ICSE Physics Paper-1 Grade X
Solution for 2022-23 Examination

PHYSICS

(SCIENCE PAPER 1)

Maximum Marks: 80

Time allowed: Two hours

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during the first 15 minutes.

This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section A is compulsory. Attempt any four questions from Section B.

The intended marks for questions or parts of questions are given in brackets

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Section - A (40 Marks)

(Attempt all questions from this section)

Question 1:

Choose the correct answers to the questions from the given options. [15]

[15 Marks]

(Do not copy the questions, write the correct answers only.)

(i) Clockwise moment produced by a force about a fulcrum is considered to be:

(a) Positive
(b) Negative
(c) Zero
(d) None of these

Ans: b. Negative

If the effect of the body is to turn it clockwise the moment of force is called clockwise and it is taken negative.

(ii) When the speed of a moving object is doubled, then its kinetic energy.

(a) remains the same
(b) Decreases
(c) is doubled
(d) becomes four times

Ans: d. Becomes four times

If v becomes 2v, then

$KE = \frac{1}{2}m(2v)^2 = \frac{4}{2}mv^2$

= 4 times the initial Kinetic Energy.

Therefore, when the object's speed doubles, its kinetic energy doubles to four times the initial kinetic energy.

(iii) The energy conversion in a washing machine is from

(a) magnetic to electrical
(b) electrical to mechanical
(c) electrical to magnetic
(d) magnetic to electrical

Ans: b. Electrical to mechanical

In a washing machine, electrical energy is converted into mechanical energy.

(iv) Which of the following radiations suffers maximum deflection in a magnetic field?

(a) Alpha radiations
(b) Beta radiations
(c) Gamma radiations
(d) X-radiations

Ans:The correct option is (b) Beta radiations

Gamma radiations and X-rays are both electromagnetic waves, and they cannot deflect in an electric or magnetic field.

The deflection of Beta radiations is more than that of Alpha radiations since a β-particle has charge density higher than that of α-particle.

(v) Speed of blue light in water is:

(a) more than green light
(b) more than orange light
(c) more than violet light
(d) more than red light

Ans: The correct option is (c) more than violet light

The wavelength of light is directly proportional to the speed of light in the medium. This means that the greater the wavelength of light, greater will be the speed of light.As we know that, the wavelength of blue light is greater than the wavelength of violet light. Therefore, the speed of blue light will be greater than the violet light.

(vi) A concave lens produces only _____ image.

(a) real, enlarged
(b) virtual, enlarged
(c) virtual, diminished
(d) real, diminished

Ans: (c) virtual, diminished

A concave lens always diverge light rays and it always produces virtual, diminished image.

(vii). When a body vibrates under a periodic force, the vibrations of the body are always:

(a) natural vibrations
(b) damped vibrations
(c) forced vibrations
(d) resonant vibrations

Ans: c. forced vibrations

The vibrations of a body which take place under the influence of an external periodic force acting on it, are called the forced vibrations. When the external periodic force is applied to the vibrating body, the body gradually acquires the frequency of the applied periodic force

(viii). Two notes are produced from two different musical instruments, such that they have the same loudness and same pitch. The produced notes differ in their.

(a) Waveform
(b) Frequency

(c) Wavelength
(d) Speed

Ans. (a) Waveform

Quality is used to describe the quality of the waveform as it appears to the listener. Therefore the quality of a note depends upon the waveform. Two notes of the same pitch and loudness, played from different instruments do not sound the same because the waveforms are different and therefore differ in quality or tone

(ix) When a current I flows through a wire of resistance R for time t then the electrical energy produced is given by:

(a) I^2Rt
(b) IR^2t
(c) IRt
(d) IRt^2

Ans. (a) I^2Rt

According to Joule , the heat produced by an electric current I flowing through a resistance R for a time t is proportional to I^2Rt

(x). Choose the correct relation for e.m.f (ε) and terminal voltageV:

(a) ε = v (always)
(b) V > ε (always)
(c) V < ε (When the cell is in use)
(d) None of these

Ans. c. V = emf−Ir, V < ε (When the cell is in use)

(xi) If the strength of the current flowing a wire is increased, the strength of the magnetic field produced by it:

(a) Decreases
(b) Increases
(c) Remains the same
(d) First increase then decreases

Ans.(b) Increases

The strength of the magnetic field is always proportional to the magnitude of current flowing. Hence, when the current increases, the magnetic field also increases.

(xii) Specific latent heat of a substance:

(a) Is directly proportional to the mass
(b) Is directly proportional to the change in the temperature
(c) Depends on material
(d) Is inversely proportional to the mass

Ans. (c) Depends on material

Different materials have a different **specific latent heat**.

Specific latent heat depends on the strength of the bonds holding the particles to each other.

