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Provincial Department of Education - NWP

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Third Term Test - Grade 13 - 2024

Physics I

Two hours

Instructions:

- *This question paper consists of 50 questions in 10 pages.*
- *Answer **all** the questions.*
- *Write your **index number** in the space provided in the answer sheet.*
- *Read the instructions given on the back of the answer sheet carefully.*
- *In each of the question **1 to 50**, pick the 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.***

Use of calculators is not allowed.

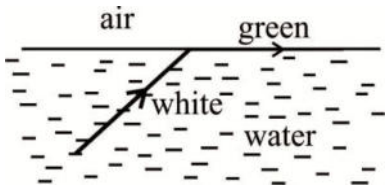
($g = 10\ m\ s^{-2}$)

1. The gravitational constant G has the derived units:
   (1) N m (2) N m kg^{-1} (3) N kg m^{-1} (4) N m^2 kg^{-2} (5) N kg^2 m^{-2}2

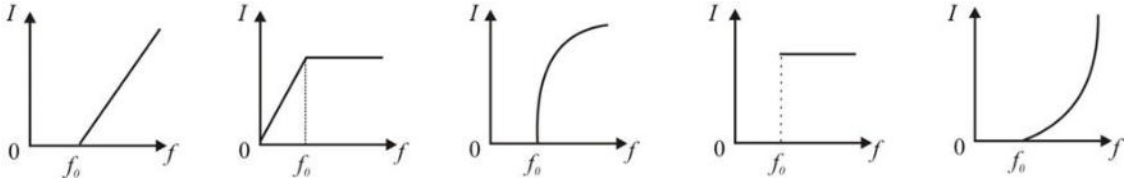
2. "An object completely submerged in a fluid displaces its own volume of fluid". This is:
   (1) Law of floatation (2) Archimedes' principle (3) Pascal's principle
   (4) False (5) true, but none of the above

3. Which of the followings is not a fundamental particle according to the standard model?
   (1) Electron (2) Positron (3) Photon (4) Mesons (5) Lepton

4. White light is incident on the interface of water and air as shown in the figure. If green light is just critically refracted. Then the emerging ray in air contains.
   (1) Yellow, orange, red
   (2) Violet, indigo, blue
   (3) All colors except green
   (4) Red only
   (5) All colors



5. A monochromatic light beam is incident on a photosensitive surface of a photo cell. If the intensity of the incident beam is not changed, which of the following graphs best represents the variation of photo current (I) of with the frequency (f) of the incident light. ($f_0$represents the threshold frequency of the photosensitive material),



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

6. Consider the following statements regarding the working of a transformer:

(A) A transformer works on the principle of electromagnetic induction.

(B) A transformer can change both the voltage and frequency of an alternating current.

(C) The efficiency of an ideal transformer is 100%.

Of the above statements:

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

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

7. The sum of the kinetic and potential energies of a system of objects is conserved:

(1) only when no external force acts on the objects.

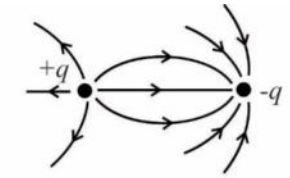
(2) only when the objects move along closed paths.

(3) only when the work done by the resultant external force is zero.

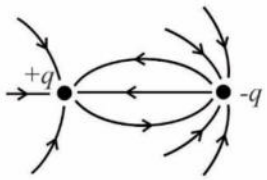
(4) always.

(5) none of the above.

8. Which of the following shows the correct spread of electric field lines?



(1)



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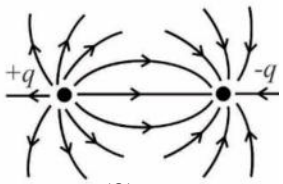

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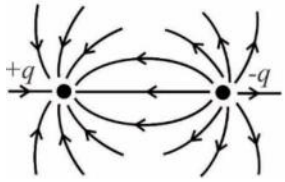
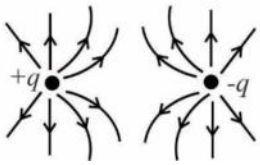


(4)



(5)

9. The magnitude of the torque acting on a current-carrying single loop of wire in a uniform magnetic field is determined by:

(1) the magnetic flux density, the current, the area of the loop, and the angle between the magnetic field and the loop only.

(2) the magnetic flux density, the current, and the area of the loop only.

(3) the magnetic flux density, the current, and the angle between the magnetic field and the loop only.

(4) the magnetic flux density, the current, and the length of the loop only.

(5) the magnetic flux density and the area of the loop only.

10. Consider the following statements about the electrostatic induction.

(A) Only insulators can be charged with electrostatic induction

(B) When charge with electrostatic induction object must be grounded.

(C) An object can be charged only as negative with electrostatic induction.

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

11. X-ray diffraction (XRD) is used for

(1) See high resolution images of small particles.

(2) Kill germs and bacteria in food items.

(3) Recognize damages and cracks in metal tubes.

(4) Determine the crystalline structure of protein and minerals.

(5) Determine the age of universe.

12. Two rods A and B having lengths l_1 and l_2 respectively, and same cross-section have thermal conductivities K_1 and K_2 respectively. They are placed in back to back contact and a constant temperature difference is maintained across the combination. If the system is well lagged, the ratio of the quantities of heat flowing through A and B in a given time at the steady state is

(1) $\frac{K_1}{l_1} : \frac{K_2}{l_2}$ (2) $\frac{K_1}{l_2} : \frac{K_2}{l_1}$ (3) $K_1 : K_2$ (4) $l_1 : l_2$ (5) 1: 1

13. A simple pendulum of length L and mass M has frequency f. To increase its frequency to $2f$:

(1) increase its length to $4L$ (2) increase its length to $2L$ (3) decrease its length to $\frac{L}{2}$

(4) decrease its length to $\frac{L}{4}$ (5) decrease its mass to $\frac{M}{4}$

14. Consider the following statements regarding the Hall effect:

(A) The Hall voltage is proportional to the strength of the magnetic field applied perpendicular to the current.

(B) The Hall Effect can be used to determine the type of charge carriers in a metal.

(C) The Hall voltage is zero when the magnetic field and the current are perpendicular.

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.

15. Three vectors $\underline{a}$, $\underline{b}$ and $\underline{c}$ are such that $\underline{a} + \underline{b} + \underline{c} = 0$ their magnitudes are denoted by a , b and c respectively. Which of the followings are possibly true about these vectors?

(A) $a^2 + b^2 = c^2$ (B) $a + b = c$ (C) $|\underline{a} - \underline{b}| = r$

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

(4) Only (A) and (C) (5) All (A), (B) and (C)

16. Consider the following statements on wave fronts.

(A) The wave front is the figure obtained by connecting all the points which are in phase on waves generated by a source.

(B) The wave propagates perpendicular to the wave fronts.

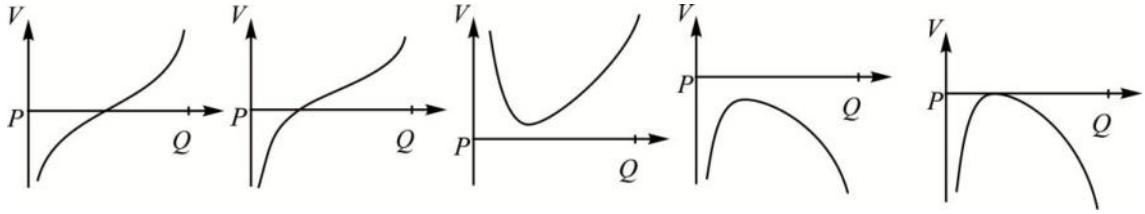
(C) Wave fronts generated by a point light source are spherical.

Of the above statements.

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

(4) Only(A) and (C) are true. (5) Only(B) and (C) are true.

17. The line PQ connecting the surface of the Earth E and the moon M is given by the following figure. Which of the followings best represents the variation of gravitational potential V along the line PQ?



