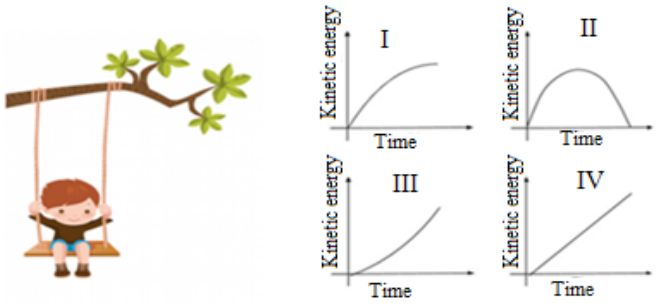
SECTION A [40 MARKS]
ANSWER **ALL** QUESTION

Question 1

a) **Directions: For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than one choice circled, NO score will be awarded.** **[25]**

i. A child on a swing is shown below. Which of the given graphs correctly describes the variation of kinetic energy with time if the child swings from one extreme end to another?



A I
B II
C III
D IV

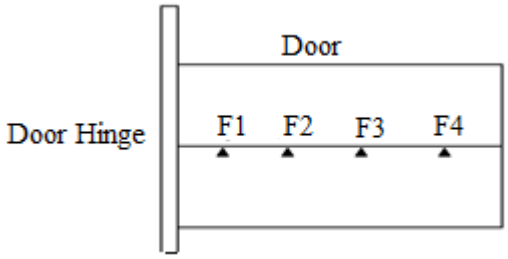
ii. Name the law that establishes the relationship between masses of two bodies and the distance between them.

A Law of inertia
B Newton's laws of motion
C Newton's universal law of gravitation
D Newton's law of gravitational constant

iii. Which best supports the efficient and sustainable use of energy?

A conventional ovens and LED bulbs
B latest technology and fossil fuel
C incandescent bulbs and insulation
D energy-efficient appliances and insulation

iv. If you are asked to open a door by applying a force at different points of application as shown below, which of the following points would you choose so that a minimum force is required?

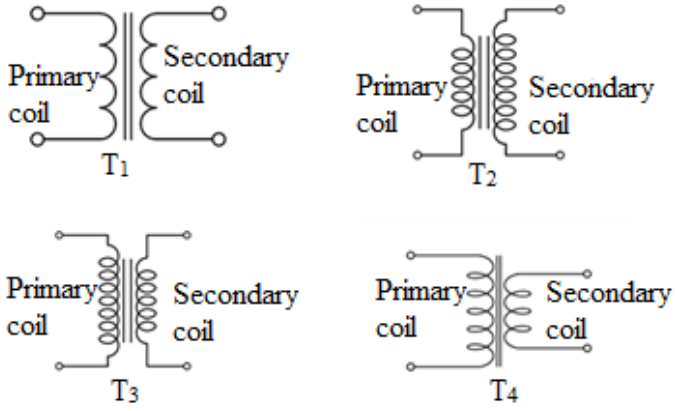


A F1
B F2
C F3
D F4

v. One of the benefits of using a hydraulic machine is the multiplication of
A force.
B speed.
C operating time.
D fuel efficiency.

vi. Which of the given relation is **TRUE** about the principle of calorimetry?
A heat gained > heat lost
B heat gained < heat lost
C heat gained = heat lost
D heat gained ≥ heat lost

vii. Pema owned a mini cottage industry and required electricity to increase productivity. So instead of buying more energy from Bhutan Power Corporation, he thought of using a transformer to increase the voltage. Which of the following transformers would you recommend?

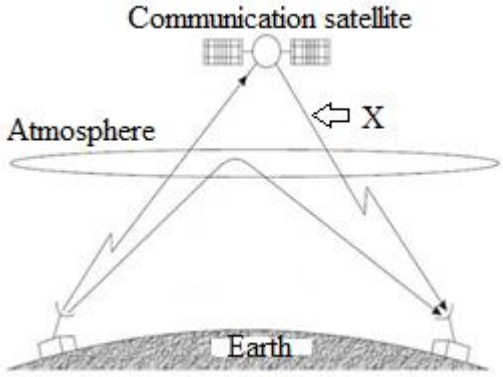


A T1
B T2
C T3
D T4

viii. Electromagnetic (EM) radiation has different wavelengths and frequencies. Which form of EM radiation has the highest penetrating ability?