(xiii) Specific heat capacity of a substance X is 1900 Jkg^{-1}°C $^{-1}$ means

(a) Substance X absorbs 1900J for 1°C rise in temperature
(b)1 Kg of substance X absorbs 1900 J heat for 1°C rise in temperature
(c)1 kg of substance X absorbs 1900 J heat to increase the temperature
(d)1 Kg of substance X absorbs 1900 J heat to cool down by 1°C

Ans. (b)1 Kg of substance X absorbs 1900 J heat for 1°C rise in temperature

(xiv) When a ray of light travels normal to the given surface, then the angle of refraction is:

(a) 180^0
(b) 90^0
(c) 0^0
(d) 45°

Ans. (c) 0^0

(xv) Small air bubbles rising up a fish tank appear silvery when viewed from some particular angle is due to the:

(a) reflection
(b) refraction
(c) dispersion
(d) total internal reflection

Ans. (d) total internal reflection

Question. 2

(i) [3]

(a) When does the nucleus of an atom tend to become radioactive?

(b) Name a single pulley in which displacement of load and effort is not the same.

(c) State one advantage of this pulley.

Ans.

(a) When the number of neutrons becomes greater than protons, then the nucleus of that atom becomes radioactive.

(b) A differential pulley, also known as a chain hoist or chain block, is a type of pulley system where the displacement of the load and the effort are not the same.

(c) One advantage of a differential pulley system is that it allows for a smaller effort to lift a heavier load.

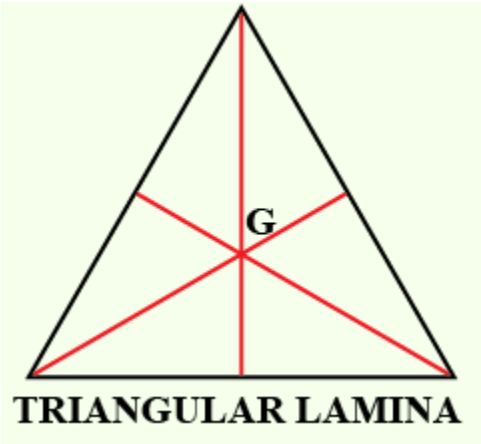
(ii) [2]

(a) What is the position of the centre of gravity of a triangular lamina?

(b) When this triangular lamina is suspended freely from any one vertex, what is the moment of force produced by its own weight in its rest position?

Ans:

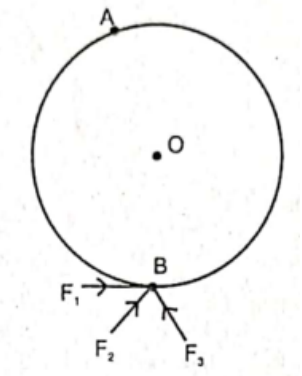
(a) For triangular lamina, the centre of gravity lies at the point of intersection of its medians.



(b) When a triangular lamina is suspended freely from any one of its vertices, it comes to rest in a position where the weight vector is aligned with the vertical line passing through the suspended vertex. At this point, the lamina

is in rotational equilibrium, which means that the sum of the moments of all external forces acting on the lamina is zero

(iii) The diagram shows wheel O pivoted at point A. Three equal forces F_1, F_2 and F_3 act at point B on the wheel. [2]



(a) Which force will produce maximum moment about A?
Ans: The force F1 will produce the maximum moment about A

(b) Give a reason for your answer in (a).
Ans: The moment produced by a force is given by the magnitude of the force multiplied by the perpendicular distance from the point of application of the force to the pivot point. In this case, the perpendicular distance from the line of action of F_1(Tangential force) to the pivot point A is equal to the Diameter of the wheel, while the perpendicular distance from line of action of F_2 and F_3 is less than the diameter Therefore, the moment produced by force F1 will be greater than the moments produced by forces F2 and F3, since F1 has the largest perpendicular distance from the pivot point A. Thus, force F1 will produce the maximum moment about A.

(iv) [2]

(a) What should be the angle between the direction of force and the direction of displacement ,for work to be negative?

(b) Name the physical quantity obtained using the formula *U/h*, where U is the potential energy and *h* is the height.

Ans: (a) The angle should be 180^0 between force and displacement, for the work to be Negative

(b) This formula gives the amount of potential energy possessed by an object per unit height above a reference point due to the gravitational force between the object and the Earth. This quantity is the weight of the object.

(v) Calculate the power spent by crane while lifting a load of mass 2000 kg,at velocity of 1.5 m/s (g = 10 ms^2) [2]

Ans. Power = $\frac{W}{t} = \frac{f.d}{t} = mgv = 2000 \times 10 \times 1.5$ = 30000 W

(vi) A metal foot ruler is held at the edge of a table. It is pressed at its free end and then released. It vibrates.
(a) Name the vibrations produced.
(b) State one way to increase the frequency of these vibrations. [2]

Ans:
a) The vibrations produced are known as free vibrations or natural vibrations
b) To increase the frequency of these vibrations, one way is to reduce the length of the ruler. This can be done by placing the ruler partially off the table so that a shorter length of the ruler is free to vibrate. The shorter the length of the ruler, the higher the frequency of its natural vibrations

(vii) 'A geyser is rated 240 W -220 V'. Explain the meaning of this statement.

Ans: If a geyser is rated at Power equal to 240 W and voltage is equal to 220 volts it means that it consumes 240 W of power when 220 volts of voltage is applied to it and the current which it draws will be equal to I is equal to power upon volts so I will be equal to 1.09 A when the geyser is connected to 220 volts of supply it draws a current of 1.09 ampere and consumes 240 W.