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

18. The following equations represent some typical nuclear reactions: -

(I) ${}^{9}_{4}\mathrm{Be} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{6}_{3}\mathrm{Li} + {}^{4}_{2}\mathrm{He}$

(II) ${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$

(III) ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{148}_{57}\mathrm{La} + {}^{85}_{35}\mathrm{Br} + 3\ {}^{1}_{0}\mathrm{n}$

Which of the following descriptions of these reactions is/are correct?

(A) Reaction (I) represents a α-decay.

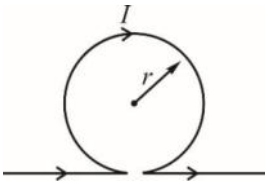
(B) Reaction (II) represents a nuclear fusion.

(C) Reaction (III) represents a chain reaction.

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

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

19. A long straight conductor, carrying a current I, is bent into the shape shown in the figure. The radius of the circular loop is r. The magnetic field at the centre of the loop is



(1) $\frac{\mu_0 I}{2r}\left(1+\frac{1}{\pi}\right)$ into the page (2) $\frac{\mu_0 I}{2r}\left(1-\frac{1}{\pi}\right)$ out of the page

(3) $\frac{\mu_0 I}{2r}\left(1-\frac{1}{\pi}\right)$ into the page (4) $\frac{\mu_0 I}{2r}\left(1+\frac{1}{\pi}\right)$ out of the page

(5) zero

20. Which of the following/s is/are Free of chromatic aberration?

(A) convex lens
(B) concave lens
(C) prism
(D) plane mirror.

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

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

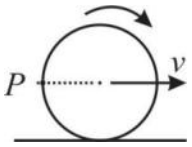
21. In an astronomical telescope, under normal adjustment, which of the following statements is/are correct?
(A)The first image is formed at the focal plane of the objective.
(B)The first image is real and inverted.
(C)The focal length of the objective is longer than that of the eyepiece.
(1) (A) only (2) (C) only (3) (B) and (C) only
(4) (A) and (B) only (5) (A), (B) and (C)

22. Consider the following statements regarding the speed of sound
(A) It decreases with the increment of density in **any medium** under constant temperature.
(B) Speed of sound increases with an increase in temperature when the medium is kept at constant pressure.
(C) Speed of sound is independent of the frequency of the sound wave.
(1) Only (A) is true. (2)Only (B) is true. (3) Only (C) is true.
(4) Only (B) and (C) are true (5) All (A), (B), and (C) are true.

23. Which of the following statements about logic gates is not correct?
(1) An AND gate outputs a high signal only when all its inputs are high.
(2) A NOT gate inverts its input signal.
(3) A NOR gate outputs a low signal only when all inputs are high.
(4) An XOR gate outputs a high signal when both inputs are the same.
(5) A NAND gate outputs a low signal only when all inputs are high.

24. When a fluid passes through the constricted part of a pipe, its
(1) Velocity and pressure decrease
(2) Velocity and pressure increase
(3) Velocity decreases and pressure increases
(4) Velocity increases and pressure decreases
(5) Velocity and pressure remain unchanged.

25. A uniform wheel rolls horizontally along the ground without slipping. The speed of the centre of mass of the wheel is v. The instantaneous speed of point P on the circumference and on a horizontal line through the center relative to the ground is



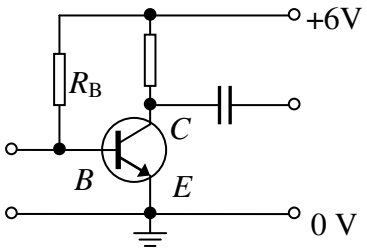
(1) v (2) $\frac{v}{\sqrt{2}}$ (3) $\sqrt{v}$ (4) 2 v. (5) zero.

26. An Object A, with heat capacity C_A and initially at temperature T_A, is placed in thermal contact with an object B, with heat capacity C_B and initially at temperature T_B. The combination is thermally isolated. If no phase changes occur, the final temperature of both objects is:

(1) $\frac{C_A T_A - C_B T_B}{C_A + C_B}$ (2) $\frac{C_A T_A + C_B T_B}{C_A + C_B}$ (3) $\frac{C_A T_A - C_B T_B}{C_A - C_B}$

(4) $\frac{C_A - C_B}{T_A - T_B}$ (5) $\frac{C_A + C_B}{T_A - T_B}$

27. The figure shows a typical voltage-amplifier circuit built from a transistor with current gain 90. It operates normally on a collector current of 3 mA and with the base-emitter junction voltage V_{BE} = +0.7 V. What should be the value of the base resistor R_B?

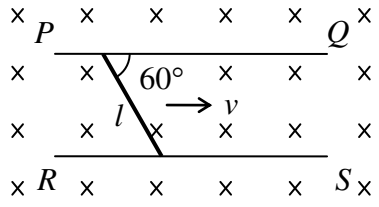


(1)128 kΩ (2)159 kΩ
(3)144 kΩ (4)176 kΩ
(5) 199 kΩ

28. A wave of frequency 500 Hz has a velocity 360 m s^{-1}. The distance between two nearest points which are 60° out of phase, is
(1)1.2 cm (2)12 cm (3) 120 cm (4)7 cm (5)70 cm

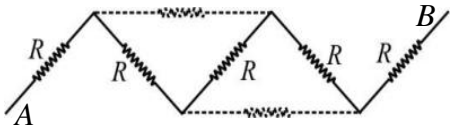
29. In an experiment to determine the specific heat capacity of a metal using the method of mixtures, a student obtained a value for the specific heat capacity that is higher than the standard value. The student explained this result with the following reasons:
(A) Heat may have been lost to the surroundings before the metal was transferred into the calorimeter.
(B) The initial temperature of the metal may have been reported higher than the actual temperature.
(C) The calorimeter may not have been properly insulated, allowing heat exchange with the environment.
Of the above statements,
(1) only A can be accepted. (2) only B can be accepted.
(3) only A and B can be accepted. (4) only B and C can be accepted.
(5) all A, B, and C can be accepted.

30. A metal rod of length l is inclined at 60° to rail PQ as shown. It is moved across a uniform magnetic field along the direction of the two horizontal rails PQ and RS. If the rod moves with a uniform velocity v and the flux density of the field is B, the e.m.f. induced in the rod is



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

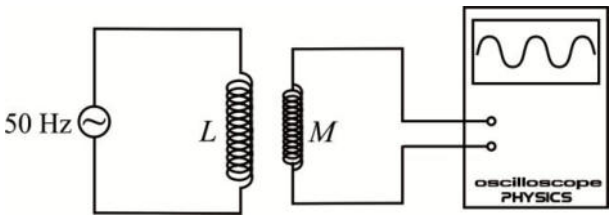
31. Five resistors are connected as shown in the figure. What will be the **change** in resistance between A and B if two similar conductors as shown in the figure by dotted lines are added? Resistance of each conductor is R.



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

32. A coil *L* is connected to a 50 Hz alternating supply of constant peak voltage. It is placed closer to a separate coil *M* which is connected to an oscilloscope as shown in the figure. Then the screen of the oscilloscope shows a sinusoidal trace.

Coils are then wrapped around a soft iron core which can be used for a transformer. If the oscilloscope scale has not been changed, then what effect can be expected?



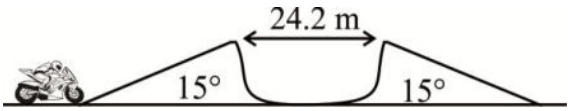
	Amplitude of the wave	**number of waves on the screen.**
(1)	Increases	Increases
(2)	Increases	unchanged
(3)	Unchanged	Decreases
(4)	Decreases	Unchanged
(5)	Unchanged	Unchanged

33. A Plastic ball is floating on a liquid whose temperature is raised continuously. With the expansion of the liquid, the up thrust on the floating ball
(1) remains unchanged (2) Increases,
(3) Decreases (4) first decreases and then increases
(5) Can't predict without density and coefficient of expansion of the liquid.

