.

(A) In high pressure water boils under temperature above 100^0C

(B) In high pressure water boils under temperature below 100^0C

(C) Heat lost is reduced

(D) Condensation of vapour is preserved.

Correct statement is /are

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

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

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26. The gravitational potential at the surface of planet x of mass M is equal to the gravitational potential at the surface of the plarent y of mass m, the ratio $\frac{raduis\ of\ X}{radius\ of\ Y}$ gives.

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

27. In a calorimeter with heat capacity $500JK^{-1}$,1kg of water is taken and heated by using an immersion heater of power 2kW. If heat lost to the envorment is neglected, what is the rat of temperature rise in water? (specific heat capacity of water $1200Jkg^{-1}K^{-}$)

(1) $0.3\ ^0Cs^{-1}$ (2) $0.35\ ^0Cs^{-1}$ (3) $0.43\ ^0Cs^{-1}$ (4) $0.45\ ^0Cs^{-1}$ (5) $0.5\ ^0Cs^{-1}$

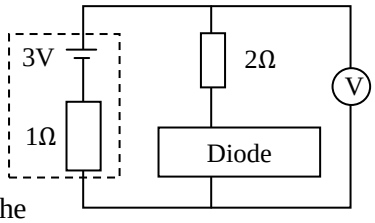
28. A nucleus of uranium -238 deacys in a series of steps to form a nucleus of lead – 206

$$^{238}_{92}U \rightarrow \cdots\cdots ^{206}_{82}Pb$$

as shown. An α particle or a β^- particle is emitted during each step, then what is the total number of β^- particle emited?

(1) 6 (2) 8 (3) 10 (4) 16 (5) 12

29. An ideal diode has zero resistance in forward biasing and infinite resistance in reversed biasing. The figure shows that the ideal diode is connected across a series connection of 2Ω resistor and a 3V cell with 1Ω internal resistance.



A high resistance voltmeter is connected parallel to diode and resistor. The correct reading of voltmeter for both biasing of diode is.

	Forward biasing	**Reverse biasing**
(1)	1V	3V
(2)	2V	0V
(3)	2V	3V
(4)	3V	0V
(5)	3V	3V

30. The condition under which a micro wave oven heat up food items containing water molecules most efficiently is.

(1) Infrared wave produce heating in a micro wave oven

(2) The frequency of the micro waves must match with the resonance frequency of the water molecules

(3) The frequency of micro waves has no relation with natural frequency of water molecules.

(4) Micro wave are the heat waves which always produce heat.

(5) Micro waves must contain photons with high energy

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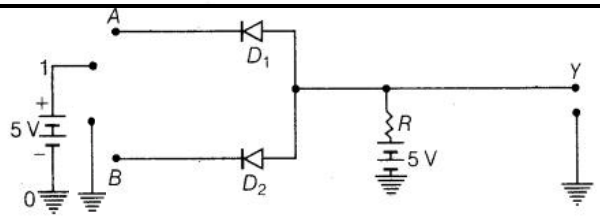
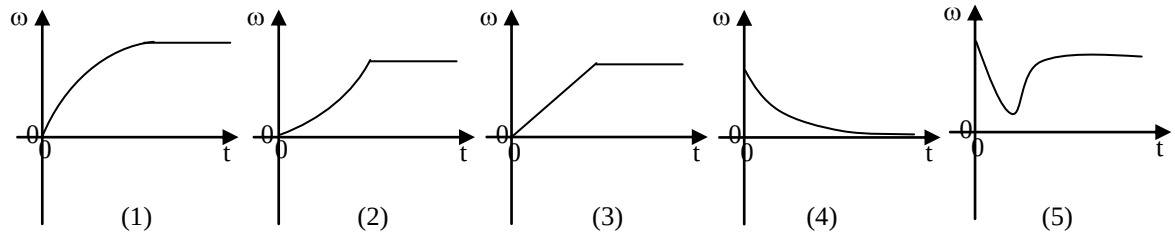
31. The circuit shown above is made up of diodes, resistors and cells. A and B are the inputs and Y is the output. Which of the following logic gates function is similar to it?



(1) OR (2) NOR (3) AND (4) NAND (5) XOR

32. The static and kinetic frictions between the floor and ball is $\mu_s = \mu_f = \mu$. A horizontal velocity is applied to the ball without any angular velocity at center of mass of ball. which of the following graphs shows the correct variation of angular velocity of ball with respect to its center of mass (ω) with time (t) is.



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

33. According to Lenz's law, the effect created by the induced Electric current in a conductor is.

(1) Support the causing factors

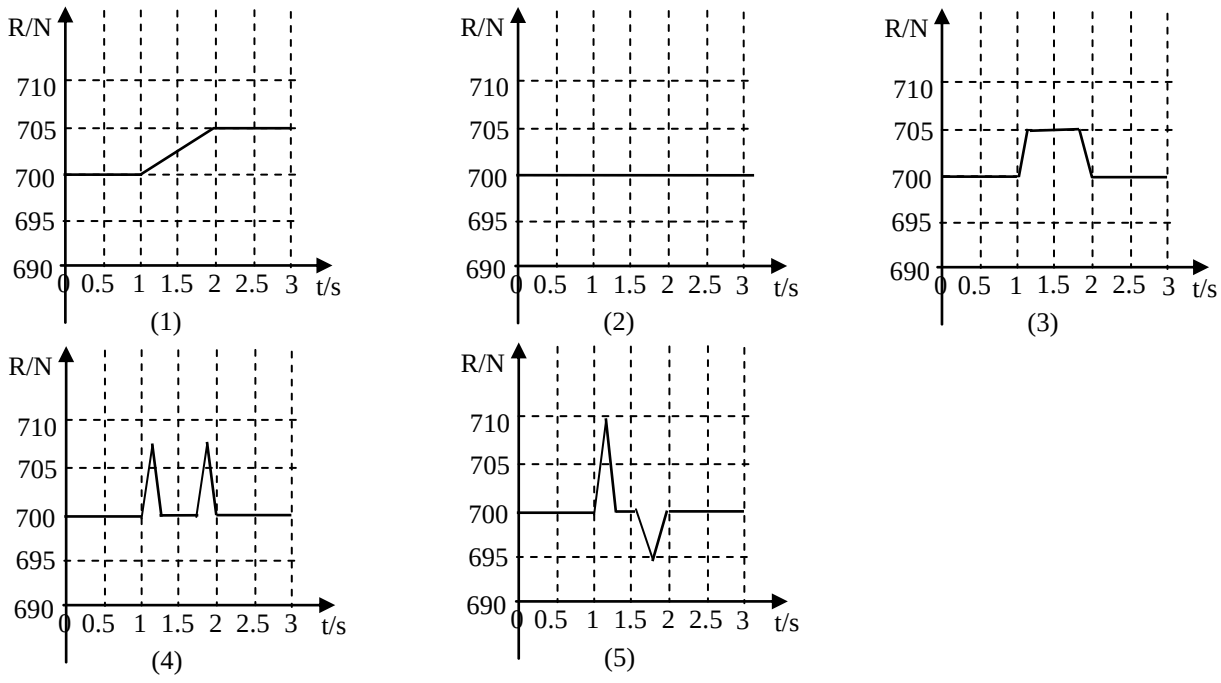
(2) Oppose the causing factors

(3) Create high heat effect

(4) support very high electrical potential

(5) oppose very high electrical potential

34. You were standing still over an electronic balance with holding a huge physics book inyour hand at that instance the reading of the balance was 700N. You start to rise the book upward at time t=1sec when the time reaches t=2 you stops rising and the book found ½ m higher than before. Which of the following graphs shows the best variation pattern of reading of balance (R) with time (t)?



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

[See page 8

35. When a car sounds a horn of frequency 100Hz and approaches an observer standing in the way with the velocity of $20ms^{-1}$. When the speed of sound in air is $330ms^{-1}$, the apparent frequency of horn to the observer is.

(1) 360Hz (2) 300Hz (3) 220Hz (4) 200Hz (5) 110Hz

36. Constant volume gas thermometer and liquid in glass thermoeter are used in the same time to measure a certain room temperature

(A) Since both the thermometers are scalled according to the ice and steam points, they both show same reading.

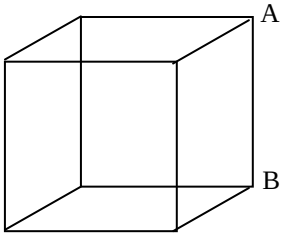
(B) Since the thermometric property of liquid in glass thermometer doesn't vary linearly with temperature, they show different readings

(C) Even though the volume of glass bulb doesn't change linearly with temperature, the gas has high expansion with temperature so that it gives the reading closer to room temperature.

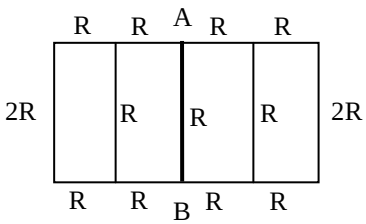
Form the above statements,

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

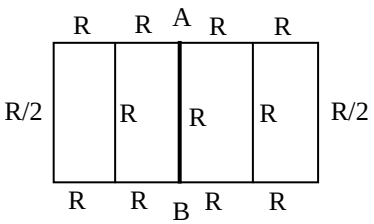
37. A cubic structure is made up of 12 identical rods. Each of them has a resistance R.