Question 3 **[2 marks each]**
(i)

a. Is it possible for a concave lens to form an image of size two times that of the object? Write Yes or No.
b. What will happen to the focal length of the lens if a part of the lens is covered with an opaque paper?

Ans:

a. No, because concave lens always produces a diminished image
b. When half of the convex lens is covered with an opaque paper, the rays of light occurs and image will be formed as how the normal lens receives, which means that the focal length remains the same, but, only the brightness or intensity of the light will be diminished due to the covering of opaque paper.

(ii)

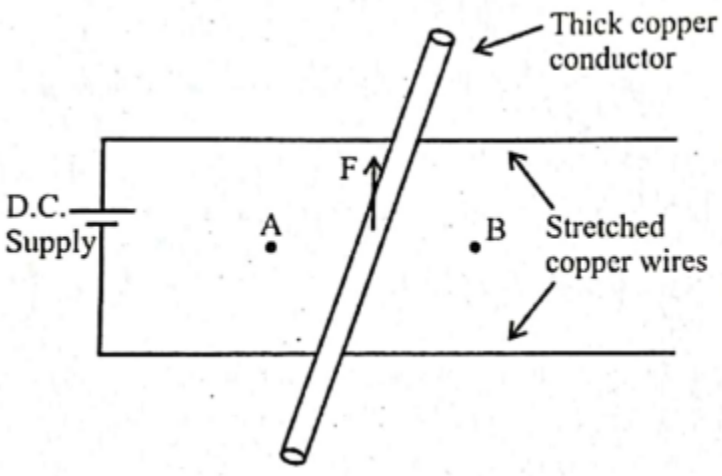
(a) Which electrical component protects the electric circuit in case of excess current and which can also be used as a switch?
(b) Name the wire to which this electrical component is connected in an electric circuit.

Ans:

(a)MCBs protect the electric circuit in case of excess current .MCBs are switches that turn off automatically when there is an overload or a short circuit. After solving the problem in the circuit, the switch can be turned back on, and then the current flows as usual.

(b) A MCB is connected in series with the main line (live wire) in the household circuit.

(iii) A copper conductor is placed over two stretched copper wires whose ends are connected to a D.C. supply as shown in the diagram.



(a) What should be the magnetic poles at the points A and B lying on either side of the conductor to experience the force in the upward direction?

Ans: To make the points A and B lying on either side of the conductor experience the force in the upward direction, the magnetic poles at A and B should be of opposite polarity. Specifically, the pole at point A should be North (N) and the pole at point B should be South (S).

(b) Name the law used to find these polarity

Ans: The law used to find these polarities is the Fleming's left-hand rule for dc electric motors. This rule relates the direction of the force on a current-carrying conductor in a magnetic field to the direction of the current and the direction of magnetic field.

(iv) Thermal capacities of substances A and B are the same. If mass of A is more than mass of B then:

(a) Which substances will have more specific heat capacity?

Ans.

Q = mcΔT

specific heat capacity = $\frac{heat\ capacity}{mass\ of\ body}$

Thermal capacities of substances A and B are same and,

Since the mass of A is more than mass B, so

The substance B will have more specific heat capacity

(b) Which substances will show greater rise in temperature if the same amount of heat is supplied to both?

Ans.

Q = mcΔT

If Thermal capacities of substances A and B are same Then

$\Delta T \propto \frac{1}{mass\ of\ body}$

Sincs mass of A is more than mass B

so substance B will show greater rise in temperature

(v) How is the radioactivity of a radioisotope affected if it undergoes a chemical change? Give a reason for your answer.

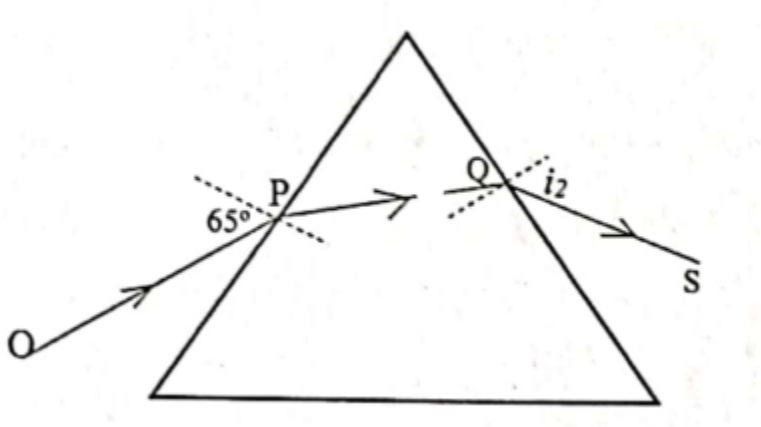
Ans:
Radioactivity of an element is not affected by the chemical change as radioactivity is a nuclear phenomenon and doesn't involve extranuclear electrons.

Section B (40 Marks)
(Attempt any four questions from this sections)

Question 4:

(i) The diagram below shows the ray OP travelling through an equilateral prism of a certain material. [3]

(a) Calculate the value of i_2, if the angle of deviation is 43°.
(b) What is the ray QS called?