34. A submarine is armed with a SONAR (sound navigation and ranging) system. It helps to detect moving objects around the submarine. The operational frequency of the sonar is 42 kHz. When this submarine is at rest a torpedo (a self-propelled underwater missile) is moving with 200 m s^{-1} towards the submarine at rest. If the speed of sound in water is 1400 m s^{-1}what is the frequency of the wave received by sonar due to the reflection of wave from the torpedo?
(1) 36 kHz (2) 42 kHz (3) 48 kHz (4) 56 kHz (5) 64kHz

35. A lens of focal length 20 cm has an object of height 3.0 cm placed 100 cm in front of it. The image formed is
(1) Upright and smaller than the object (2) inverted and smaller than the object.
(3) Inverted and larger than the object. (4) upright and larger than the object.
(5) Upright and the same size as the object.

36. The rider shown in the figure is going to cross create of width 24.2 m. The minimum velocity he must achieve to make this effort successful is (neglect the air resistance and dimensions of the bike.)



(1) 16.3 m s^{-1} (2)22 m s^{-1} (3) 25m s^{-1} (4) 28m s^{-1} (5) 30m s^{-1}

37. The dew point of certain mass of air at 27 °C is 22 °C. The SVP of water at 22 °C and 27 °C are 12.6 mm of Hg and 17.5 mm of Hg respectively. The relative humidity of this volume of air is
(1) 82 % (2)72% (3) 62% (4) 52% (5) 42%

38. When a ray of light is refracted by a prism such that the angle of deviation is minimum, then

(A) the angle of emergence is equal to the angle of incidence

(B) the refracted ray is always parallel to base of the prism.

(C) the ray is symmetric around the refracting angle.

Of the above statements

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

(4) Only (A) and (C) are true. (5) Only (A) and (B) are true.

39. Which of the following statements about a battery is correct?

(A) The electromotive force of a battery is the maximum potential difference between the terminals of the battery.

(B) As a dry cell ages, its internal resistance goes up.

(C) Output power of a battery is maximum when the external resistance is minimum.

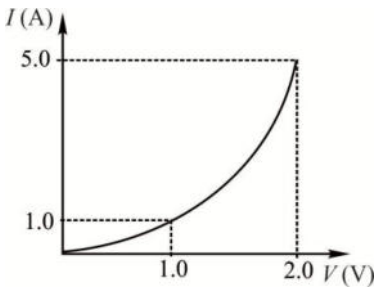
(1) Only (A) (2) Only (B) (3) Only (A) and (B)

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

40. Two spherical soap bubbles have radii 40 mm and 60 mm. They coalesce so that they share a common surface. If the radii of the bubbles remain unchanged, the radius of curvature of the common surface is, (assume that the radius of the spheres except at the common surface and pressure and temperature of the bubbles remain unchanged.)

(1) 40 mm. (2) 50 mm. (3) 60 mm. (4) 120 mm. (5) 240 mm.

41. The variation of current with the voltage applied across a non ohmic conductor is as shown. What is the change in resistance of the device when the voltage increases from 1.0 V to 2.0 V?



(1)It decreases by 0.25 Ω.

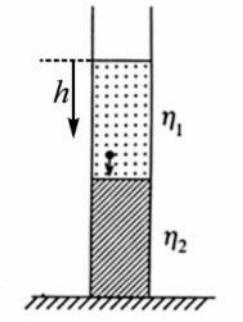
(2) It increases by 0.25 Ω.

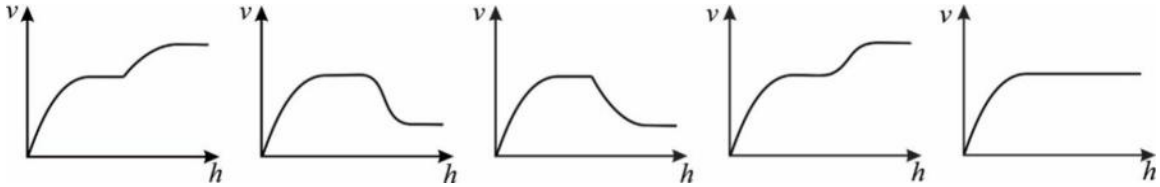
(3)It decreases by 1.50 Ω.

(4) It increases by 0.60 Ω.

(5)It decreases by 0.60 Ω.

42. A small sphere is released from rest at the top of a tall container of two immiscible liquids as shown in the figure. The coefficient of viscosity of the top liquid is η_1 while that for the bottom liquid is $\eta_2 (<\eta_1)$. Which of the followings graph shows how the speed of the sphere varies with the depth of the liquid (till it reaches the bottom)? Assume that the depth of each liquid is sufficient to reach the terminal velocity and the density of the sphere is greater than the density of both liquids.

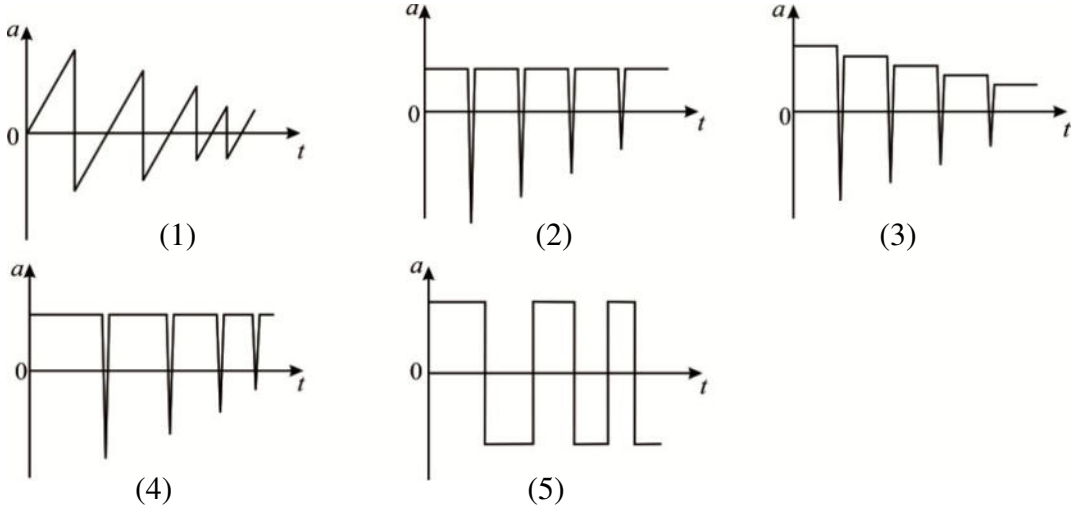




(1) (2) (3) (4) (5)

43. A capacitor has a capacitance of 1 F. Which of the following deductions must be correct?
(A) It stores 1 C of charge at a potential difference of 1 V.
(B) It gains 1 J of electrical energy when it has 1 C of charge.
(C) It will be fully charged in 1 s id a constant current of 1 A is sent.
(1) (A) only (2) (C) only (3) (A) and (B) only
(4) (B) and (C) only (5) (A), (B) and (C)

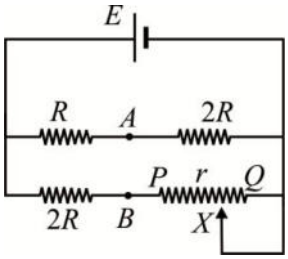
44. A rubber ball is released from rest on to a hard floor from a certain height and bounces several times. Which graph represents the variation of its acceleration a with time?