A microwaves
B radio waves
C gamma rays
D infrared radiation

ix. Study the communication system shown in the figure given below. Name the electromagnetic waves marked X.



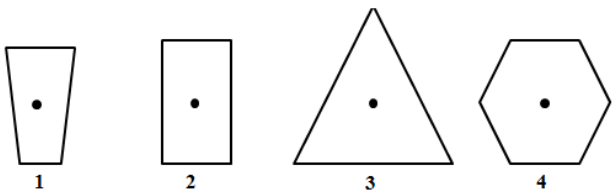
A UV rays
B microwaves
C radio waves
D infrared rays

x. The amount of heat gained or lost by a body depends upon specific heat capacity, difference in temperature and

A mass of the body.
B weight of the body.
C density of the body.
D volume of the body.

xi. All of the following objects are of same density and the centre of gravity of each object lies at the same height from the ground level. Arrange them in an ascending order of their stability.

A 1, 2, 3, 4
B 1, 2, 4, 3
C 2, 3, 4, 1
D 3, 4, 2, 1



xii. One of the applications of space exploration is to find the evidence of life elsewhere. The four main requirements for life in the universe is identified as

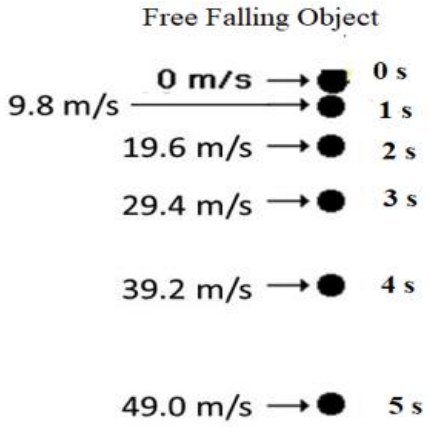
I liquid water and energy sources
II liquid water and sun's radiation
III energy sources and high temperature
IV nutrients and protection from elements

A I and II.
B II and III.
C III and IV.
D IV and I.

xiii. For bodies having same area of base, the stability is maximum when the position of centre of gravity is

A at the top.
B at the lower part.
C within the body.
D outside the body.

xiv. The figure represents the increasing speed of a body under free fall at equal intervals of time. As the object speeds up, the drag force experienced by the body



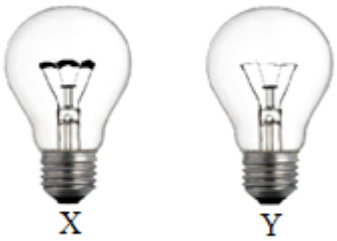
A increases.
B decreases.
C becomes zero.
D remains the same.

xv. Four knives of equal weight and different sharpness are shown in the table below. If an equal force is applied on all knives to cut the same object, which knife will cut the deepest?

A P
B Q
C R
D S

Knife	Cross-section area of knife edge (cm^2)
P	0.002
Q	0.004
R	0.006
S	0.008

xvi. Two light bulbs X and Y are identical in all respects except that the filament of bulb X is thicker than Y. If the same potential difference is applied to both the bulbs, then

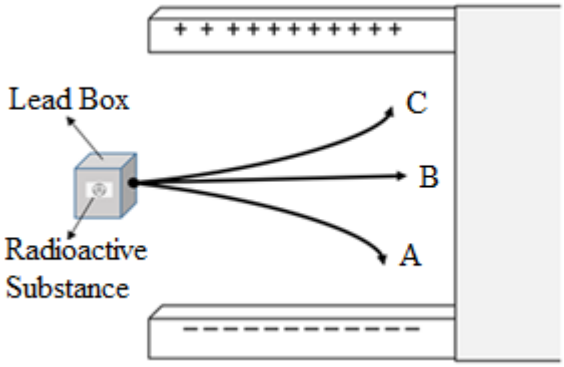


A X will produce more heat as it has lower resistance.
B X will produce less heat as it has greater resistance.
C Y will produce more heat as it has higher resistance.
D Both the bulbs will produce same amount of heat.

xvii. If uranium $\left({}^{238}_{92}\mathrm{U}\right)$ ejects a beta (β) particle, how many protons are left in the new element?