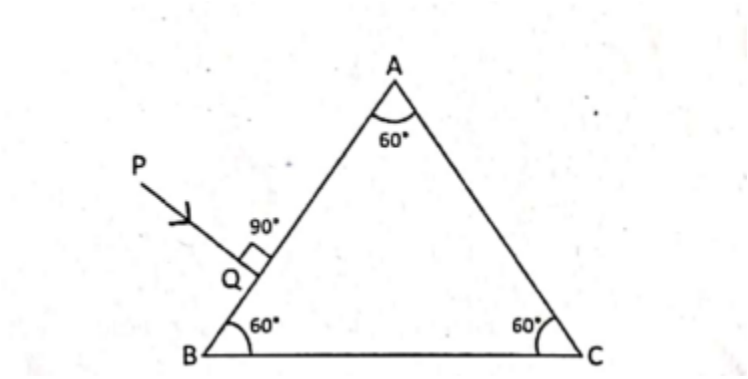


Ans:

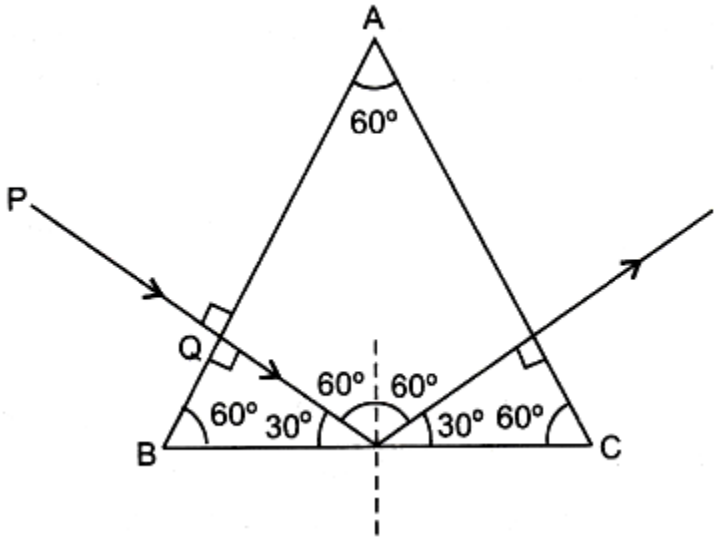
a. We know that angle of deviation is given as
$\delta = i + e - A$
Where i = angle of incidence, e = angle of emergence, and
A = Angle of prism, A = 60^0 for an equilateral prism.
Given $\delta = 43^0$, i = 65^0 and i_2= e
Substituting the values we get:
$i_2 = \delta + A - i = 43^0 + 60^0 - 65^0 = 38^0$

b. The ray QS is called the emergent ray.

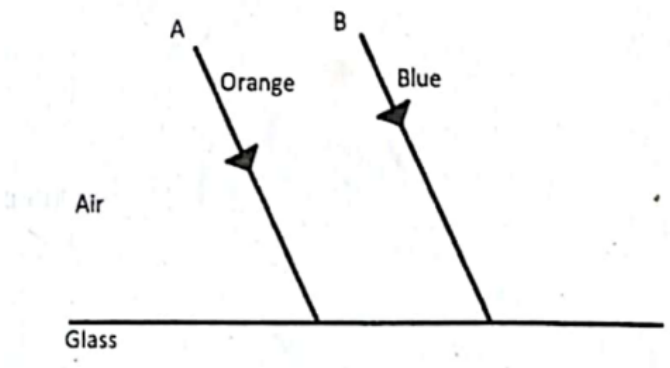
(ii) Copy the diagram given below and complete the path of the light ray PQ, as it emerges out of the prism by marking necessary angles. The critical angle of glass is 42°. [3]



Ans:

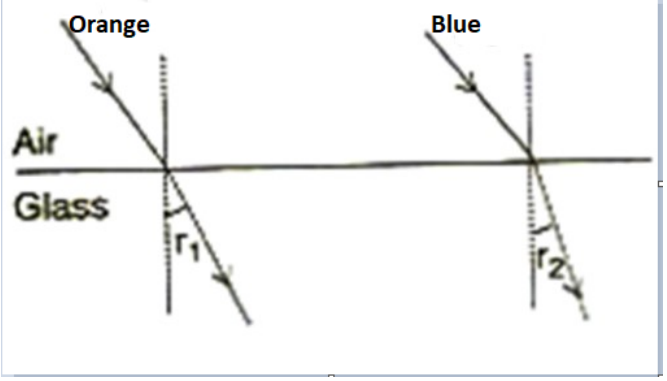


iii) The diagram below shows two parallel rays A (Orange) & B (Blue) Incident from air , on air-glass boundary [4]



(a) Copy and complete the path rays of A and B

Ans.the refractive index of glass is less for Orange light, while it is more for Blue light ($\mu_O < \mu_B$), So Orange ray is deviated less while the blue is deviated more i.e. angle of refraction r_1 for Orange is more than angle of refraction $r_2$for Blue ray.