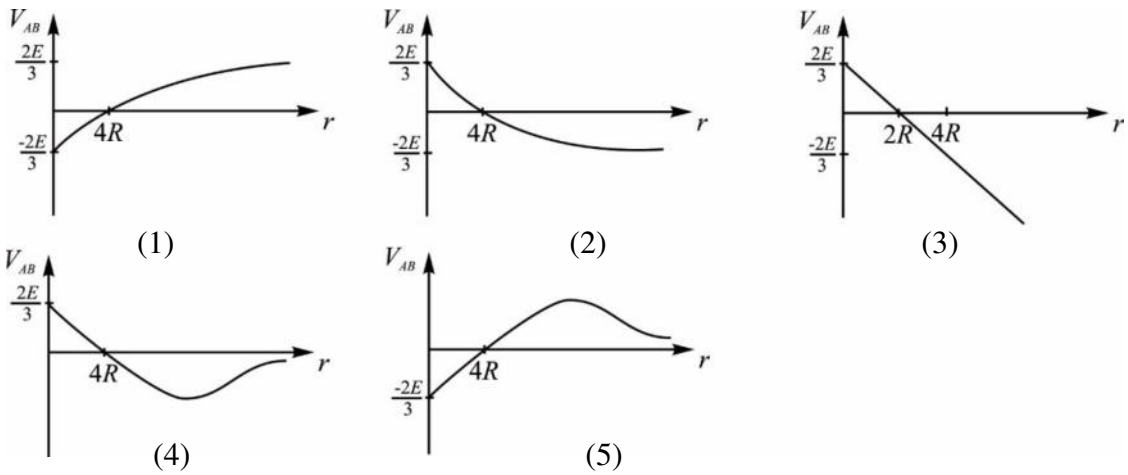
(1) (2) (3) (4) (5)

45. Two wires X and Y of the same length and of the same metal are each stretched to the same tension. The diameter of wire X is half that of wire Y. The ratio of the elastic potential energy stored in wire X to that stored in wire Y is
(1)1 : 1. (2)1 : 2. (3)1 : 4. (4)2 : 1. (5)4 : 1.

46. Three fixed resistors and a variable resistor of resistance r are connected to a battery of e.m.f. E, with zero internal resistance as shown in the figure. X is a pointer which can be used to change the value of r. Assume that r can be changed from zero to extremely high value.

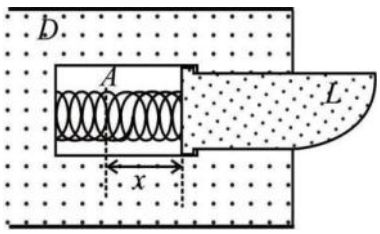


The variation of the potential difference (V_{AB}) between points A and B with r is best represented by

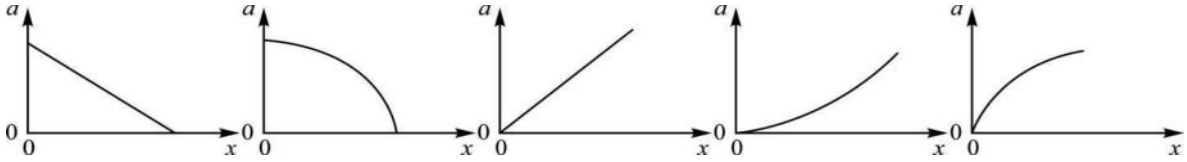


(1) (2) (3) (4) (5)

47. The given diagram shows a spring-operated latch fitted in a door. *D* is the cross section of door, *L* represents the latch and *A* is the position where the latch starts to move. The mechanism is well-lubricated so that the friction can be neglected. The latch is pushed in and then released suddenly. The spring remains within its elastic limit throughout the motion.



Which of the following graphs best shows the variation of the acceleration *a* of the latch with the distance *x* moves before it is stopped?

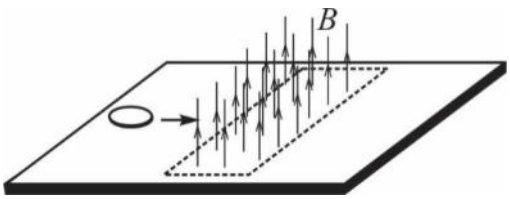


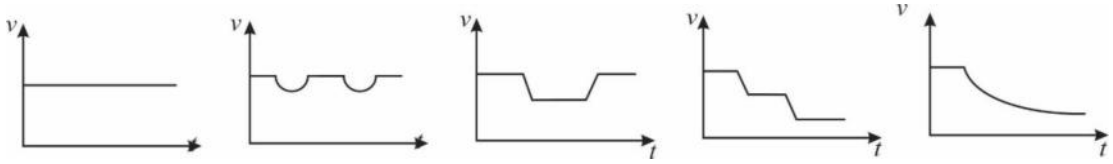
(1) (2) (3) (4) (5)

48. A violin sting is tuned at a location where the speed of sound in air is 345 m s^{-1}, such that the frequency of the note exactly 391 Hz when played unfingured. A violinist vibrated a tuning fork of frequency 391 Hz together with violin sting and hears zero beats. Violinist plays the same string at a different location where the speed of sound is 360 m s^{-1}. However, assume that the frequency of the tuning fork is still remaining exactly at 391 Hz at the new location. If the tuning fork is sounded simultaneously with the same violin string (unfingured) in the new location, how many beats per second will the violinist hear?

(1)17 (2) 13 (3) 9 (4) 5 (5) zero

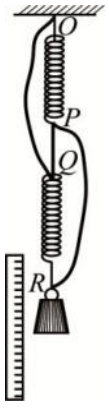
49. A copper coin slides on a horizontal frictionless table. There is a square region of constant uniform magnetic field perpendicular to the table, as shown. Which graph correctly shows the speed *v* of the penny as a function of time *t*?





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

50. Two identical springs are attached to a mass as shown in the figure. Springs are connected by the light inelastic string *PQ*. *OQ* and *PR* are two light inelastic identical strings which are initially loose. If *PQ* string is suddenly cut,



(1) The mass will move down and comes to equilibrium.
(2) The mass will move up and comes to equilibrium.
(3) The mass will stay at the same position and comes to equilibrium.
(4) The mass will fall off.
(5) Upward or downward movement of mass depends on the spring constant *k*.

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Provincial Department of Education - NWP

තෙවන වාර පරීක්ෂණය - 13 ශ්‍රේණිය - 2024

Third Term Test - Grade 13 - 2024

Examination No.: .....

PHYSICS - II

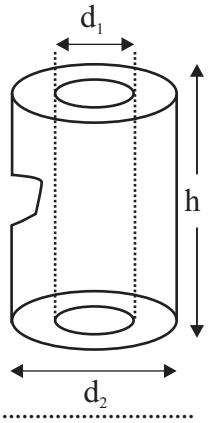
Time : 03 hours

Extra reading time 10 minutes

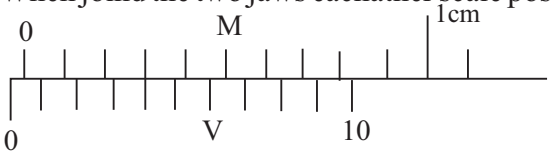
- **Answer for all questions.**

PART A - Structured Essay

(01) You are provided brocan cylinder with cavity and vernier calliper.



(a) When joind the two jaws eachather scale position is given below.



Find the zero error of the instrument.

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(b) (i) Which part of the instrument used to find the diameter of the cavity.

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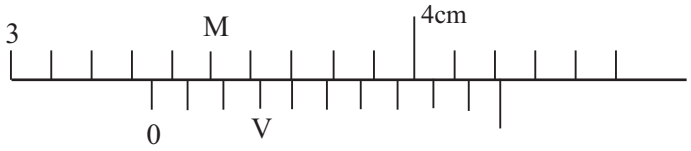
(ii) When adjust the instrument for that, relevant scale position is given below. What is the reading of it. Give it by cm.



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(iii) Find the correct value of d_1 by cm.

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(c) (i) Which part of the instrument used to find it outer diameter.

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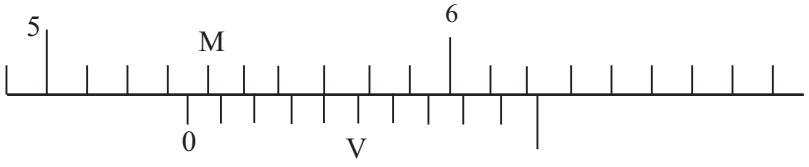
(ii) When adjust the jaws for that, relevant scale position is given below. What is the reading of it. (give it by cm)



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(iii) Find the correct value of d_2 by cm.