A 90 protons
B 91 protons
C 92 protons
D 93 protons

xviii. Study the experimental setup given in the figure below and answer the question.



When a radioactive substance is placed inside a lead box, it emits rays which are deflected into different directions. Which of the following statements describe the ray 'A'?

I It has negative charge.
II It cannot pass through paper.
III It has low penetrating power.
IV It has the highest penetrating power

A I and II
B II and III
C III and IV
D IV and I

xix. A mysterious radiation penetrates through soft tissues and skin. Which one of the following shows its harmful effect and a useful application.

I Over exposure to the radiation causes HIV.
II Over exposure to the radiation causes cancer.
III Normal levels of radiation can be used for sterilizing needles.
IV Limited doses of radiation can be used for imaging internal body parts.

A I and III
B I and IV
C II and III
D II and IV

xx. The efficiency of a transformer can never be 100%. However, we can maintain the efficiency by using laminated iron core to prevent eddy current. Which of the transformers given in the table will be the most efficient?

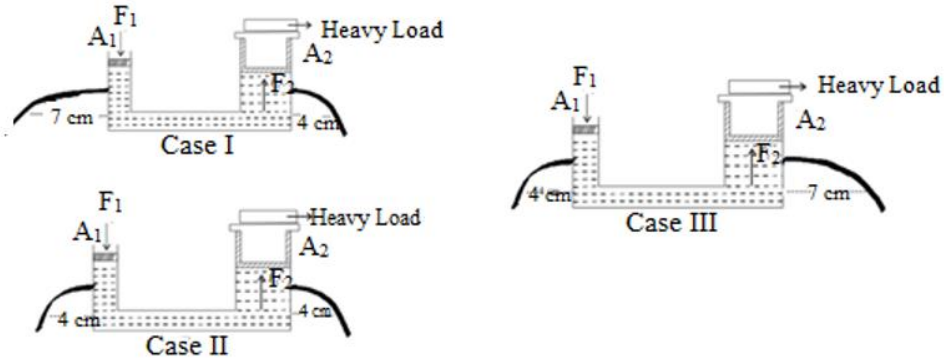
A U
B V
C W
D X

Transformer	Resistance provided by lamination (Ω)
U	10
V	20
W	30
X	40

xxi. Blowing over the surface of hot tea will

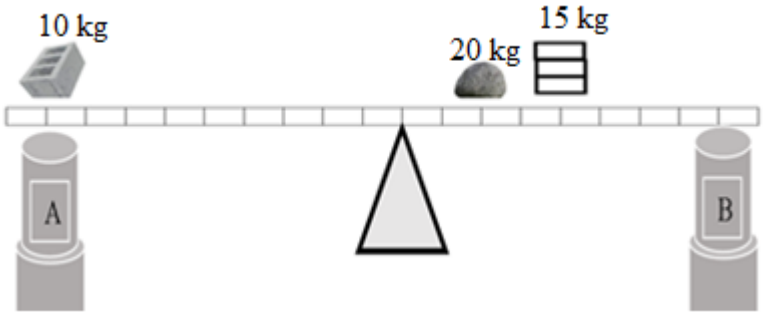
A make the tea lose heat.
B remove air particles and heat.
C establish thermal equilibrium between tea and the surrounding.
D facilitate a greater rate of heat transfer by increasing the temperature gradient.

xxii. The figures below shows an experimental set-up of hydraulic machines with water spouting from two identical holes. The set-up that obeys Pascal's law is

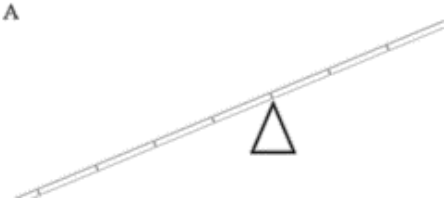


A Case I
B Case II
C Case III
D Case I, II and III

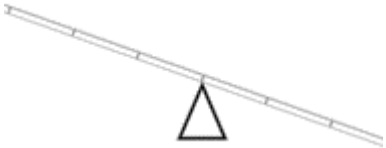
xxiii. If the supports A and B are removed, what will happen to the seesaw?