(b) How do the speed of these rays differ in glass

Ans.Since the refractive index of glass is less for Orange light, while it is more for Blue light ($\mu_O < \mu_B$)in glass, the orange light travels faster than blue light.

(c) Are the two refracted rays in glass parallel?Give reason

Ans. The two refracted rays inside glass are not parallel. The reason is that the speed of orange light in glass is more, while it is less for the blue light, so the orange ray bends less, while the blue ray bends more (i.e.,angle of refraction r_1 for Orange is more than angle of refraction $r_2$for Blue ray.)

Question 5:

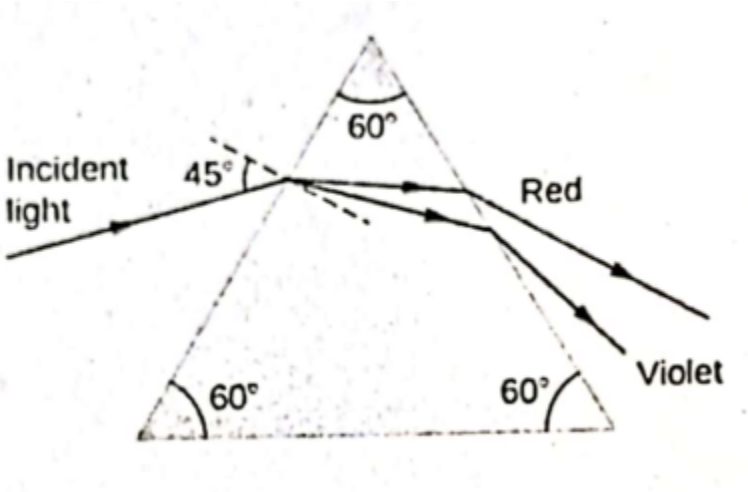
(i) A convex lens of focal length 10 cm is placed at a distance of 60 cm from a screen. How far from the lens should an object be placed so as to obtain a real image on the screen? [3]

(ii) [3]

a. A coin kept inside water [**μ** =4/3] when viewed from air in a vertical direction appears to be raised by 3.0 mm. Find the depth of the coin in water.
b. How is the critical angle related to the refractive index of a medium?

(iii) [4]

a. Infrared radiations are used in warfare. Explain with reason, why?
b. A ray of light is incident at 45° on an equilateral prism in the diagram below.



1. Name the phenomenon exhibited by the ray of light when it enters and emerges out of the prism.
2. State the cause of the above phenomenon mentioned by you.

Ans

(i) Given data

Distance of the image from the lens v = 60 cm
Distance of object from the lens, u = ?

The focal length of the lens, f = 10 cm

Using the lens formula we get,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{10} = \frac{1}{60} - \frac{1}{u}$

$\frac{1}{u} = \frac{1}{60} - \frac{1}{10}$

$\frac{1}{u} = \frac{1-6}{60}$

$\frac{1}{u} = \frac{-1}{12}$

u = - 12 cm

The negative sign shows that the distance is measured in the opposite direction of the incident light.

The lens should be placed at 12 cm to obtain a real image.

(ii) [3]

a. Given $\mu = \frac{4}{3}$,

And the shift = 3 mm

Let the real depth be x mm, then

Apparent depth = $\frac{x}{\mu} = \frac{x}{\frac{4}{3}} = \frac{3x}{4}$

Shift = real depth - apparent depth

$= x - \frac{3x}{4} = \frac{x}{4} = 3\ mm \Rightarrow x = 3 \times 4 = 12\ mm$

b. The ratio of velocities of a light ray in the air to the given medium is a refractive index. Thus, the relation between the critical angle and refractive index can be established as the Critical angle is inversely proportional to the refractive index.

$sin\ C = \frac{1}{\mu}$

(iii) [4]

a. Infrared radiations are used as signals during the war as they are not visible and they are not absorbed much in the medium. Ordinary visible light is scattered by haze but infrared (IR) radiation can penetrate through

the haze without being scattered. Therefore, these can be used as signals on distant objects obscured by atmospheric haze.

b.

1. When white light ray passes through a prism, it disperses into seven different colours, and this phenomenon is called dispersion.
2. When white light passes through a glass prism, its constituent colours (red, orange, yellow, green, blue, indigo, violet) travel with different speeds in the prism because the refractive index is colour dependent. This causes the dispersion of light.

Question 6

(i) A block and tackle system of pulleys has velocity ratio 4. [3]

(a)Draw a labelled diagram of the system indicating clearly, the direction of the load and the effort.

(b) What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system?

(ii) A metre scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it. [3]

(a) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf

(b) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre?