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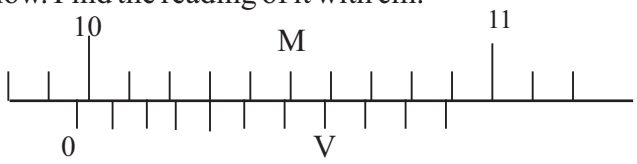
(d) (i) For measure the hight *h* of the cylinder when it hold the two jaws, scale position is given below. Find the reading of it with cm.



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(ii) Find the correct value of *h* by cm.

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(e) (i) Before the damage of the cylinder write down the expression for volum V of material which made of it, using d_1 , d_2 and *h*.

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(ii) Find the value of V with cm^3 using above obtain result get $\pi = 3$.

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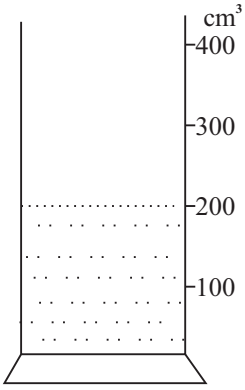
(f) (i) When damage cylinder totally immerse the given measuring cylinder, water level goes up from $200cm^3$ to $300\ cm^3$. Find volume V_d of the damage cylinder.



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(ii) How much the volume of removed by damage of the cylinder (give with cm^3)

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(iii) If density of the cylinder is made of $2500kgm^{-3}$ find the mass of removed part with gram.

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(02) Resonance phenomenon can be used to determine the speed (V) of transverse waves in a sonometer wire being kept under constant tension.

(a) (i) Considering vibrating amplitude and length draw the nature of fundamental mode and first over tone in a stretched wire.

(ii) What is the reason, you have drown amplitude as above two situation.

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(b) (i) If fundamental resonance length was got as l by the f frequency tunin fork get the expression for velocity (V) of transfers wave in a wire.

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(ii) Rearrange that expression to plot the graph where the dependant variable is not a reciprocal of a measurement.

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(c) (i) Teacher instruct to the children before start the experiment cheack, can be get the reading for fundermental tone for longer tuning fork. What is the reason for it.

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(ii) Fundermental vibration is easilly observe for all tuning fork, than over tone of it. What is the reason for this.

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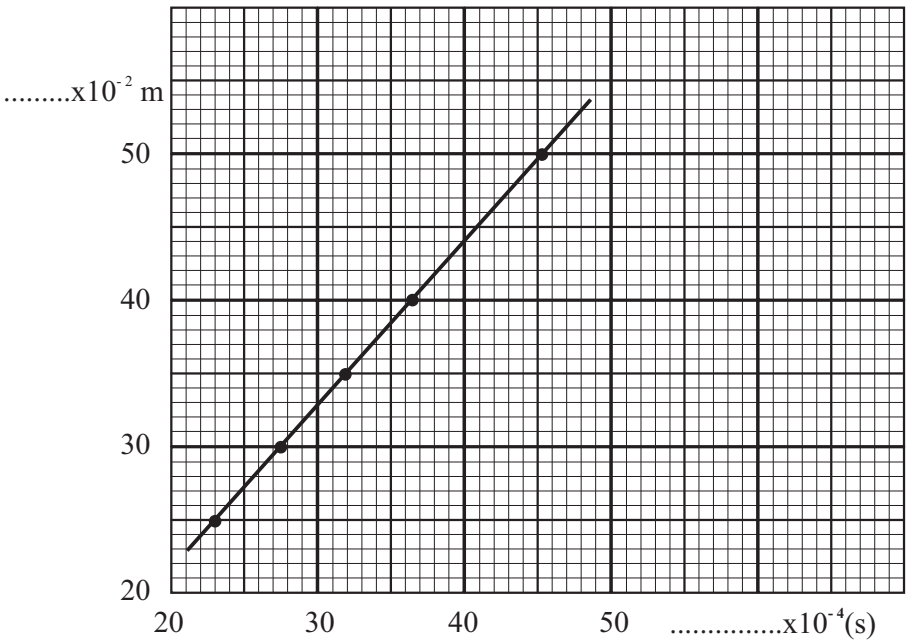
(d) Obtain graph by the student is given below.



(i) Lable the axis of the graph

(ii) Mark the more suitable two point on the graph to find the gradient.

(iii) Get the gradient of the graph (simplicaion is not necessary)

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(iv) Calculate the value of V. (give the nearest digit)

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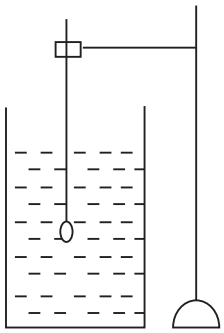
(e) What are the erras at getting the resonance length *l*.

1. .....

2. .....

(03) Figur shows a uncompleted set-up to determine the dew point of air in the laboratory experimentally and determine its relative humidity.



(a) Write down the expression for relative humidity RH, using saturated Vapor pressure at room temperature P_s and saturated Vapor pressure at dew point P_d.

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(b) (i) Underline the move suitable thermometer for this experiment in given bellow.

1) 0 - 50 °C 2) 0 - 100°C 3) 0 - 200 °C

(ii) What is the reason for your selection.

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(iii) Draw the most important instrument not mentioned in the diagram.

(c) (i) Moisture level around the calorimeter altering by the exhale air is disturbed to get the move accurate result. What is the precautions that you would take to minimize them.

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(ii) Insterd of this state the main factor for disturb the formation of the dew and give how to minimize it.

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(d) Lowering the temperature of water must be done controlled manner. For this what procedure are you follow.

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(e) To get the more accurate value reading must be get two situation and get the mean value of it what are they.

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(f) At this experiment calorimeter is used with a lid or without a lid. Give the reason.

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(g) What is the other reading that you should take in this experiment.

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(h) When the temperature of a certain laboratory was 25°C, it's dew point was found to be 21 °C using the following table determine the relative humidity of the laboratory. (Give the nearest digit)

temperature °C	17	19	21	23	25	27	29
Saturated water vapour pressure mm Hg	15.58	16.83	18.32	21.38	24.42	26.32	29.35

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(i) There are more student in the room, which experiment is done. How to depend it result of the experiment.

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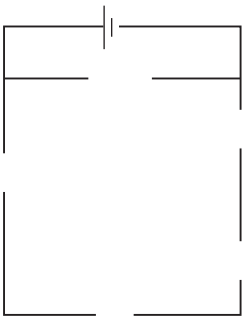
(04) The given uncompleted circuit can be used in a school laboratory to experimentally determine the e.m.f. (E) and the internal resistance (r) of a dry cell.



(a) (i) Given digital voltmeter (V) and milli ammeter (mA) connected to the suitable place of circuit.

(ii) Mark the polarity of them.

(iii) Connect the rheostat to the suitable place by using symbol.

(iv) Complete the circuit connecting the resistance R and suitable key K.

(b) (i) What is the reason for using digital voltmeter (V).

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(ii) What is the value of rheostat keeping initially maximum or minimum give the reason.

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(c) (i) When passing the large current in circuit, dry cell can be discharge quickly. What method is used to minimized it.

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(ii) Discharge of the cell can be occur another action. What is that action. What method is used to minimize it.

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(d) (i) Write down the expression for e.m.f. E by using internal resistance r, current I, potential difference V across the terminals of the cell.

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(ii) Rearrange that equation to find the E and r by using leniar graph. Clearly indicate the independent and depending variable.