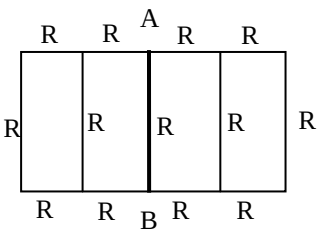
The resultant resistance between the points A, B is measured by considering the symmetric nature of cube. Which of the following is similar to the above structure?



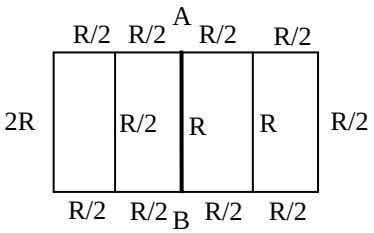
(1)



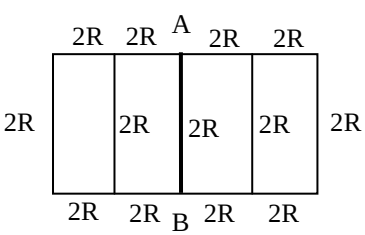
(2)



(3)



(4)



(5)

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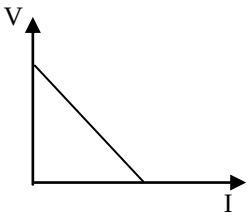
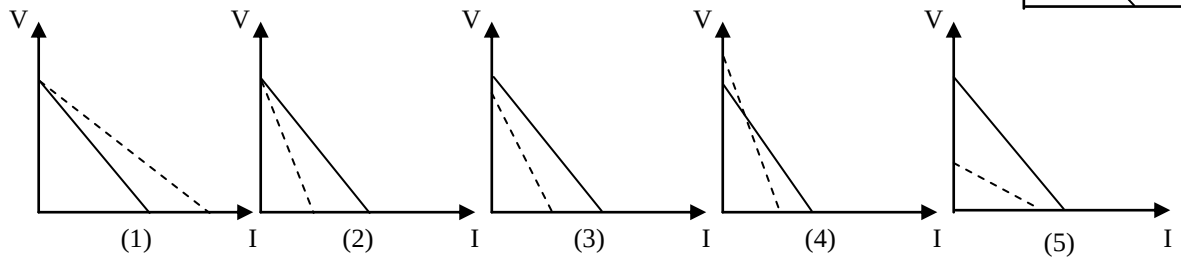
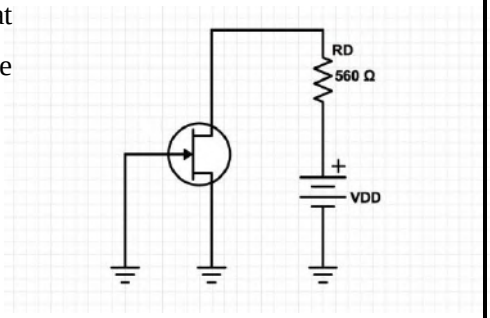
38. A graph of potential difference (P.d) V across a cell against current (I) in the cell is shown in the figure. As the cell reaches the end of its useful life, its internal resistance increase and its emf decreases. Which of the following diagrams shows a graph of V against the cell nearing its end of useful life?



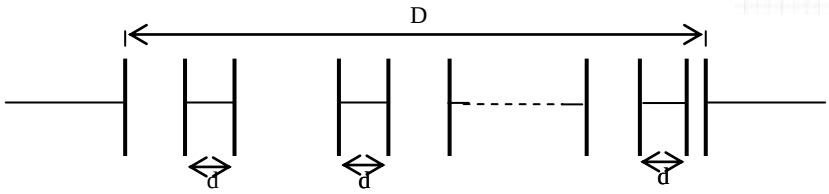


39. In the given junction field effect transistor (JFET) circuit, what should be the least V_{DD} value required to keep transistor in active stage? (here V_p = -4V, I_{DS} =12mA)



(1) 4V (2) 10.72V (3) -4V
(4) 2.72V (5) 4.72V

40.



The structure shows the continuous combination of capacitors made up of identical plates with crossectional area A. Here distance between two capacitance plates could differ. But the perpendicular wire connects capacitor plates are of same length d. the distance between the initial and final capacitor plate is D. If there is n number of capacitors are present, the equalent capacitance of this system is.

(1) $\frac{\varepsilon_o A}{D-nd}$ (2) $\frac{\varepsilon_o A}{nd}$ (3) $\frac{\varepsilon_o A}{D-\frac{n}{2}d}$ (4) $\frac{\varepsilon_o A}{D-(n-1)d}$ (5) Cannot calculate

41. In an experiment carried out by a student in order to determine the resistivity (ρ) of substance in a shape of a wire using a meter bridge, he obtained a value which was lower than the actual value. He explained the reasons for his results through following statements.

(A) The emf of cell used could be dropped while experimenting

(B) Using the one measure valueof the diameter instead of using the average value multiple measurements of diameter taken at the different positions of the wire in this experiment.

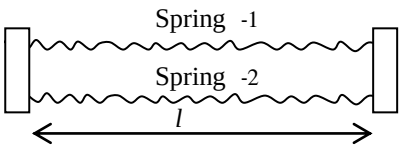
(C) Instead of actual length of wire a lesser value could be used

Of the above statements,

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

[See page 10

42. A spring with natural length l_1 and spring constant k_1 is attached to another spring with natural length l_2 and spring constant k_2. Both the springs are connected parallel to each other.

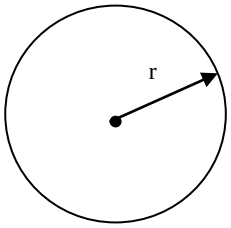


If the combined system acts like an individual spring with natural length l and spring constant k, then.

(1) $K = K_1 + K_2, l = \frac{l_1 l_2}{l_1 + l_2}$ (2) $K = K_1 + K_2, l = \frac{l_1 K_1 + l_2 K_2}{K_1 + K_2}$ (3) $K = K_1 + K_2, l = \frac{l_1 K_2 + l_2 K_1}{K_1 + K_2}$

(4) $K = \frac{(l_1 K_1 + l_2 K_2)}{(l_1 + l_2)}, l = \frac{(l_1 K_1 + l_2 K_2)}{(K_1 + K_2)}$ (5) $K = \frac{(l_2 K_1 + l_1 K_2)}{(l_1 + l_2)}, l = \frac{(l_1 K_2 + l_2 K_1)}{(K_1 + K_2)}$

43. As shown in the figre, a soap bubble exist in air with the surface tension γ and radius r at temperature T. Which of the following statements is false regarding that bubble?



(1) No of moles of air present in unit volume inside the bubbles is $\frac{4\gamma}{rRT}$ higher than in atmospheric air

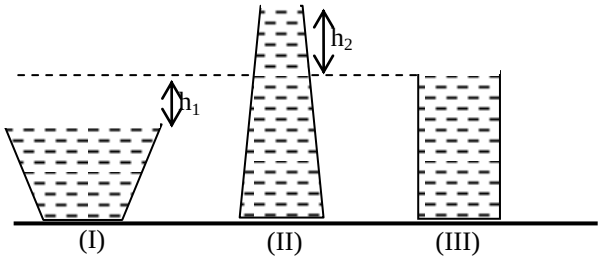
(2) Slight increase in temperature always increase the size of bubble.

(3) Slight increase in temperature increase the pressure inside the bubble

(4) Work will be done by the air inside the bubble when temperature rises slightly

(5) Te heat gain by bubble due to increase in temperature is not equal to the summation of work done by gas, increase in internal energy of gas and the heat required to increase the temperature of the solution which makes the bubble.

44. Vessal shown below have same bottom surface area (A) and same volume (V). Each of them is filled completely with the water of density ρ_w.