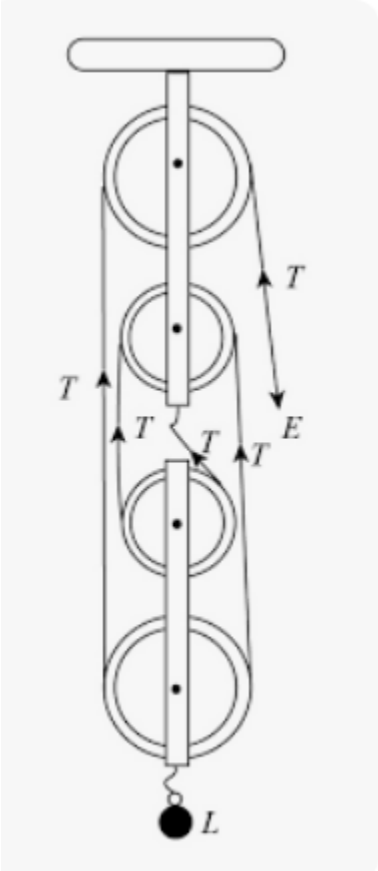
(iii) A car of mass 120 kg is moving at a speed of 18 km/h and it accelerates to attain a speed of 54 km/h in 5 seconds. Calculate: [4]

(a) the work done by the engine

(b) the power of the engine

Ans:

(i) (a)The labelled diagram of the system of block and tackle system of pulleys is shown indicating clearly the points of application and direction of load and effort



(b) The tension in the four segments of the string supports the load L. Therefore, L = 4T and E= T

Mechanical advantage = $\frac{Load}{Effort} = \frac{4T}{T} = 4$

(ii) (a) Total weight = 50 gf

Let the weight of [0 to 40] cm be W_1 and that of [40 to 100] cm be W_2

$W_1 + W_2$ = 50 gf

At equilibrium : Anti-clockwise movement = Clockwise movement

$(40 - 0) \times W_1 = (100 - 40) \times W_2$

$40\ W_1 = 60\ W_2$

$40\ (50 - W_2) = 60\ W_2$

$2000 - 40W_2 = 60\ W_2$

$2000 = 100W_2$

$W_2 = 20\text{gf}$

$W_1 = 50\text{ gf} - W_2 = 50\text{gf} - 20\text{gf} = 30\text{gf}$

When ruler is cut at centre then weight of part [0 to 50 cm] is:

$W_3 = W_1 + \frac{10}{60} W_2 = 30\text{ gf} + \frac{20}{6}\text{ gf} = 33.33\text{ gf}$

Weight of part [50 to 100 cm] is:

$W_4 = 50\text{ gf} - 33.33\text{ gf} = 16.66\text{ gf}.$

So the part [0 to 50 cm] of the ruler will weigh more.

(b) When the ruler is pivoted at centre, then let the required weight to balance the ruler be W_5. Since, the weight of [50 to 100 cm] side is less, so the required weight has to be placed at [50 to 100 cm] side.

At equilibrium,

Anti-clockwise movement = Clockwise movement

$[50 - 0] \times W_3 = [100 - 50] \times [W_4 + W_5]$

$50 \times 33.33 = 50 \times [16.66 + W_5]$

$W_5 = 33.33 - 16.66 = 16.66\ gf.$

(iii)(a) Given, m = 120 kg, $v_1 = 18\ km/h = \frac{18 \times 1000}{60 \times 60}\ m/s = 5\ m/s,$

$v_2 = 54\ km/h = 15\ m/s\ and\ t = 5\ s.$

Work done = Change in kinetic energy = $\frac{1}{2} m\ (v_2^2 - v_1^2)$

$= \frac{1}{2} \times 120 \times (15^2 - 5^2)$

= 12000 J

(b) Power = $\frac{Work\ done}{Time} = \frac{12000}{5} = 2400\ watt.$

Question 7

(i) [3]

(a) Which characteristic of sound is affected due to the larger surface of a school bell?

Ans: The larger surface area of a school bell can affect the amplitude or loudness of the sound produced by the bell. When the surface area of a bell is increased, it allows for a larger amount of air to be displaced when the bell is struck, resulting in a larger sound wave and a louder sound. However, it's important to note that other factors such as the shape and material of the bell can also affect the sound it produces.

(b) Calculate the distance covered by the Ultrasonic wave having a velocity of 1.5 kms^{-1} in 14 s, when it is received after reflection by the receiver of the SONAR.

Ans: The distance covered by the ultrasonic wave can be calculated using the formula:

Distance = Velocity × Time

Here, the velocity of the ultrasonic wave is given as 1.5 km/s, and the time taken for it to travel to the target and back (i.e., round-trip time) is 14 s. Since the wave travels to the target and back, the actual distance covered will be half of the total distance travelled by the wave. So, we can calculate the distance covered by the ultrasonic wave as follows:

Distance = (Velocity × Time) / 2
= (1.5 km/s × 14 s) / 2
= 10.5 km

Therefore, the distance covered by the ultrasonic wave is 10.5 km when it is received after reflection by the receiver of the SONAR.