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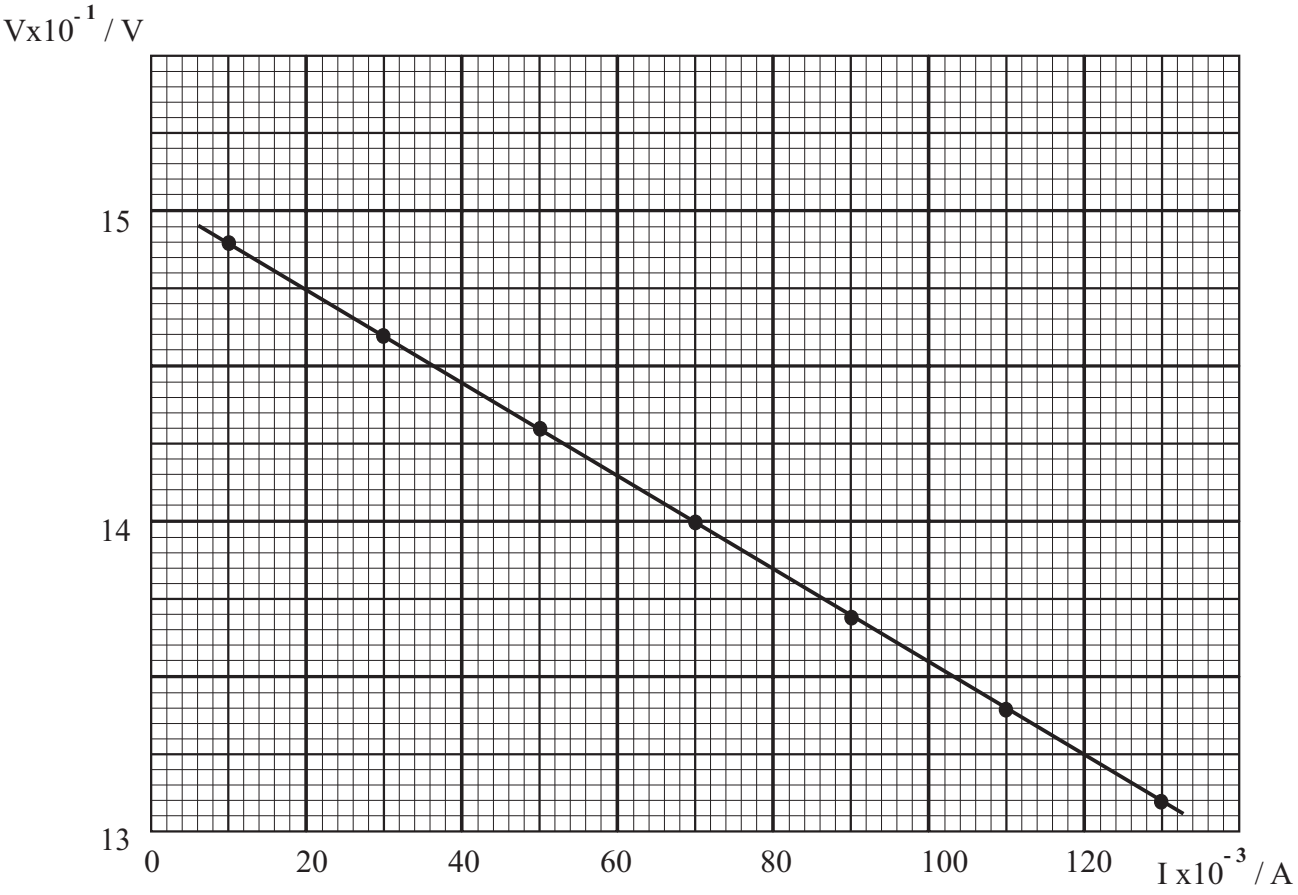
(e) A plotted graph is given below, obtained data by the student.



(i) Mark the more suitable two point to obtain the gradient of the graph.

(ii) By it find the internal resistance of the cell.

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(iii) Find the e.m.f. of the cell.

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Part - B (ESSAY)

- Answer four questions only.

(05) (a) State the principle of conservation of linear momentum.

(b) State the principle of conservation of energy.

(c) A motor car of mass 1200kg is moving along a rough horizontal straight road. The coefficient of friction between the tyres and road is 0.3. The car starting from rest accelerates with a constant rate to achieve the final velocity of $30ms^{-1}$ covering a distance of 400 m.

(i) Calculate the kinetic energy of the motor car at a speed of $30ms^{-1}$.

(ii) Calculate the frictional force acting on the car.

(iii) Calculate the work done against friction over the distance of 400m.

(iv) Show that the acceleration of the motor car is $\frac{9}{8}$ ms^{-2}.

(d) The work done against air resistance over the distance of 400m is 50.2×10^5 J.

Show that the sum of the kinetic energy of the car and work done against friction and air resistance is 70.0×10^5 J.

(e) Take the net work done by the engine as 70.0×10^5J. The energy released by burning 1l of fuel is 42.0MJ and 28% of this is used for the net work done. The density of fuel is 0.78 kg l^{-1}. How much fuel mass is burned by the engine during this acceleration.

(f) If the driver shifts into neutral gear while the car is moving at constant velocity of $30ms^{-1}$, the brakes fail. The driver steers into a safety lane to stop the car at a distance of 400m with a deceleration of $\frac{9}{8}$ ms^{-2}. Calculate the coefficient of friction between the tyres and road at the safety lane. (Neglect the air resistance)

(g) Suppose the driver is unable to turn the car moving at $30ms^{-1}$ into safety lane. It collides head - on with another identical car travailing at the same velocity. $\frac{3}{4}$ th of total kinetic energy of two cars is converted into another form of energy.

(i) Find the speed of a motor car just after the collision.

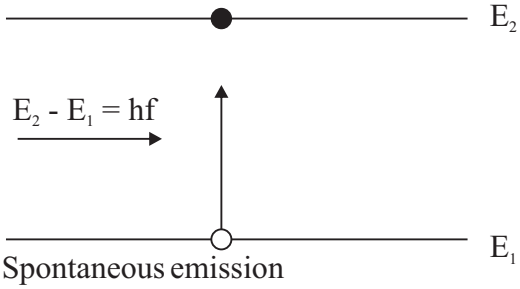
(ii) Calculate the momentum change of a motor car.

(iii) Is it possible to apply the principle of conservation of linear momentum even if the kinetic energy is converted into another form of energy. Explain this.

(06) For better understanding of laser mechanism, it is necessary to examine the processes that take place in the interaction of electromagnetic radiations with matter. When a light beam interacts with a material medium, three processes can take place. They are

01. Absorption

An atom is excited from the lower energy level of energy E_1 to the upper energy level of energy E_2 by absorbing a light photon of energy ΔE given by $\Delta E = E_2 - E_1 = hf$.



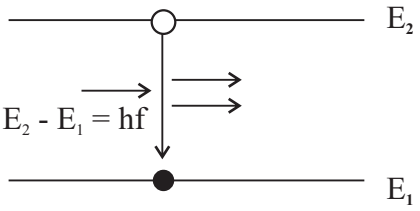
02. Spontaneous emission

The excited atom at the upper energy level, E_2 emits the extra energy it possessed in the form of light photon of energy hf and falls back to its ground state of energy E_1. The emitted photons are in random motion and travelling in all directions (and is incoherent)

The rate of spontaneous emission is proportional to the number of excited atoms (N).

$$\left(\frac{\Delta N}{\Delta t}\right) \alpha N$$

03 Stimulated emission



If a photon of exactly the correct energy approaches an excited atom in a higher energy level E_2, it may be induced to fall to a lower level E_1 and emit another photon. The remarkable fact is that this photon has the same phase, frequency and direction of travel as the stimulating photon which is itself unaffected.

The rate of stimulated emission $\frac{\Delta N}{\Delta t}$ is proportional to the number of excited atoms (N) and the density of incident radiation of energy, ΔE, exactly equal to the energy separation of the two levels given by $\Delta E = E_2 - E_1 = hf$. The emitted photons can stimulate the other atoms to emit photons. As a result of this light is amplified.

The stimulated emission of radiation is the concept of the laser action. In order to generate the laser light by the stimulated emission, laser photons produced in the laser medium should be multiplied rapidly. For this following conditions must be satisfied.

1. It is necessary to have more atoms in an upper than a lower level. This condition is called an 'inverted population.'
2. It is essential to have an intermediate energy level called a 'metastable' level for the excited atoms to stay considerably long time before they decay to a lower level.

(i) What is meant by the laser light?

(ii) Why are the radiations in the form of light photons given by the spontaneous emissions incoherent.

(iii) Explain the reason of having a higher intensity for the laser light produced by the stimulation emission than the incident light?