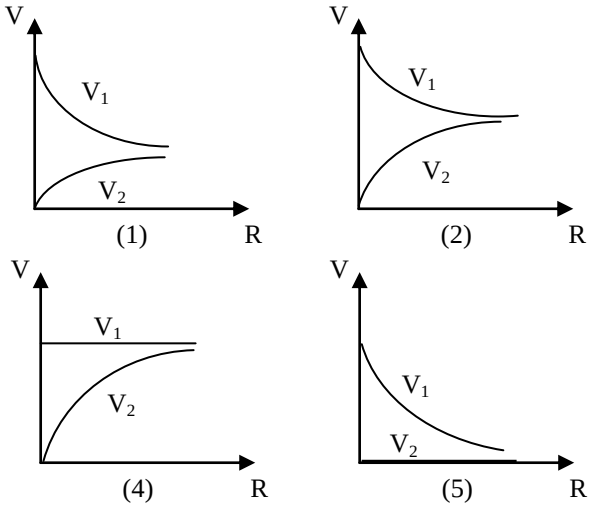


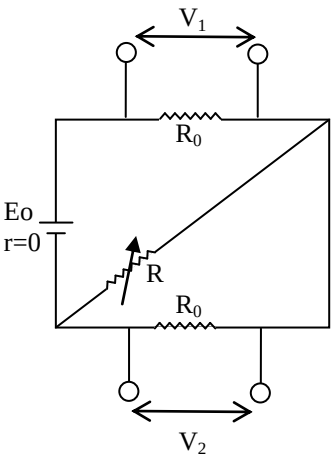
The magnitude and direction of resultant force given by water to the curved surface of vessels are given by,

	(I)	(II)	(III)
(1)	$(V-Ah_1)\rho_w g$ ↓	$(Ah_2 - V)\rho_w g$ ↑	0
(2)	$(V + Ah_1)\rho_w g$ ↓	$(V+Ah_2)\rho_w g$ ↑	0
(3)	$Ah_1\rho_w g$ ↓	$Ah_2\rho_w g$ ↑	0
(4)	$Ah_2\rho_w g$ ↑	$Ah_2\rho_w g$ ↓	0
(5)	$(V-Ah_1)\rho_w g$ ↑	$(Ah_2 - V)\rho_w g$ ↓	0

[See page 11

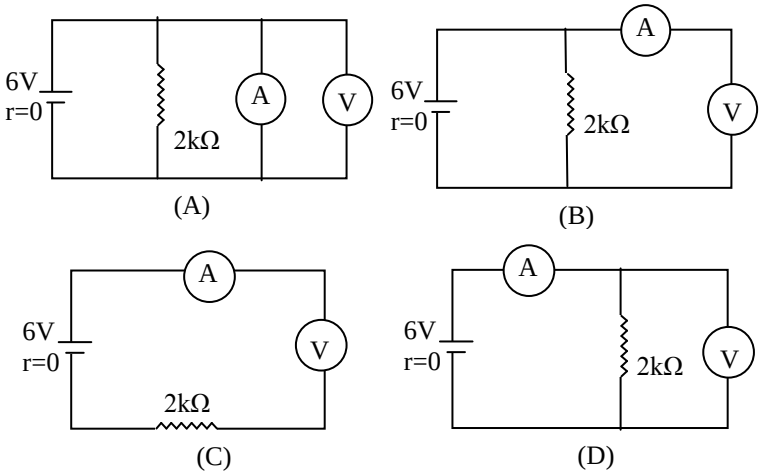
45. In the circuit shown in the figure the internal resistance of cell with emf to E_0 is negligible. When the variable resistance changes from zero to infinity, the graph which best represent the variation of v_1 and v_2 with resistance R is,



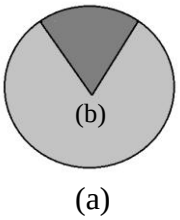


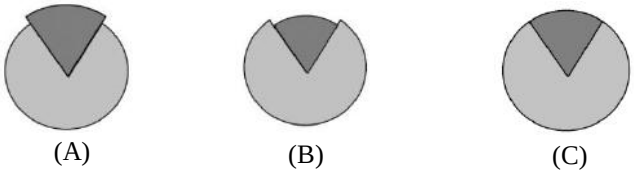
46. In the circuits shown, identical ampere meters (A) and volt meters(V) are connected. The ratio $\frac{V\ reading}{A\ reading}$ is

(1) Equal in (A) and (B)
(2) Equal in (B) and (C)
(3) Equal in (C) and (D)
(4) Equal in (A) and (D)
(5) Non of them have equal values



47. The figure shows that a sector (a) is removed from a circular plate of linear expansivity α_a and it is replaced with an another sector (b) of same size with the linear expansivity of α_b.When the temperature of this system is slightly increased by a small value,(here $\alpha_b > \alpha_a$)

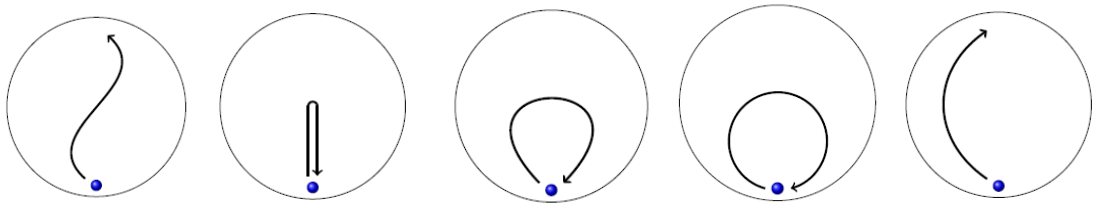




(1) Found fight as sown in A
(2) Found loose as shown in A
(3) Found hight as shown in B
(4) Found loose as shown in B
(5) Found loose as shown in B

[See page 12

48. A child throws a ball upwards to it when he/she was inside a rotating space station of circular shape.The ball was caught again by the child when the station completes its half rotation. The path of the ball in the view of that child is (The figure shows that the child is sitting in the base of the rotating station and the initial position of the ball also shown)



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

49. In figure (a), a solenoid produces a magnetic field whose strength increase into the plane of the page An. induced current is produced in a conducting loop surrounding the solenoid and this curent lights bulb A and B. In the figure (b),points P and Q are connected by a free wire in the plane of paper.Afer P and Q are connected,

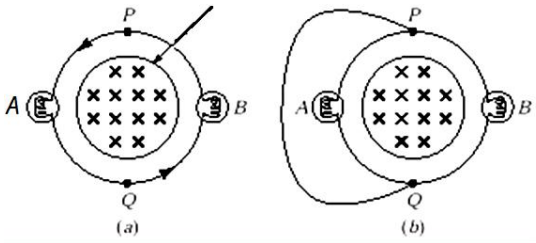
(1) Bulb A goes out, Bulb B gets brighter

(2) Bulb B goes out, Bulb A gets brighter

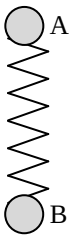
(3) Bulb A goes out, Bulb B gets brighter

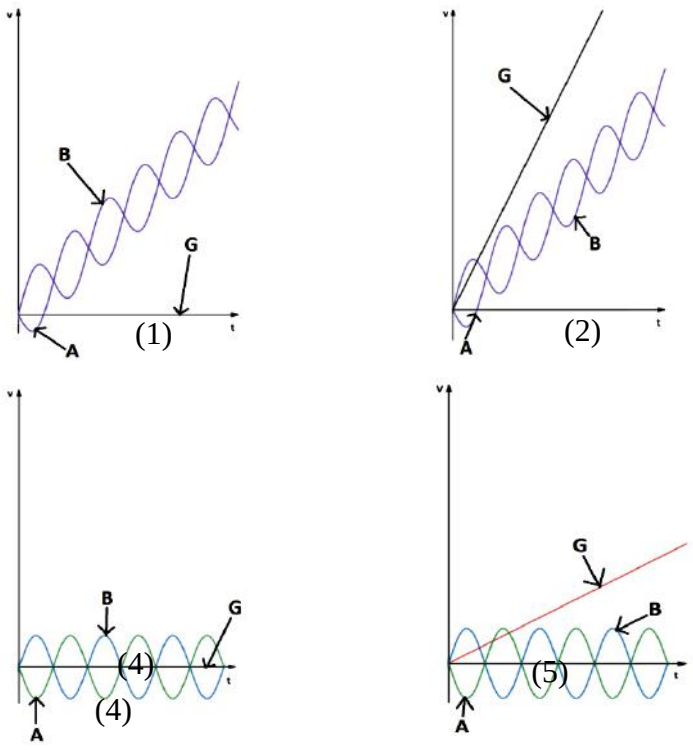
(4) Both bulbs gout

(5) None of the above



50. 2 identical masses A and B are attached to the end of a light spring as shown in the figure. When the system is compressed while keeping the axis of the spring as vertical and released, the graph which correctly shows the variation of the velocity (V) of the centre of mass of the system(G) against time (t) in the continuos motion is,





கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர) முன்னோடிப் பரீட்சை - 2018
General Certificate of Education (Adv. Level) Pilot Examination - 2018

பௌதிகவியல் II
Physics II

01 E II

மூன்று மணித்தியாலம்
Three hours

Index No :...................................

Instructions :

- ❋ This question paper consists of pages.
- ❋ This paper comprises of two parts **A and B**. The time allotted for the **two parts** is **three hours only.**
- ❋ **Use of calculators is not allowed.**

Part A – Structured Essay (Pages 2 - 9)

- ❋ Answer all the questions on the question paper itself.
- ❋ Write your answers in the space provided for each question.
- ❋ Please note that the space provided is sufficient for the answer and that extensive answers are not expected.

Part B – Essay (Pages 11 - 22)

- ❋ This part consists of **six** questions. Answer **four** questions only. Use the papers supplied for this purpose.
- ❋ At the end of the time allotted for this paper, tie the two papers together so that Part **A** is on top and hand them over to the Supervisor.
- ❋ You are permitted to remove only Part **B** of the question paper from the Examination Hall.