(ii) (a) Complete the following nuclear changes: [3]

$$^{238}_{92}\mathbf{P} \rightarrow \mathbf{Q} + {}^{4}_{2}\mathbf{He} \rightarrow \mathbf{R} + {}^{0}_{-1}\mathbf{e}$$

Nuclear reaction was accompanied with release of a particle having mass number and atomic number equal to 4 and 2 respectively. Hence emitted atom is an alpha particle.

$$^{238}_{92}\mathbf{U} \rightarrow {}^{234}_{90}\mathbf{Th} + {}^{4}_{2}\mathbf{He} + \textbf{energy}$$

Secondly parent nucleus Q changes into daughter nucleus
R due to beta decay. When a beta particle is emitted, the atomic number increases by 1 but the mass number of the parent nuclei remains the same.

$$^{234}_{90}\mathbf{Th} \rightarrow {}^{234}_{91}\mathbf{Pa} + {}^{0}_{-1}\mathbf{e}$$

(b) Name the nuclear radiation which has the highest ionising power.
Ans: Alpha particles have the highest ionisation power than the other two types of radiation owing to the fact that an α-particle is doubly ionised helium nucleus, i.e. $\mathbf{He^{2+}}$

(iii) We are able to see the T.V. channels clearly when we set T.V. on auto-tuning. [4]

(a) Which phenomenon led to the clear visibility of the channels, due to auto-tuning?
Ans: The phenomenon that led to the clear visibility of the channels due to auto-tuning is called Resonance

b) Define the above phenomenon mentioned by you.
Ans : Resonance is a phenomenon that occurs when an object is subjected to an external force at its natural frequency, causing it to vibrate with a large amplitude. In the context of TV channels, the phenomenon of resonance is not directly related to the clear visibility of TV channels due to auto-tuning.
However, resonance can occur in TV antennas, which are used to receive TV signals from broadcasting stations. When a TV antenna is tuned to the frequency of a particular TV channel, the antenna can resonate with the frequency of the TV signal, amplifying the signal and improving the reception quality

(c) Give *any one* more example of this phenomenon.
Ans: Another example of resonance is in musical instruments, where the natural frequencies of the instrument's components, such as strings or air columns, can resonate with the applied force of the musician playing the instrument, creating the characteristic sound of the instrument

Question 8
(i) (a)Define specific resistance [3]
Ans. Specific resistance is defined as "the resistance offered per unit length and unit cross-section area of that material when a known quantity of voltage applied at its end ".
$\rho = \frac{R.a}{l}$
The SI unit of specific resistance is Ohm-m.

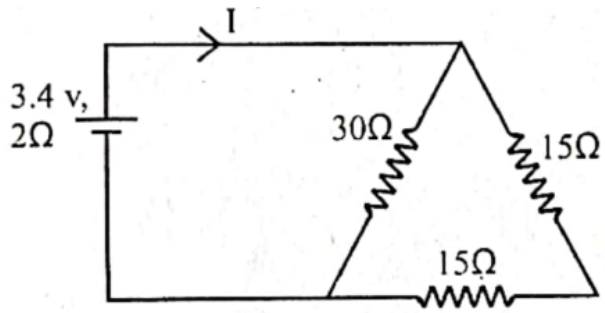
(b) What happens to the specific resistance of a conductor if it's length is Doubled
Ans. The specific resistance resistance of a conductor is inversely proportional to its length (l) as $\rho \propto \frac{1}{l}$.
The specific resistance of a conductor would be decreased by 2 times or halved, if the length of the conductor is doubled.

(c) Name a substance whose specific resistance remains almost unchanged with increase in it's temperature
Ans.The resistance of alloys like german-silver, Manganin, Constantan practically does not change with rise in temperature.

(ii) (a)Which nuclear radiation will travel undeviated in an electric field? [3]
Ans. Gama radiations will travel undeviated in an electric field
(b) How can one stop the radiations escaping from a nuclear reactor in a nuclear power plant?
Ans. The steel containment vessel serves as a barrier to prevent leakage of any radioactive gases or fluids from the plant. An outer concrete building serves as the final layer, protecting the steel containment vessel.
(c) Name one internal source of background radiation.

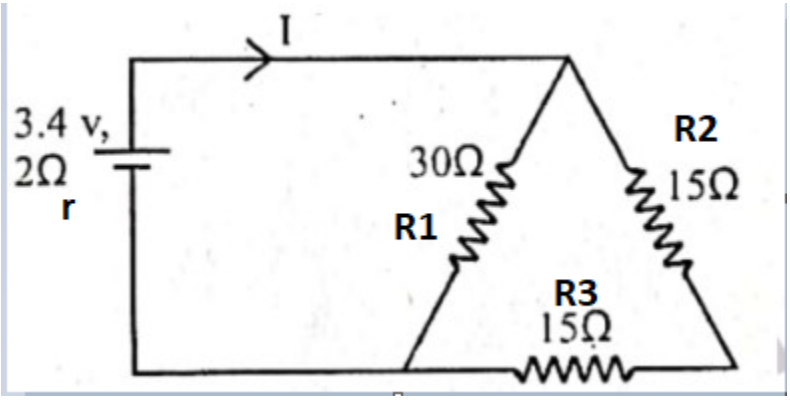
Ans. All people have internal radiation, mainly from radioactive potassium-40 and carbon-14 inside their bodies from birth.

(iii) Find the value of current **I** drawn from cell. [4]



(a) Calculate the current I

Ans.