(iv) What is the difference between the laser light and light emitted by the filament bulb?

(v) What is meant by the 'inverted population'?

(vi) Is it possible to obtain an inverted population by increasing the temperature?

(vii) Why is it not suitable to use a two - energy level system (E_1 and E_2) to achieve the inverted population?

(viii) The population inversion can be practically achieved by a (a) 3 level system and (b) 4 level system. The figure given below shows a 3 - energy level system.

E_1 ———— 5.108 eV
E_2 ———— 4.105 eV
E_3 ———— 0.790 eV

(i) Name the three energy levels E_1, E_2 and E_3.

(ii) Find the frequency of the laser beam produced.
($h = 6.63 \times 10^{-34}$ Js, $C = 3 \times 10^8$ ms^{-1}, $1eV = 1.6 \times 10^{-19}$J)

(iii) Find the wavelength of the laser beam in Å ($1 Å = 10^{-10}$m)

(ix) Write down three fields that the laser can be applied.

(x) Skin and eyes get damaged as a result of exposure to the laser beam. Explain this.

(07) (a) Introduce the term 'surface tension' of a liquid.

(b) What happens to surface tension of a liquid when the temperature increases? What is the reason for it.

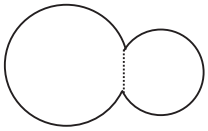
(c) Is washing clothes with warm water efficient or not? Explain it.

(d) The excess pressure (ΔP) in a soap bubble can be expressed as $\Delta P = \frac{4T}{r}$.
Identify the terms T and r.

(e) The coefficient of surface tension of a soap solution is 2.5×10^{-2} Nm^{-1}. Two soap solution bubbles of different sizes are formed by means of the solution. The excess pressure inside one soap bubble is 10 Pa and it is 20 Pa inside the other. The air pressure outside them is 1×10^5 Pa.

(i) Calculate the radii of two soap bubbles.

(ii) If the two bubbles are combined together as shown in the diagram, calculate the radius of the common meniscus.



(iii) In which direction does the common meniscus of the bubbles bend?

(iv) If the common meniscus is broken forming a single bubble, Write down necessary equations to calculate the radius of the bubble formed. Assume that the temperature remains constant. (Simplification is not necessary)

(v) The surface tension of the soap solution at 17°C is 2.5×10^{-2} Nm^{-1} and it is 2.4×10^{-2} Nm^{-1} at 27°C.

If the temperature of a soap bubble with a radius 1 cm at 17°C increases from 17 ºC to 27°C, write down necessary equations to calculate the new radius of the soap bubble at 27°C. Simplification is not necessary.

(f) A soap film is made on a flat horizontal metal frame. A circular rubber loop of radius 2cm is gradually placed on the soap film. Then the soap film inside the loop is collapsed. The cross sectional area of the rubber band is $1mm^2$ and young's modulus of rubber is $5 \times 10^4 Nm^{-2}$. The loop is in proportional limit.

(i) Calculate the new radius of the loop.

(ii) What is the elastic potential energy stored in the rubber loop?

(08) (a) Define the gravitational field intensity (g) and the gravitational potential (v) at a point in a gravitational field.

(b) Two masses, M and m are separated by a distance r.

(i) Write down an expression for the gravitational potential at the place of m due to M.

(ii) Write down an expression for the gravitational field intensity produced by m at the place of M.

(iii) Obtain expressions for the gravitational potential energy of M and m using b(i) above and for the gravitational force between M and m using b(ii) above.

(c) In the earth gravitational field, a satellite of mass 1200 kg is in an orbit at a height of 1700 km above the earth surface. (The radius of the earth = 6400km and $g = 10ms^{-2}$) Find the kinetic energy and the gravitational potential energy of the satellite.

(d) What is the orbital radius of a geostationary satellite? ($\pi^2 = 10$), $(400)^{\frac{1}{3}} = 7.36$)

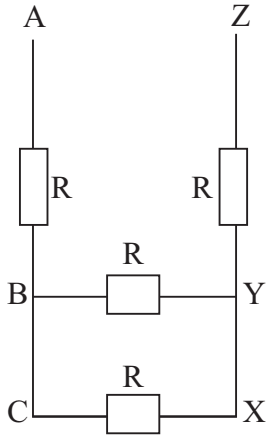
(e) If the periodic time of the geostationary satellite mentioned in (d) above is doubled, the data obtained from it can be increased. Calculate,

(i) the change in mass and,

(ii) the change in radius of the satellite to double the previous periodic time.

- Answer either Part A or Part B only.

(09) (A) (a) Resistors are used to protect certain sensitive instruments from high current passing through them. On the other hand the resistors are used for various tasks. A net work of each resistor R is shown in the following diagram.



(i) Find the equivalent resistance between following points.

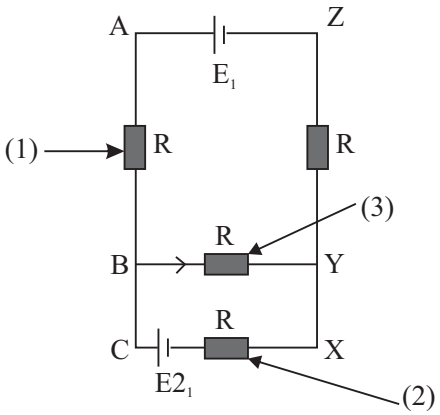
(a) between A and C

(b) between B and X

(c) between A and Z

(d) between C and z

(ii) Two cells of negligible internal resistance and electro motive forces E_1 and E_2 are connected to the above system.



E_1cell is discharging.

E_2 cell is charging.

The current passing through the resistor R_3 is in the direction BY.

The current i_1 is passing through the resister (R_1)

The current i_2 is passing through the resister (R_2)

The current i_3 is passing through the resister (R_3)

(a) Copy the above diagram to your answer script and mark the direction of current i_1, i_2 and i_3 on it correctly.

(b) Obtain the relation among i_1, i_2 , i_3 by using Kirchoff's laws.

(c) Derive an expression among E_2, R, i_2, i_3 and an expression among E_1, E_2, R, i_1, i_2 by using Kirchoff's laws.

(iii) When the two resistors R_1 and R_2 are connected in parallel, the equivalent resistance is R.

(a) Show that $R = \frac{R_1 R_2}{R_1 + R_2}$ by using Kirchoff's laws. Write down the Kirchoff's laws that use for above.

(b) Find the value of R, under following situations.

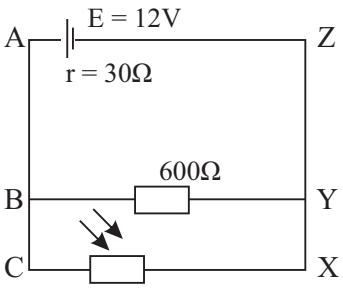
(i) When $R_1 = 600\,\Omega$ and $R_2 = 3000\,\Omega$

(ii) When $R_1 = R_2 = 600\Omega$

(iii) When $R_1 = 600\Omega$ and R_2 equal to infinity.

Draw the variation of equivalent resistance (R) against R_2 when $R_1 = 600\Omega$.

(iv) Light dependent resistor (LDR) is connected with 600Ω resistor parallelly. The cell of emf 12 V and internal resistance (r = 30Ω) is connected with the above two resistors.



(a) When the light is incident on LDR with low intensity, the resistance becomes 3000Ω. Find,

(i) the current passing through LDR,

(ii) the power dissipation through LDR.

(b) Suddenly, light is incident on LDR. In this situation resistance of LDR reduces to 200Ω. If the power of the LDR is 0.25W, is the LDR damaged or not.

(09) (B) (a) (i) Draw the output characteristic curve for npn bipolar junction transistor, when it is at the common emittor configuration Mark the active, cut off and saturated regions on the graph.

(ii) Show that the transistor can act as a switch according to the out put characteristic curve.

(iii) When the following circuit is at saturated, $\beta = 50$ and $V_{in} = 5V$, Find the value of R_B.