For Examiner's Use Only

01– Physics II		
Part	**Question No.**	**Marks**
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9(A)	
	9(B)	
	10(A)	
	10(B)	
Total		
Percentage		

Final Marks

In Numbers	
In Letters	

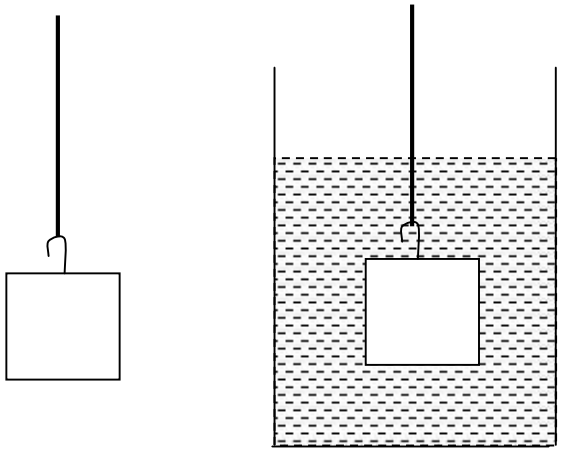
Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

[See page 2

01.

(a)



The tensions in the string when a block made of a particular type of alloy in the states of completely immersed in the air and glycerol are T_1, T_2respectively. The densities of alloy and glycerol areρ_m, ρ_g respectively ($\rho_m > \rho_g$). The volume of block with hook is V.

i. Write the expressions for T_1 and T_2.

……

……..……..…….

ii. If the ratio of $T_2/T_1 = 4/5$, $\rho_m = 6250 kgm^{-3}$, then find $(\rho_m - \rho_g)$.

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iii. If the least count of string balance used to measure tensionsis 0.1N, by considering both two instances what could be the minimum possible value for V to get error percentage less than or equal to 10%?

……

……..……

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…….

(b) Some metal balls made up of alloy mentioned above with different radii were dropped in to a tall vessel filled with glycerol from rest.

i. What could you conclude form that the time taken for the metal ball to pass the two tall portions made up of rubber bands become same?

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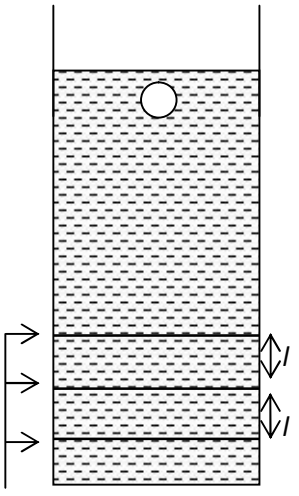
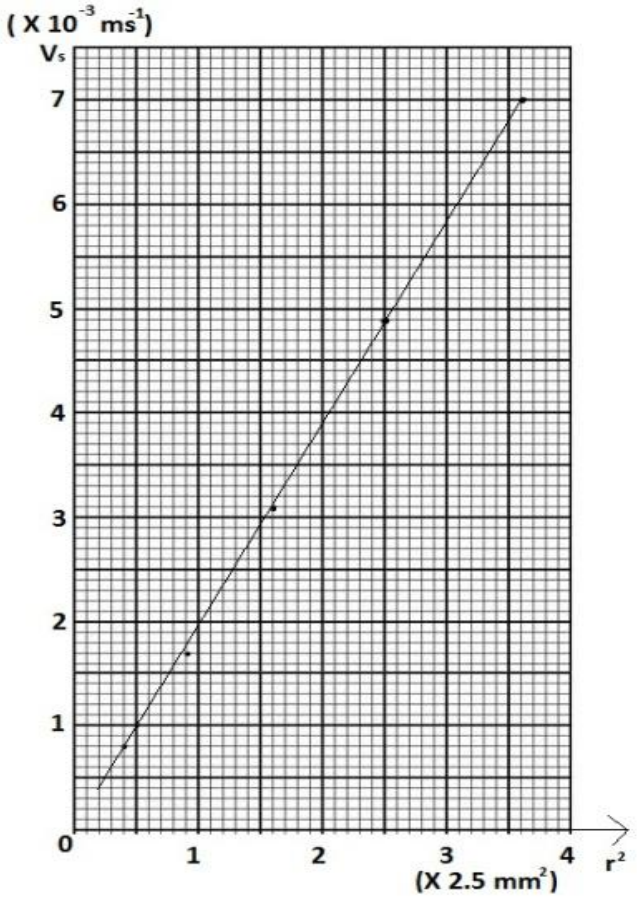


Rubber band

[See page 3

Experiment is conducted with the spheres of different radii. The graph of terminal velocity (Vs) against square of the radius (r^2) is shown below.

$$V_s = \frac{2r^2}{9n}(\rho_m - \rho_g)g$$



ii. Find the gradient and calculate the co-officient of viscosity (η) of glycerol

……

……

……

iii. What are the environmental factors affect the value of n?

……

iv. Water has a low value for coefficient of viscosity as 8.90 x10^{-4} Pas.What is the problem in using this experiment to determine the coefficient of viscosity of water?

……

……

v. After reaching the terminal velocity, the sphere moves with the constant kinetic energy. But its potential energy gradually getsreduced. Explain how the energy is conserved in this case.

[See page 4

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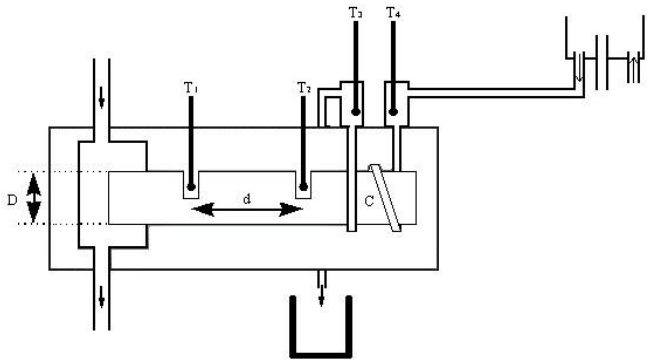
02. (a) The figure shows an experimental setup arranged to find the heat conductivity of a metal using Searle's law.



i. Listdown the measuring instruments required to carry out this experiment

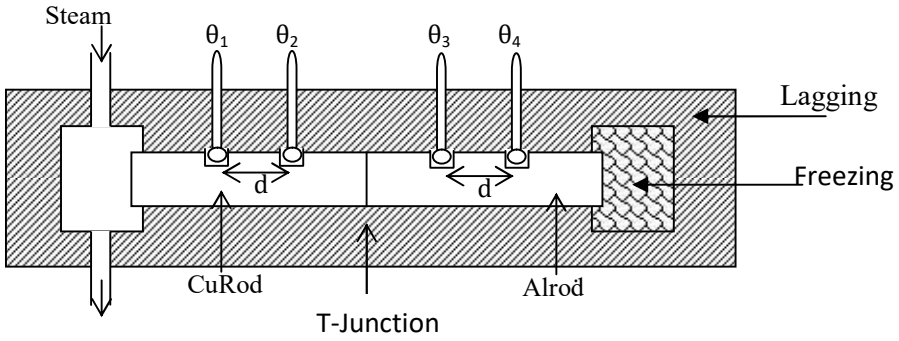
……

……

ii. What is the purpose of using the constant pressuregauge in this experiment?

……..

(b) To determine the thermal conductivity of a metal, an alternate method is used for the above method. The following figure shows the experimental setup containing the copper, aluminium rods of same lengths and same cross-sectional areas which are connected to each other end to end.



i. What is the purpose of using steam and freezing mixture in this experiment?

……..

ii. The thermal conductivities of Cu & Al are K_1& K_2 respectively. The readings of the thermometers are θ_1, θ_2, θ_3 and θ_4. By considering the heat flow through the rods get a relationship among K_1,K_2 θ_1, θ_2, θ_3& θ_4.

……

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……

……

[See page 5

iii. If $K_1 = 400 Wm^{-1}k^{-1}$ and the temperature readings obtained at the steady state are 91.2^0C, 80.1^0C, 54.6^0C, 32.4^0C then find the thermal conductivity of aluminum K_2.

……

……

……..

iv. What is the advantage of using this method instead of the usual method?

……

v. If d=5cm and the length of a rod is 15cm, then find the resultant thermal conductivity of combined rod?

……

……

……

vi. What is the temperature at junction T?

……

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……

vii. If the cross-sectional area of the rod is $8cm^2$, then what is the rate of heat flow through the rod?

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……

03. Adjusting spectrometer components is an important step in spectrometer experiments.

(a) What is the order or adjusting components in spectrometer

……

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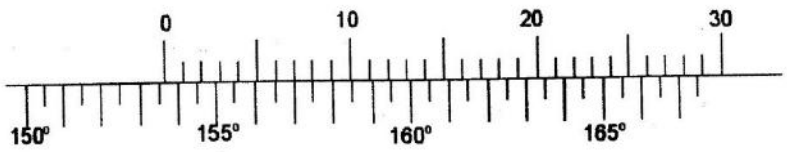
(b) How could you adjust the eye piece of telescope

……

……

(c) In the given spectrometer, 29 main scale units coincide with 30 vernier divisions.



i. What is the least count?

……

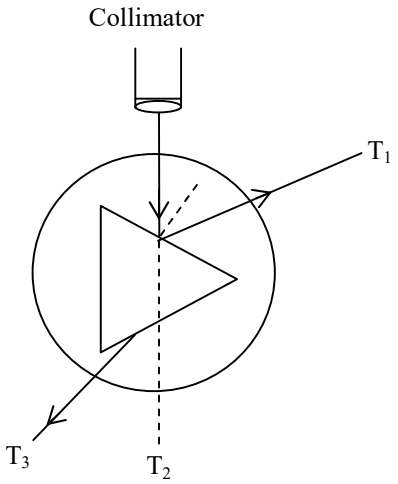
[See page 6

ii. What is the reading in the position shown in the figure?