A



C



B

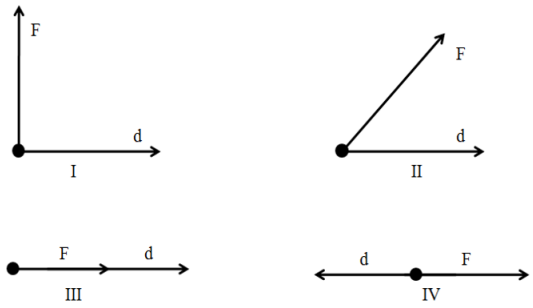
D

xxiv. Telescope **X** uses mirrors to focus the light of an image and telescope **Y** uses lenses to magnify the image. What type of telescopes are **X** and **Y**?

A X is a reflecting telescope and Y is a refracting telescope.
B X is a refracting telescope and Y is a reflecting telescope.
C Both X and Y are catadioptric telescopes.
D Both X and Y are reflecting telescopes.

xxv. Karma applies a force of 4 N on a block of 10 kg stone and displaces it by 3 m. The direction of force (F) and displacement (d) of stone is shown schematically in the figures below. In which case does he do maximum work?

A I
B II
C III
D IV



b) Fill in the blanks by writing suitable words. **[5]**

i.	Centre of gravity of a uniformly shaped circular ring will be at the _____.	
ii.	The thrust exerted by a person while sitting on the surface of a chair is equal to his _____.	
iii.	The amount of heat produced in an electric iron of 10 Ω resistance when heated for 30 s by passing a current of 5 A will be _____J.	
iv.	You can hear your friends talking in the adjacent rooms without seeing them because sound waves can undergo _____.	
v.	Mass number is the total number of_____ in the nucleus.	

c) State whether the following statements are TRUE or FALSE **[5]**

i.	Work is done whenever a force is applied on an object.		
ii.	Electrical appliances such as hair dryers, water boilers and heaters have high resistance wire with high melting point.		
iii.	The position of the centre of gravity of a body will not change with the change in a body's shape.		
iv.	While pedalling a bicycle, the forces applied are parallel to each other.		
v.	A transformer with more number of turns in secondary coil will have thicker secondary coil.		

d) Match each item under Column A with the item in Column B. Rewrite the correct pairs by writing the alphabet against the number in the space provide. **[5]**

Answer	Column B	Column B	
	i. Telescope	a. Output work > Input work	
	ii. Electromagnetic induction	b. resultant force zero	
	iii. Temperature difference between body 'A' and body 'B' is zero	c. resultant force maximum	
	iv. Practical machine	d. microorganisms	
	v. Falling object attains terminal velocity.	e. Output work < Input work	
		f. distant objects	
		g. a.c. generator	
		h. d.c. motor	
		i. Thermal equilibrium	

SECTION B [60 MARKS]

ATTEMPT **ANY SIX** QUESTIONS

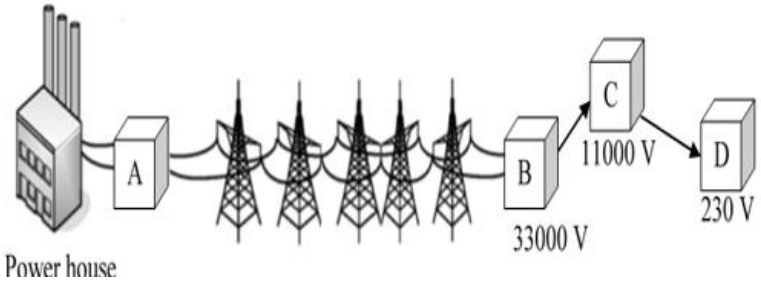
Question 2

a) In the electromagnetic spectrum, visible light lies between infrared and ultraviolet. Explain any **TWO** properties of green light. **[2]**

b) Suggest any **TWO** basic requirements with respect to the space programme in Bhutan for attaining self-sufficiency in the field of space technology. **[2]**

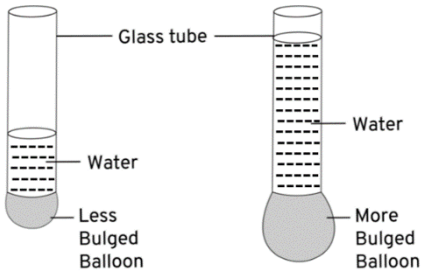
c) A woman of mass 60 kg runs up two flights of stairs that are 3m high each in 30 seconds. Calculate the useful power output developed. Take g = 10 m/s^2. **[2]**

d) A powerhouse generates an electricity of 11 kV. It is transmitted over long distances using transformers A, B, C and D as shown in the figure below. **[2]**