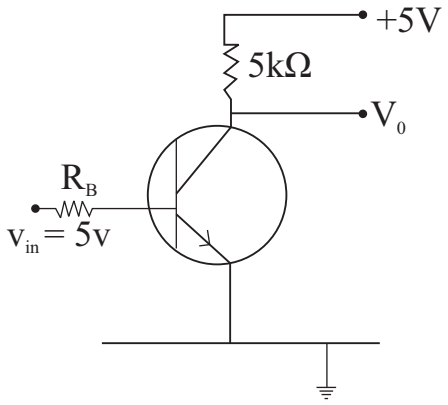


Fig. (1)

(b) (i) The light dependent resistor (LDR) is at dark and light, the resistance of LDR is 5.8kΩ and 200Ω respectively. If diagram (2) is made by using above LDR, find the potential at P at light and dark situations separately.

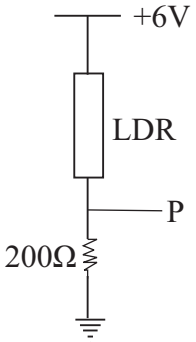


Fig. (2)

(ii) A complete circuit diagram shown in the figure (3) is made by connecting the above figure (2) and transistor (S_1) that acts in common emitter configuration. The value of $V_{BE} = 0.7V$ & current gain (β) = 300. Find I_B, I_C and potential at R(V_R) when,

(1) at dark situation,

(2) at light situation,

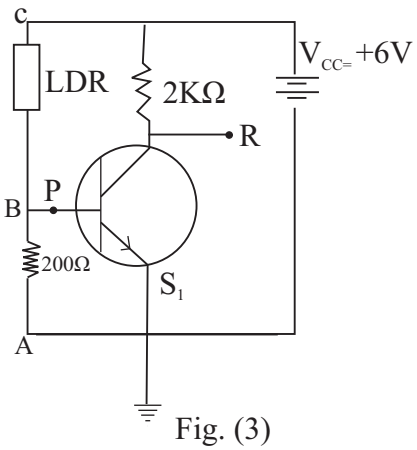
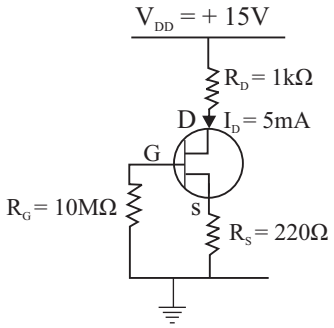


Fig. (3)

(iii) If the light sensitive bulb is used in figure (3), show that the method to use the bulb in circut to it lights at dark and switch off at light.

(c) If I_D = 5mA in the circuit shown in the figure, find the potential difference between D and S (V_{DS}) and the potential difference between G and S (V_{GS}).



- Answer either Part A or Part B only.

(10) (A) (a) Define the coefficient of real expansion of a liquid.

(b) A cylindrical metal can having a bottom of cross sectional area 10cm^2 is 30cm in height. The can is filled with a liquid of volume 100ml at the room temperature of 30°C. The real (volume) expansivity of the liquid is 2x10^{-4} °C^{-1}, the linear expansivity of the metal is 2x10^{-5} K^{-1} , heat capacity of the metal is 400JK^{-1}, specific heat capacity of the liquid is 4000Jkg^{-1}K^{-1} and the density of the liquid is 1200kgm^{-3}. A heating coil rated at 240V, 1kW is used to heat the system.

(i) How long does the heating coil take to increase the temperature of the system from 30°C to 60°C? Give an assumption you made for the calculation.

(ii) What additional time is taken by the coil to increase the temperature from 30°C to 60 °C when the supply voltage has dropped to 200 V.

(Use the equation $P = \frac{V^2}{R}$)

(c) (i) Define the boiling point of a liquid in terms of the vapour pressure.

(ii) At this moment, the liquid is at its boiling temperature of 60°C. The heater takes four minutes to completely vaporize the liquid. Find the specific latent heat of vaporization of the liquid in kJ kg^{-1}.

(iii) The container with the liquid mentioned above is heated in a hill - country area to vaporize the liquid. Explain how the melting point of this liquid varies (increase / decrease / same) at sea level.

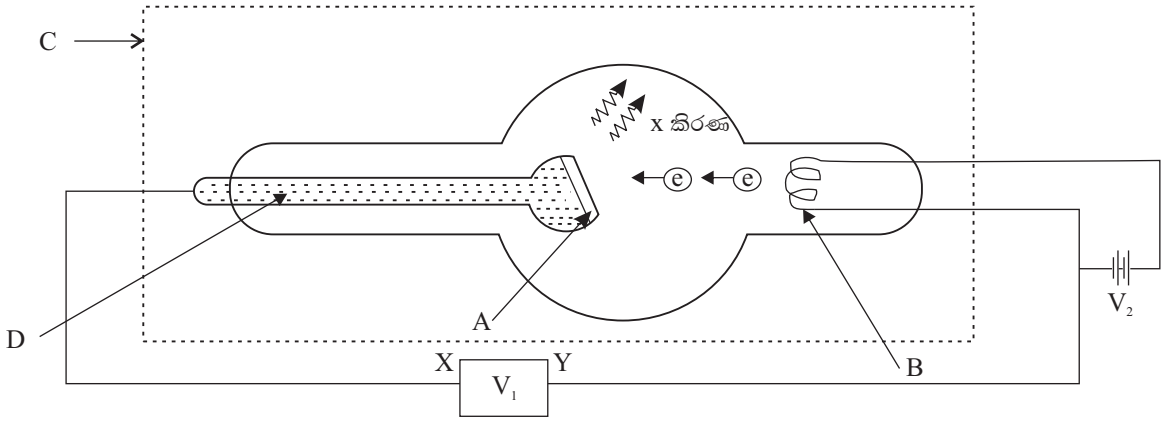
(iv) Draw a rough graph to show the variation of the rate of absorbing heat by the can with time.

(d) Define the coefficient of apparent expansion of a liquid.

(i) To what height will the liquid rise at 60°C in the container?

(ii) What is the volume (v) of a glass block at 30°C that should be kept inside the container such that the empty space remains the same at all temperatures up to 60°C. The linear expansivity of glass material is 1.5x10^{-5} °C^{-1}.

10. (B) A modern type of X-ray tube used to produce X-ray photons is shown below. The first X-ray tube was constructed by Sir William Crookes. The tube contains law pressure air (about 10^{-6} Pa) under very high voltage (about 30kV - 150kV). X-rays are produced by the bombardment of electrons travelling with a very high speed on a target metal having high melting point.



(1) Name the parts marked as A, B, C and D.

(2) Explain the purpose of using two voltage supply V_1 and V_2.

(3) What is the polarity of X and Y?

(4) What is the factor affecting the intensity of X-rays?

(5) An X-ray tube, operated at a d.c. potential difference of 40kV, produces heat at the target at the rate of 720W. Assuming 99.5% of the energy of the electrons incident on the target metal in 1s is converted into heat.

$\left(\frac{1}{99.5} = 0.01\right)$ $\left(\sqrt{\frac{8}{91}} = 0.3\right)$

Calculate, (a) the number of electrons per second striking the target.

(b) the velocity of the incident electrons.

(c) the wavelength of the X-rays produced.

(6) The target metal is embedded in a copper rod, the purpose of which is to conduct heat away from the target. If the rod is cooled by circulating a liquid through it at a rate of $0.008 kgs^{-1}$, what is the increase in temperature of the liquid?

(7) What is the De-Broglie wavelength of the electrons incident on the target metal?

(8) What is the name given for the mechanism of emitting electrons from B?

(9) State 3 properties of X-rays.

(10) State 3 uses of X-rays.

For the calculations above, use the following data.

Planck constant (h)	=	6.6×10^{-34} Js
Charge of an electron	=	1.6×10^{-19}C
Mass of an electron	=	9.1×10^{-31}kg
Velocity of light (c)	=	$3 \times 10^{8} ms^{-1}$
Specific heat capacity of water	=	$4200 Jkg^{-1}K^{-1}$