……

……

(d) An experimental setup arranged to draw the variation graph of deviation (d) with angle of incidence (i) in a prism with the help of spectrometer is shown below.



In the shown position the reading taken for the image position of light beam was T_1 and T_3 the reading taken after prim is remove and coli meter and telescope kept facing each other was T_2. Let the reading increase clock wise from T_1 to T_3.

i. Explain the formation of light ray responsible for reading T_1.

……

ii. Write the expression for angle of deviation (d) in terms of readings taken.

……

iii. Write the expression for incident angle (i) in terms of reading taken.

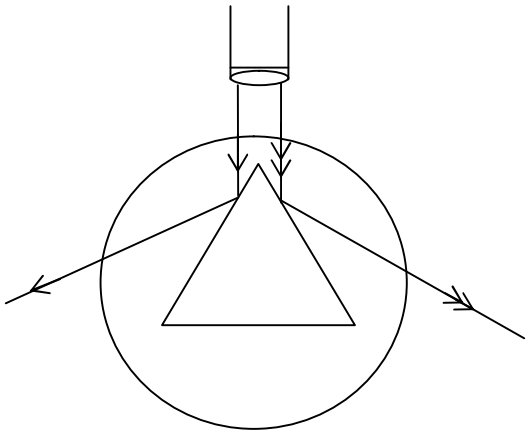
……

iv. Draw the d Vs. I graph in the axis given below.

[See page 7

v. When another prism with same dimensions as this one but have higher reflective index from other is used **to** respect this experiment. Draw the expected graph in the same diagram & mark it as X.

(e) After a proper adjustment of spectrometer, that student attempt to do an experiment to measure the prism angle (A) as shown in the figure



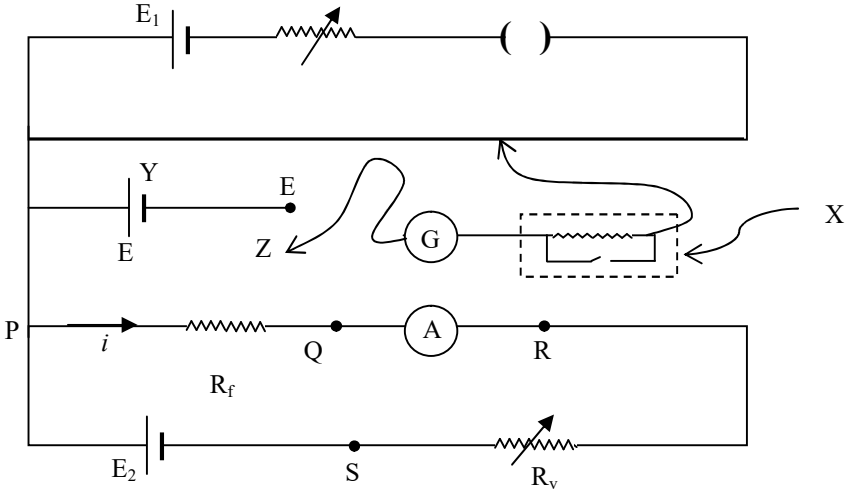
At this experiment, he was able to see the image of the slit reflected in prism surface by his naked eyes but unable to see through the telescope. Mention the reason for this?

……

……

……

04. The circuit shown below is a setup used to calibrate an ammeter by a potentiometer. Y is a standard cell with emf E. Here E_1,E_2 are cells with constant emf



[See page 8

(a) By denoting +/- sign in terminals of ammeter A show how should you connect the Ammeter.

(b) Give 2 importance of the circuit named by X.

……

……

……

(c) In that particular experiment balance length taken for standard cell is l_1 and balance length when terminal z is connected with Q is l_2 for that instance write an equation for current flow i in terms of E,R,l_1,l_2

……

……

……

(d) If emf of standard cell is 1.2V, value obtained for l_1,l_2 were 32cm, 80cm and $R_f = 1\Omega$, Find the current (i) flow ?

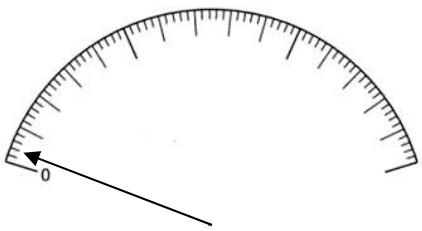
……

……

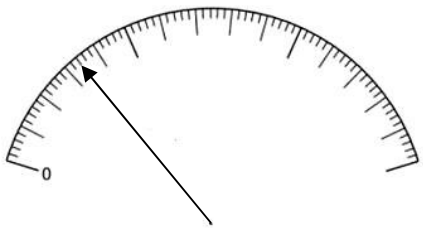
……

……

(e) The figure shows the position of the indicator whenthere is no current flow through the ammeter (1) and when the current icalculated in above (b) flows through the ammeter of the above circuit (2).



(1)



(2)

1. Draw the positions of indicator in figure (2) when 2i current pass through ammeter
2. What is reason for answer in e(1)

   ……

   ……
3. What is the least count of ammeter

   ……

[See page 9

Internal resistance of ammeter is about to be **determined**

1. For this an additional reading is required to this which point among P,Q,R and S would you connect with Z

   ……

   ……

2. When the variable resistance R_V is kept in same value as it used to find $l_2$in (d) and it connected as mentioned in f(i) then the balance length was 240cm find the internal resistance of ammeter.

   ……

   ……

[See page 10

No questions in this page

[See page 11

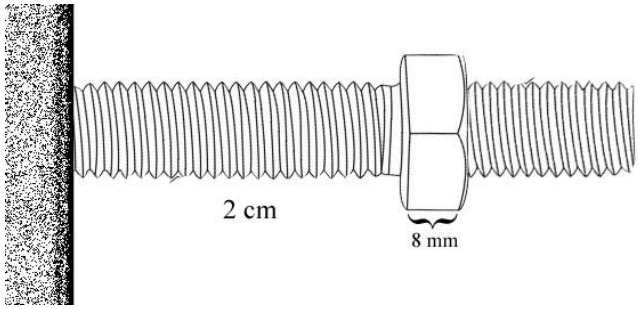
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர) முன்னோடிப் பரீட்சை - 2018
General Certificate of Education (Adv. Level) Pilot Examination - 2018

பௌதிகவியல் Physics	II II

01 E II

Essay

5.



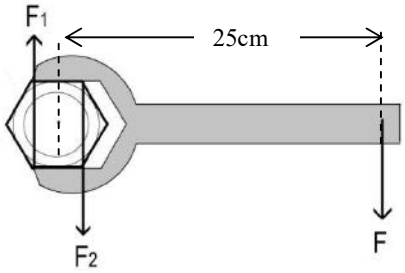
(a) The figure shows a nut of thickness 8mm which is fixed onto a bolt with pitch difference 1mm and 5mm radiusat a distance 2cm from the wall.

i) Calculate the number of pitches found in between nut and the wall.

ii) The nut is rotated in a constant rotational frequency to touch the wall. If the time required for the bolt to just touch the wall is 10 seconds, what is the rotational frequency in rpm?

iii) At that instance, the bolt provides a frictional torque $\tau_b$to the nut. If the torque that should be provided to move the nut is 0.02Nm, then find the frictional torqueτ_b.

(b) Consider the nut being tighten with the wall.



i) The maximum force a bolt could withstand without breaking is 200N. What could be the maximum reaction force present in between nut and wall?

ii) At one instance of tightening the reaction force between nut and wall is 1000N. In this stage, due to the reaction between nut and bolt, bolt gives a frictional torque τ_t in addition to $\tau_b$onto the nut. If the kinetic frictional co-officient between nut and bolt is 0.8, what is the value of τ_t?

iii) If the frictional torque between the nut and wall at a particular moment is 5.99Nm, what is the minimum torque required to tight the nut?

(b) The above calculated torque was given by a nut key below the nut. The nut is hexagonal shaped with side length 2cm. Both the bolt and nut have the same centres.

i) Calculate the force F to be applied.

[See page 12

ii) Suggest one way to reduce the force F further to be applied to nut and bolt system.

iii) Nut key applies two forces on the bolt only in its two ends. Find the two forces F_1 and F_2.

iv)The maximum force which could be experienced by nut without blending the edges is 520N. Is there any possibility for the edges of the nut to be blend? Give reason.

v) To avoid this problem how could you use the nut key in a proper manner?

(d) To tight the nut, the torque to be applied wanted to be reduced. Among the following select the correct methods proposed to reduce the torque.

A- Using thick nuts

B-Using a rubber washers in between nut and bolt

C-Using a nut with higher side length

D-Using nut with lower frictional coefficient between nut and bolt

6.

(a) The figure shows the air column inside a one end closed tube resonates at the fundamental frequency. Length of this tube is *l*.

(i) Give the wavelengths of the air column which resonates at the fundamental frequency and the first overtone with this tube. (Neglect the end errors)

(ii) Give the fundamental frequency, first overtone of this tube if the velocity of sound in air is V.