Both R2 and R3 are in series hence their combine resistance is 15Ω+15Ω = 30Ω

R2,R3 (30Ω) and R1(30Ω) are parallel

Hence combine resistance will be 30/2 = 15 Ω

Total resistance of circuit = 15 Ω + 2 Ω = 17 Ω

I = $\frac{e.m.f}{total\ resistance} = \frac{3.4}{17} = 0.2\ A$

(b) Calculate the terminal voltage

Terminal voltage V = emf−Ir

= 3.4 - (0.2)(2)

=3.4 - 0.4

= 3 V

Question 9

(i) Calculate the total amount of heat energy required to melt 200 g of ice at 0°C to water at 100°C.

(Specific latent heat of ice 336 J g^{-1}

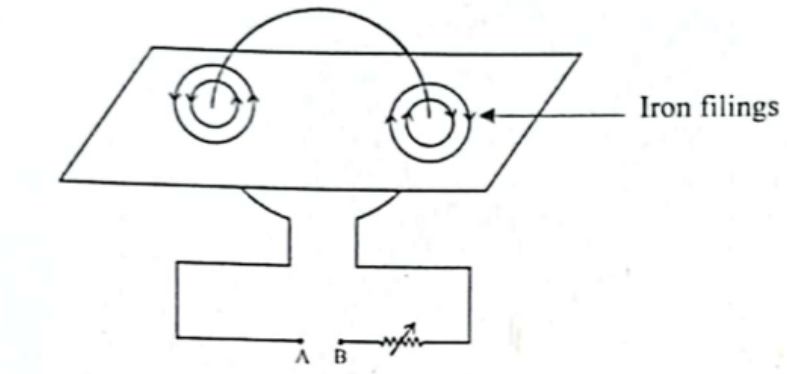
Specific heat capacity of water = -4.2 J g^{-1}C $^{-1}$) [3]

(ii) (a) State the principle of calorimetry.

(b) Name the material used for making a calorimeter.

(c) Write one characteristic property of the material chosen for making a Calorimeter. [3]

(iii) The diagram below shows a cardboard on which iron filings are kept. A wire bent in the form of a loop is seen passing through the cardboard. When current flows through it the iron filings arrange themselves as shown below.



(a) State the polarities of the battery at A and B

(b) State the effect on the magnetic field if an iron is held along the axis of the coil.

(c) State one way to

1. Change the polarity of the coil
2. Decrease the strength of the magnetic field around the coil. [4]

Ans:

(i) Heat required = latent heat for conversion of ice to water+heat required to raise the water temperature by 100℃

Q = mcΔT for temperature change in same phase

Q = mL for phase change at the same temperature.

Given, Mass of ice = 200g,

C_W = 4.2 J g^{-1} K^{-1}

L_i = 336 J g^{-1}

Amount of heat energy gained by 200g of ice at 0℃ to convert into water
= 200 × 336 = 67200 J

Amount of heat energy gained when temp. of 200g of water at 0°C rise to 100℃
= 200 × 4.2 × 100
= 84000 J

∴ Total amount of heat energy gained (Q) = 67200 + 84000 = 1.512 × 10^5 J

(ii)

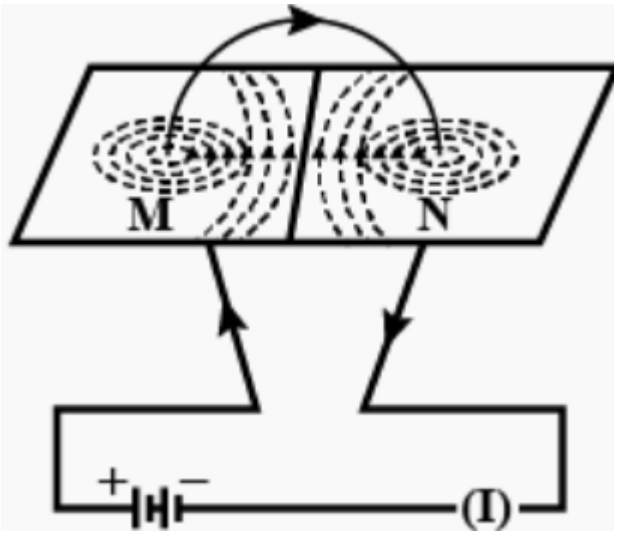
(a) The principle of calorimetry (or principle of mixtures) states that for an insulated system, heat energy lost by the hot body is equal to the heat energy gained by the cold body.
$m_1c_1(t_1 - t) = m_2c_2(t - t_2)$

(b) Calorimeters are made of copper.Copper has a small Specific Heat Capacity and the thin box ensures that the box has small heat capacity. Thus the calorimeter box can absorb a small amount of heat from the contents of the calorimeter.

(c) Calorimeters are made of copper because copper is a good heat conductor, has a low specific heat capacity, and a light copper wall receives/delivers negligible heat. Cu has a moderate specific heat capacity, so it immediately leads the equilibrium temperature by absorbing a small amount of heat.

(iii)

(a) A is +ve terminal and B is -ve terminal. At A current is upward so magnetic field line is anti-clockwise and it has north polarity. At B current is downward so magnetic field line is clockwise and it has south polarity.



(b) If an iron is held along the axis of the coil, the strength of the magnetic field is increased.

(C)

(1) The polarity of the coil can be changed by reversing the direction of the current.

(2) The strength of the magnetic field around the coil can be decreased by decreasing the current which can be achieved by increasing the resistance.