Which transformer A, B, C or D is a step-up transformer? Why?

e) Two balloons made of the same materials were attached to the bottom of two glass tubes of equal diameter as illustrated. Water was poured into each glass tube.



i. What could be the aim of this experiment? **[1]**

ii. Why do you think the balloon in the second tube is more bulged compared to the first tube? **[1]**

Question 3.

a) Write down the point of centre of gravity for the following given bodies. **[2]**

Shape of bodies	Position of C.G	
Spherical ball		
Circular ring		
Triangular lamina		
Thin uniform rod		

b) On a special project to revive the dying art of traditional sword making, a group of youth collected 2000 g native iron ores with a specific heat capacity 462 J/Kg °C. Calculate the amount of heat released to the surrounding if the iron ores cool from 80 °C to 20 °C after melting. **[2]**

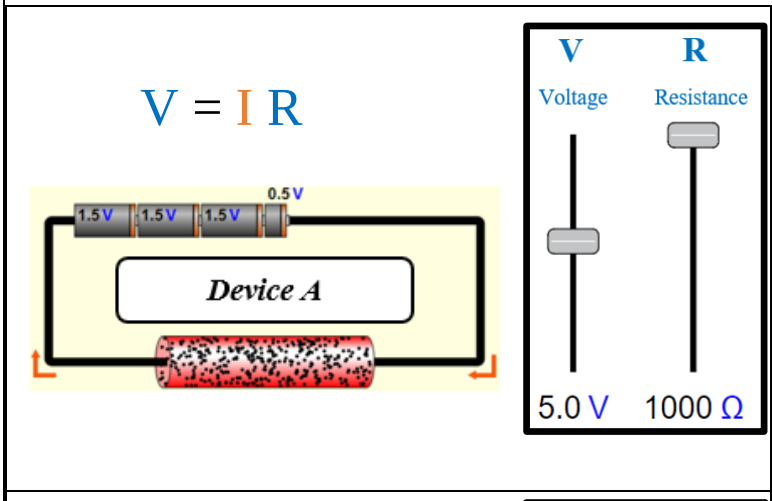
c) *A number of different wireless technologies have been developed for very short distances. These are referred to as 'short-range wireless communication.' Signals travel from a few centimeters to several meters. In contrast, signals in medium-range wireless communication travel up to 100 meters or so, while signals in wide-area wireless communication can travel from several kilometers to several thousand kilometers.* **[2]**

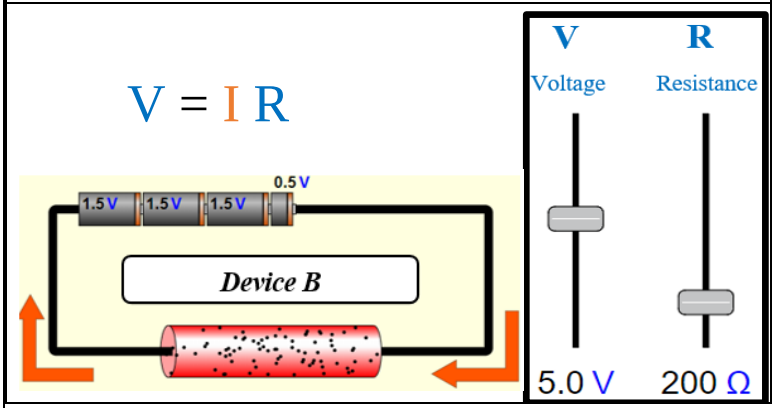
Read the information and write **Yes** or **NO** for each statement.