(iii) State at which point A or B, the pressure change is high when the sanding wave is formed in this tube and draw the graph of pressure variation against time at the point with high pressure change.

(c) External auditory canal of animals is like the one end closed tube above. Ear drum vibrates due to the pressure variation caused due to the vibration of the air column inside the external ear. The electric pulse produced in the internal ear reaches the brain and we sense the sound. A small pressure change is enough for the electric pulse to be produced. The node forms at the ear drum as the pressure change is high at ear drum when the air column inside the external auditory canal resonates with the sound wave. Due to this, the ear is highly sensitive to the frequencies of the sound waves and its nearest values. The graph in figure-1 shows the variation of the least sound intensity level with the frequency sensed by the normal human ear. (Consider the velocity of sound in air as $336 ms^{-1}$)

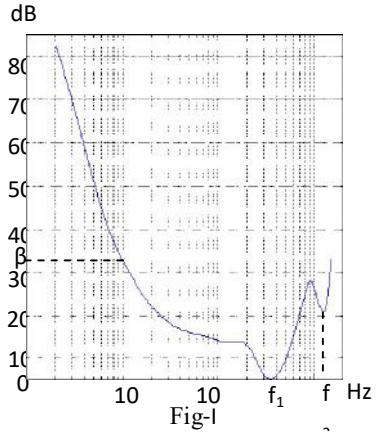


Fig-I

(i) If the length of the external auditory canal is 2.4 cm, calculate the values of f_1, f_2.

(ii) The figure-2 shows the graphs of the variation of sound

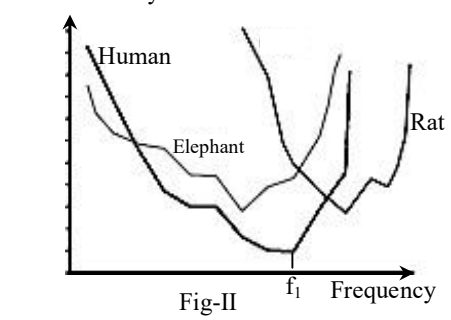


Fig-II

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intensity level with the frequency of elephant and rat by comparing with the human. What is the reason for the values of f_1 frequency corresponding to the both elephant and rat is seen to be like in the graph shown?

(iii) If the least sound intensity of the frequency of 100Hz which can be sensed by the human ear is 2×10^{-9} Wm^{-2}, calculate β. (Consider lg 2 = 0.3)

(iv) If sound intensity **I** of a sound wave in air is given by the equation $2\pi^2 f^2 a^2 \rho v$, find the minimum amplitude of the sound wave of frequency f_1 which can be sensed by the human ear. (Density of air = 1.2 kgm^{-3} and consider $\sqrt{\frac{1}{2.4 \times 336}} = 0.0352$)

(v) If the sound intensity that can produce the pain in human ear is $1Wm^{-2}$, calculate the least sound intensity of the sound wave of frequency f_1 which can produce pain.

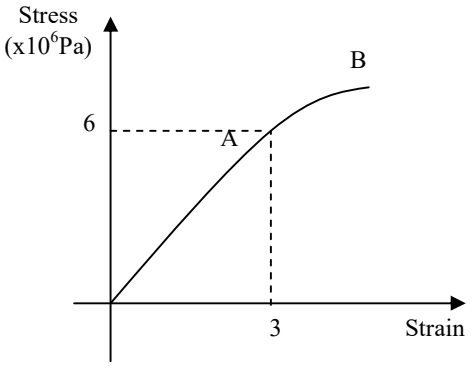
(c) If the least sound intensity level of the sound wave of frequency f_1 which can be sensed by a man with hearing defect,

(i) What is the least sound intensity of the sound wave of frequency f_1 which can be sensed by this man?

(ii) If this man uses a hearing device to sense the sound waves of frequency f_1 at the intensity which can be sensed by the normal humans, by how much times the intensity of the sound energy should be increased by this device?

7.

(a)Resilin is an unusual protein that shows the elastic properties. The above protein can be found in some insects. Stress vs strain curve of the resilin is given below. The given graph suits for both tension and thrust.



i) Identify the points A, B?

ii) Find the young's modulus of resilin?

(b) In an insect, Resilin is attached to the body with its wings. When this insect flies, Resilin get strained when its wings rise and relaxed when the wings come down. Resilin attached with one wing which is 1cm long and with the cross-section area of $1mm^2$ when its relaxed. An insect has 2 wings. Strain caused by Resilin when the insect flies is 3. It emits the elastic potential energy when the wings come down which is gained while the wings go up. 96% of this energy is absorbed by the insect to do work.

i) Calculate the force acting on the Resilin when its strained to 3?

ii) Calculate the amount of energy stored in Resilin attached to one wing?

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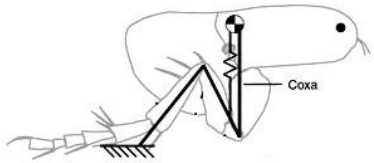
Consider an insect is floating in the air. For this, insect has to flap its wings in the rate of 5 times per second. In this instance work done by insect is against gravitational force.

iii) Find the rate of work done (power) by the insect when it floats in the air?

Consider an insect is flying horizontally with a constant velocity. Here, due to the Bernoulli's principle the amount of work that should be done against gravity is minimized. For all the constant velocities the insect could fly horizontally, 0.064W power is enough to work against the gravitational force. Anyhow due to the presence of air drag force that insect also has to work against it too.

iv) If that insect flaps its wing at the rate of 5 times per second to fly at the velocity of $20ms^{-1}$, then find the value of k?

v) If the insect can flap its wing only up to the rate 10 times per second, what is the maximum velocity the insect could fly horizontally?



(C)Flea have pads made up of resilin in a place called coxa in its posterior legs. Those pads can be considered as a cube of side length 2×10^{-4} m. This insect doesn't have any wings. This insect's locomotive mode is by hopping with the help ofResilin. As shown in the figure Resilin pads functions like a spring, it converts the elastic energy stored by compression into kinetic energy with 92% efficiency and move in a projectile path. The mass of flea is 0.46mg. Normally the maximum compression strain could reach by the flea is 0.5.

i) Calculate the force constant k in one pad of resilin.

ii) Calculate the force in one pad of flea when the strain was 0.5.

iii) What is the maximum velocity the flea could reach?

8.

Pulse Electric Field (PEF) is a technique used in industrial food preparation. Due to this technique microbial disintegration is carried out that is micro-organisms are degraded by this technology. This technology is used to disinfect milk, yogurt, liquid egg and fruit juices until now. It helps to dry some food items also. Unlike other common methods such as ohmic heating microwave heating and Higher Hydraulic Pressure (HHP) , it has high yield. The disinfected food from this method can be maintained for long time than the others.requirement of less time, reduction of nutrition loss arealso the advantages of this method. Limiting enzyme function only to a limitation, only affect vegetative bacteria are some of its disadvantages.

In this method, tubes containing electrodes with the shape very similar to capacitors are used. Electric field is produced by passing liquid foods continuously and applying electric potential difference in the form of pulse between the plates. When the electric field is formed, a potential difference is formed between the inner and the outer surfaces of the cell walls of cells trapped within them. Cell undergoes the irreversible disintegration when the applied electric field strength increases than its critical value (E_c)

The states at second by second.

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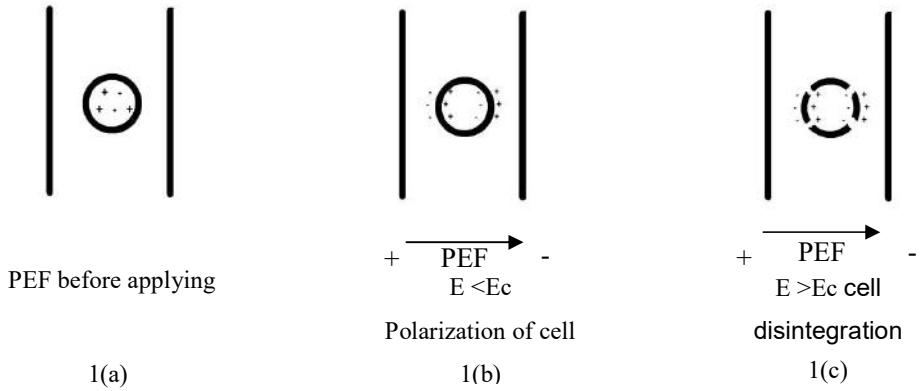