In Communication	**Yes/No**	
Bluetooth uses microwaves		
Wi-fi uses infrared radiations		
Bluetooth establishes internet		
Wi-fi is a medium range communication		

d)

i. Use the given data to calculate the amount of current flowing through devices A and B. **[2]**





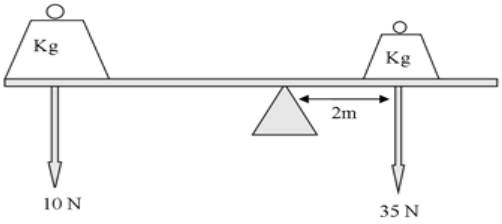
ii. If both the devices are heating appliances, which one will you use? Support your answer with **ONE** reason. **[1]**

e) In the fields of space exploration, Bhutan has also launched its first ever Bhutanese nano satellite on 29th June 2018 which was developed by a group of Bhutanese engineers. What is the name of the first Bhutanese satellite? **[1]**

Question 4

a) When we do work, energy is dissipated in the form of heat, light and sound due to resistive force. List down **TWO** examples of resistive force. **[1]**

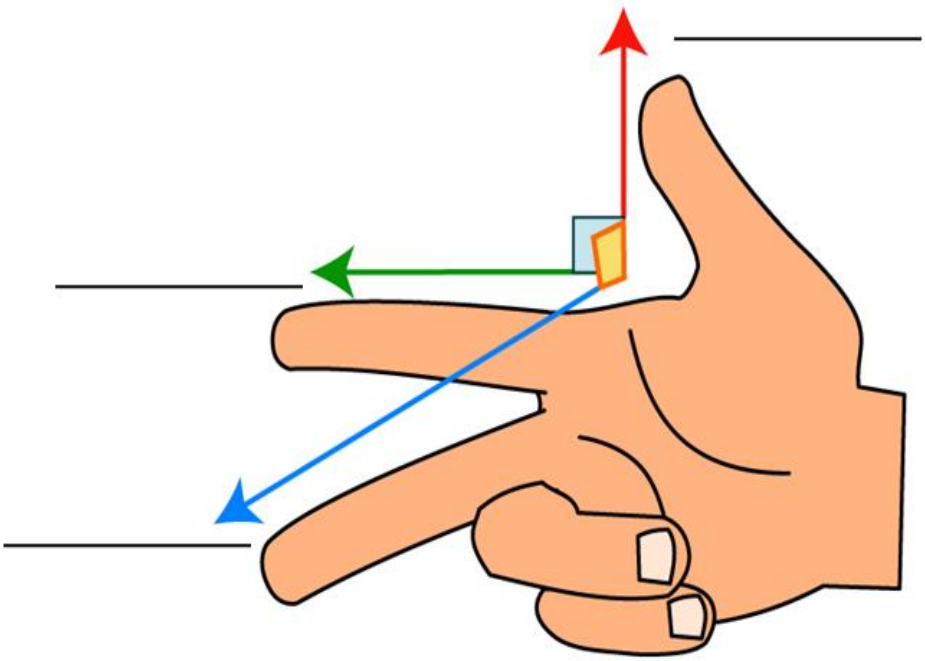
b) The diagram below shows two masses balanced on a level beam.



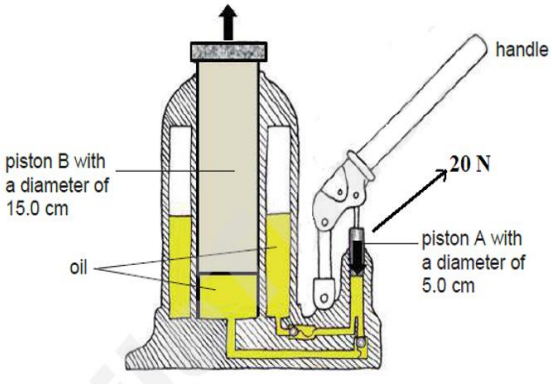
How far is 10 N weight from the pivot? **[2]**

c) Radiation has a wide range of uses in the field of medicine, agriculture and industry. However, radiation is also hazardous to mankind if not handled with safety measures. Evaluate the helpful and harmful effects of radiation. **[2]**

d) Which rule is illustrated below? Name the variables indicated by each arrow. **[2]**



e) The figure below shows the usage of a hydraulic jack to lift up the body of a car during the replacement of its tyre. A force of 20 N is exerted on piston A.