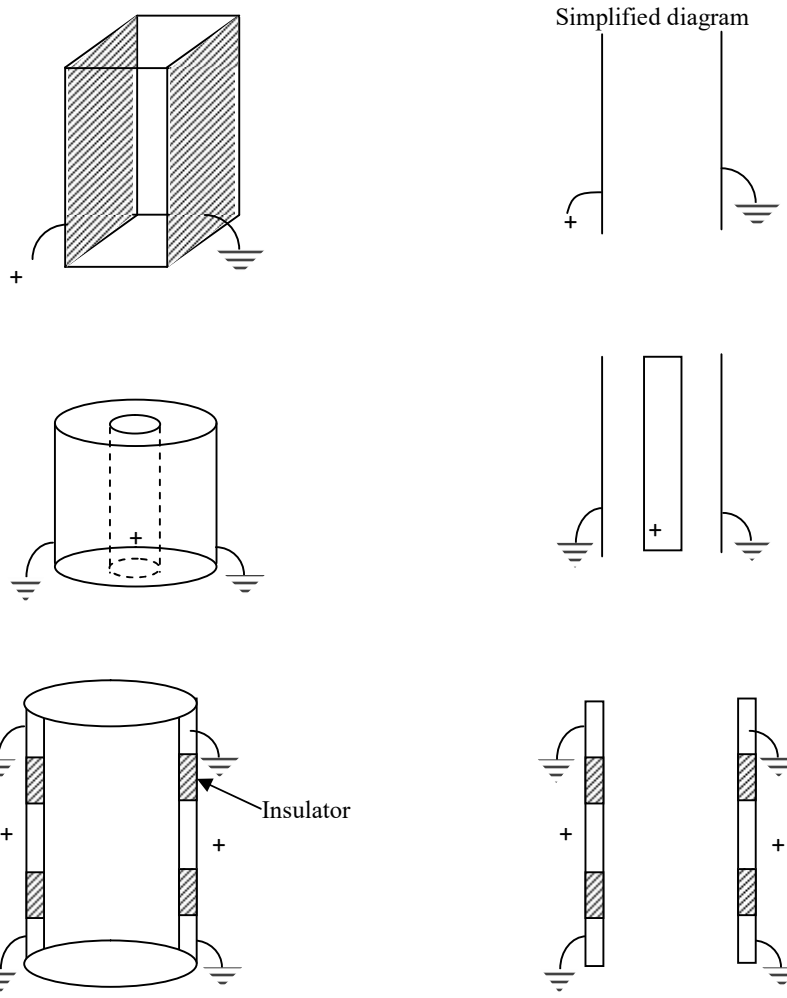
PEF before applying

Polarization of cell

disintegration

1(a) 1(b) 1(c)

The ways of applying electric pulse in between the plates.



Liquid food flow is allowed in the gaps of the above said 2(a),2(b),2(c). Those parts where the electric field is applied is called as treatment chamber. Capacitance of chambers (C) in faraday (F) is given by the equation given below

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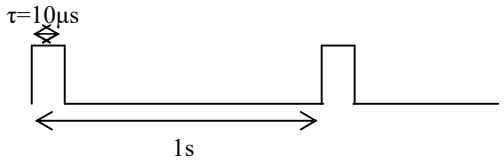
$$C = \frac{\tau \delta A}{d}$$

Here τ is the pulse duration (s),σ-electric conductivity of liquid food, A-cross section area of a plate, d-distance between the plates.

The treatment room used for the treatment of orange juice as in the type of 2(a) has plates of cross section area $0.1m^2$ and distance between plates is 5cm. This juice has an electric conductivity of $0.5\Omega^{-1}m^{-1}$. Electric field strength used here is 20kV/cm. Shape of the pulse used here is shown below. This pulse is applied to the plates in the frequency of 1 Hz.



3.6 tons of liquid food is treated in this room in an hour

(a) Give 2 uses of PEF in the food production?

(b) Give one advantage and disadvantage of using PEF in the production of food?

(c) Explain briefly the way that microbial cell is disintegrated by pulse electric field(PEF).

(d)Copy the sample diagrams of 2(a),2(b),2(c) and draw the electric field lines.

(e) Consider the treatment of particular orange juice,

i) Show that the equation $C = \frac{\tau \delta A}{d}$ is dimensionally correct?

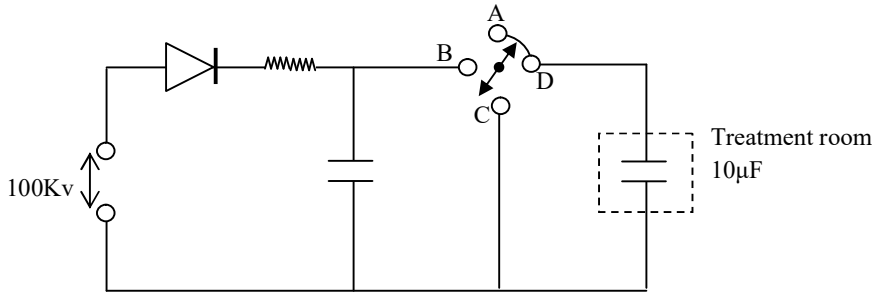
ii) Calculate the capacitance between plates.

iii) What is the potential difference between plates whilethe PEF is passed?

iv) What is the power of the electric energy given to the treatment room?

v) From this, calculate the energy spent for a unit mass of juice in kJ/kg.

(f) Simple diagram of the circuit that produce the electric pulse is given below



i) If electric contact is made between B and D and let to attain stable stage, calculate the charge stored in the capacitor of the treatment room?

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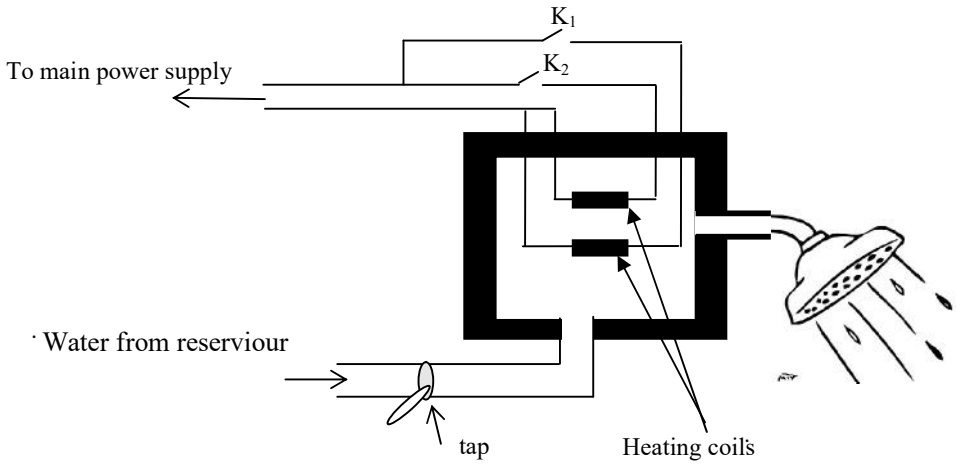
ii) If the rotating part in this rotating switch is rotating with a constant angular velocity, draw the graph for the variation of potential difference across the treatment room?

9. Answer only Part (A) or Part (B)

(A) The simple structure of a shower system which is designed to connect to the main power supply is shown in the figure given below.



The operational system shown in the figure is able to function with one or two heaters of power 3.6kW.

a) What is the current derived from the main power supply when one of two switches k_1, k_2 is closed/ON?
b) Which is the most appropriate fuse which should be connected for the safety in the given 10A fuse, 16A fuse, 31A fuse?
c) This shower is operated averagely for 30 minutes per one day when the both switches k_1, $k_2$are closed. What is the cost for one month of 30 days? (The cost of electric energy of one kilowatt for one hour is Rs.20.00)
d) What is the resistance of one coil when the heater works?
e) During heating, the resistivity of the wire material which made the coil at the operating temperature is 4.5×10^{-7} Ωm and the diameter of the wire is 0.30mm. What is the length of wire in one coil? (Consider the resistivity of the coil made material as 4.5×10^{-7} Ωm)
f) The co-officient of the resistivity of the coil made material is given by $\alpha = \frac{R_\theta - R_0}{R_0 \theta}$ and its value is $\alpha = 7.5 \times 10^{-5} {}^oC^{-1}$.
    (i) What is meant by the R_o considered above?
    (ii) If the temperature of the coil during the operation is 200^0C, calculate the R_o.
g) When the shower works in a certain day, the temperature of the inlet water is 10^0C and the rater of water flow is adjusted to 3.6×10^{-3} m^3min^{-1}. Specific heat capacity of water is $4200 Jkg^{-1}K^{-1}$ and the density of water is $1000 kgm^{-3}$.
    (i) What is the temperature of the outlet water when only one heating coil works?
    (ii) To which value the rate of water flow should be adjusted to equalize the outlet temperature of the water when both two heating coils operate to the value of outlet temperature calculated in above g (i)?
    (iii) Since the temperature of the water is less than 10^0C in cold days, the rate of water flow should be reduced to equalize the outlet water temperature to the value calculated in above g (i). During this, required water was not be able to obtain from the shower in the usage time. It is concluded that lengths of both two heating coils may be reduced to solve

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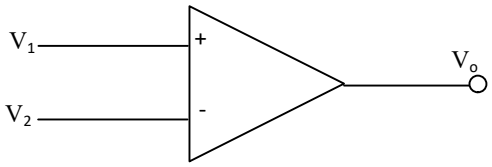
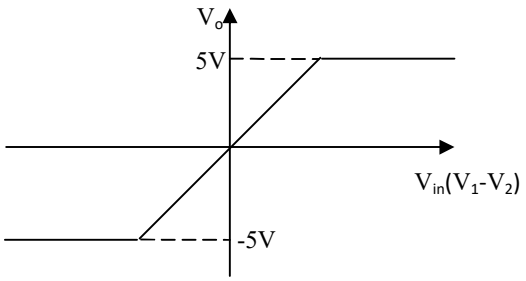
this problem. Describe individually the possibility, distress and the danger of this conclusion.

(B) The figure shows an operational amplifier of open loop gain 10^5 and the graph showing the variation of output voltage (V_0) with the input voltage (Vin). As the input resistance of the operational amplifier is very high, the current flow between the input ends is negligible.



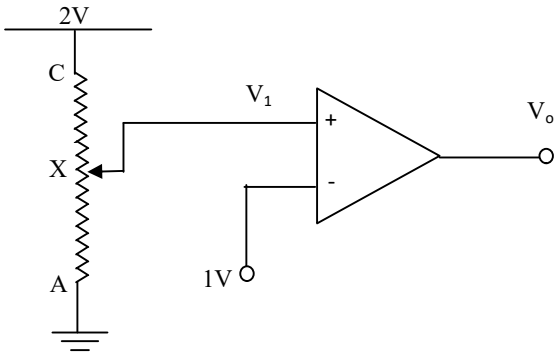


\(a)

(i) Find the minimum positive value (V_{min}) of V_{in} required to saturate this amplifier.

(ii) Find minimum value of V_1 to get the output voltage 5V when $V_2$is 1V and show that it is approximately equal to 1V

(b)



The negative terminal of the above operational amplifier is permanently attached to 1V and the potential at the positive terminal V_1 is changed by moving the positive terminal across the variable resistor AC

(i) If the resistance across AX is $1k\Omega$ in a state in which V_1 is adjusted to be 1V find the value of the resistance across AC.

(ii) Find the resistance across (V_{min}) in a state in which the point X is in the variable resistor such that the minimum input positive potential (V_{min}) to saturate the operational amplifier

(iii) When the V_{in} is increased from zero to V_{min} show that the change in the resistance across the AX is negligible compared to the change in resistance across AC.

(c)

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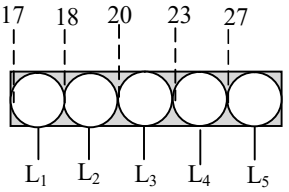
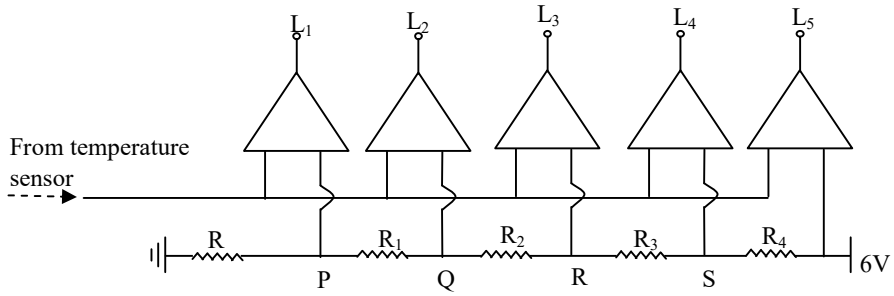
The rent for a room in a hotel which consist of many rooms is determined by a basic rent and some additional rents. In these additional rents, one is determined by the temperature and the time of operation of air conditioner. This rent is determined as certain amounts for certain temperature intervals.



This temperature intervals are observed by the number of glowing LED s. A computer joined with a sensor which detects the time of glow and the number of glowing LED calculates the additional rent. The corresponding LED s for each room are found inside a control room. The below figure shows a system of LED inside the control rooms. When the temperature of the room is increased the number of glowing LED increases and the temperature at which a LED starts to glow can be obtained from the temperature scale at the left side to that LED. At temperatures above 27°C, all LED s light up and at temperatures below 17°C all LED s go off. An operational amplifier circuit designed to satisfy this need is given below. The positive saturation voltage 5V of this operational amplifier is used to light up the LED column



When the temperature increased by a °C the potential got from the temperature sensor is increased by 500mV. Value of R, R_1, R_2, R_3, R_4 are selected in simple ratios for the proper function of LED s

(i) Should the positive terminal or negative terminal of the operational amplifier be connected to the potential from the temperature sensor for the proper function of the LED system?

(ii) What is the potential obtained from the temperature sensor at the instance L_5 starts to glow or fade off?

(iii) Give the potentials to be present on P, Q, R, S from the proper function of the LED

(iv) Give the value of R_1, R_2, R_3, R_4 for the proper operation of the LED

(v) If the values of resistors are adjusted such that current from power source is 1mA then find the value of R.

(d) The above room also consists a fan and a electric bulb which can operate together with that air conditioner. In this room when the air conditioner is operating electric bulb should be lighted up and the fan should be stopped. But when the air conditioner is stopped electric bulb and fan should be operated with their corresponding switches. When the air conditioner is off the fan should automatically operate when the light is turned on. Prepare a truth table for the operation of the above equipmentstaking A=1 when air conditioner is on , B=1 when the switch for the bulb is on , C=1 when the switch for the fan is on , F_1=1 when fan is operating and F_2=1 when the bulb is glowing.

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10. Answer only Part (A) or Part (B)

(A) The rate of heat generated during the body metabolic activity inside a marathon race athlete who is ready to run from rest of mass 60kg is 300W. The average environmental temperature is 30^0C in that particular day. At that instance, body temperature is maintained constant at 38^0C. After she started to run, the average rate of generation of body heat has raised by 840W.

(a) What is the reason for the body temperature to be greater than the environmental temperature?

(b) What is the rate of heat loss from the body when the athlete is at rest?

(c) What is the average rate of increase of body heat after started to run?

(d) Consider that the heat loss from the body according to Newton's cooling law, what is the maximum temperature which she will attain during the running period?

(e) Few cells (brain cells) may die inside the body when the body temperature reaches closer to 46^0C. So, in instances like this to lose the heat to the environment in high amount without raising the body temperature, water is released from the body and heat loss through the vaporization. During this process, body maintains its temperature at 44^0C.

(i) What is the rate of heat loss from body according to Newton's cooling law when the body temperature is maintained at 44^0C?

(ii) What is the minimum mass of water to be vaporized from the body to maintain the body temperature at 44^0C?

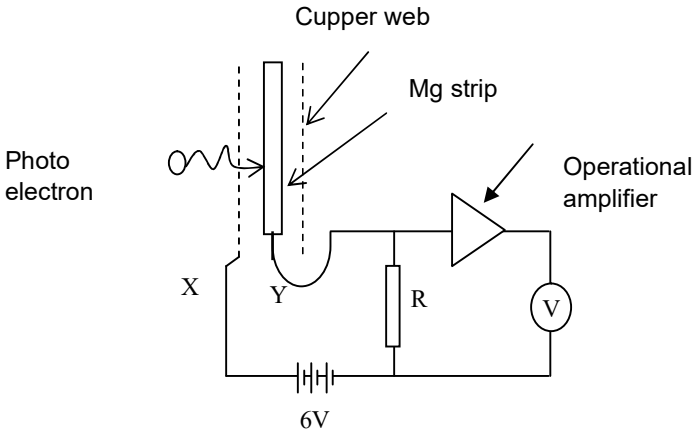
(iii) What is the assumption you have taken in the above (e) (ii)?

(f) The surrounding temperature in her running track is 30^0C and when she goes through a forest area, the body is able to maintain its temperature just above 44^0C. What is the possible reason for this?
(g) Race encouragers spray water on the marathon athletes. Give one advantage and one disadvantage caused by this.

Specific heat capacity of body = $4200 Jkg^{-1}K^{-1}$

Latent heat of vaporization of water at 44^0C = $2.025 \times 10^6 Jkg^{-1}$

(B) Give the Einstine's photo electric equation and determine the symbols.



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(a) Figure shows the Mg ribbon surrounded by Cu web. The ribbon and the cylinder are connected to 6V electric cell across a resistor R. An amplifier and a voltmeter are connected to amplify and to measure the potential difference across resistance.

Plank constant=6.6×10^{-34}Js, Velocity of electromagnetic waves in vacuum =$3\times10^{8}ms^{-1}$

i) It is confirmed that the electric current flow through resistance R when Mg ribbon is lighted with Hg lamp of wane length 254nm by showing the reading of voltmeter. Explain the way how the electric current is produced.

ii) Identify the terminals X, Y of the photoelectric cell.

iii) What is the use of 6V electric cell in this circuit?

iv) R=10Ω, input resistance of amplifier is $10^{6}\Omega$, voltage amplification of the amplifier 10^{5}. Voltmeter shows a reading of 1V when mercury light falls on electric cell. What is the number of electrons released in a unit time by this light?

(b) Calculate the energy of mercury light photons corresponding to the following wavelengths

(i) 254nm

(ii) 546nm

(c) Give your observations regarding the voltmeter reading in the following different instances of this experiment. Wavelength of mercury lamp light wave is 254nm, work functions of Mg and brass are 2.80eV and 5.05 eV respectively.

(i) Changing the terminal of electric cell
(ii) Bring the mercury light lamp away from Mg ribbon
(iii) Increasing the wavelength of light wave emitting from mercury light lamp as 546nm
(iv) Increasing electromotive force of electric cell as 10V
(v) Using brass ribbon instead of Mg ribbon

**** END OF QUESTIONS ****

No questions in this page

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