i. Calculate the amount of force exerted on piston B. **[2]**

ii. Explain why a liquid such as oil is used in the device? **[1]**

Question 5

a) A sky diver weighing 90 kg experiences a drag force of 150 N before he opens the parachute from a height of 3000 m above sea level. Find the net force acting on the sky diver. **[2]**

b) People living near lakes, sea and oceans experience moderate climatic conditions both during day and night. Use the concept of specific heat capacity of water to explain the phenomenon. **[2]**

c) The relationship between current, voltage and resistance is represented by Ohm's Law. However, Ohm's law is not applicable for all types of conductors. Differentiate between ohmic conductor and non-ohmic conductor with the help of graphical representations and examples. **[2]**

d) An electrical shop is selling two kinds of bulbs that produce the same amount of light. A comparative data for the two are shown in the table below. **[2]**

Bulbs	**Energy efficiency (%)**	**Cost of one bulb (Nu)**	**Average lifespan (h)**
1	20	15.10	4000
2	62	90.60	72000

Give **TWO** reasons to support your choice of the bulb to be used at home?

e) Suggest **TWO** safety precautions to minimize the negative impacts from radiations. **[2]**

Question 6

a) Give a reason for the following:

i. Racing cars have broad base and low height. **[1]**

ii. A person climbing a hill bends forward. **[1]**

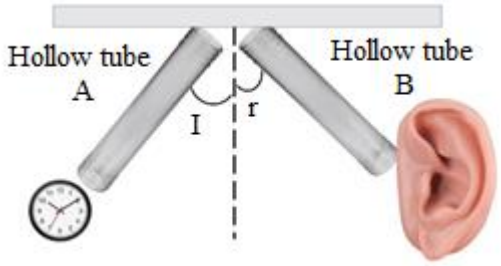
b) Specific heat capacities of different liquids are given in the table.

Substances	**Specific heat capacity in J/g^{o}C**
Water	4.19
Cooking oil	2.20
Milk	3.94

i. If 200 ml of all the substances are heated equally in a steel container having the same shape and size, which substance will get heated first? Why? **[2]**

c) Draw a labelled diagram of a telescope. **[2]**

d) The following setup was used for an experiment.



To hear the ticking sound of the watch, the angle of the tube A and B were adjusted as shown in the table.

Sl. No.	**Angle of incidence (I)**	**Angle of reflection (r)**
1.	30°	30°
2.	40°	40°
3.	50°	50°

i. State the law demonstrated in the experiment. **[1]**

ii. Write down **TWO** properties of sound waves not demonstrated in the experiment**.** **[2]**

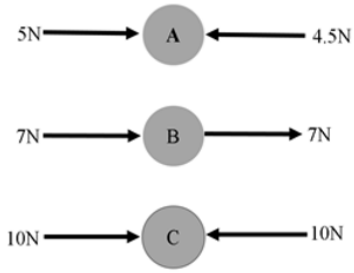
e) Snowboards are designed with greater surface area. Explain. **[1]**

Question 7

a) Replicating Galileo's experiment of falling bodies, imagine that you are dropping a metallic ball and a wooden ball of same mass and size from 30 metres height. State whether the following statements are true or false. **[1]**

i.	Metallic ball will reach the ground faster.		
ii.	Both the balls will reach the ground at the same time.		

b) Three objects A, B and C of same masses are in motion. If forces act on the bodies as shown in the figure below, which of the bodies will be in equilibrium? Explain. **[2]**



c) How is pressure of liquid related to its density? Draw a graph to illustrate pressure and density relationship. **[2]**

d) Ultraviolet (UV) radiation is divided into three categories of increasing energy: UV-A, UV-B and UV-C. UV-A is a low energy form of UV and has minimal biological effect. UV-B, a higher energy form, causes the most damage to living organisms and materials. UV-C is absorbed by oxygen in the atmosphere. Evaluate the helpful and harmful impacts of UV rays. **[2]**

e) Astronomers have confirmed the existence of more than 1,700 planets beyond the solar system and may soon prove the existence of thousands more of such exoplanets. Explain **THREE** characteristics of habitable planets. **[3]**

Question 8

a) Two copper wires of the same length and thickness conduct electricity in two different situations. The temperature of wire A is 20°C and the temperature of wire B is 80°C. Which wire do you think is a better conductor? Support your choice with **ONE** reason. **[1]**

b) Write down the mass number and atomic number of daughter nuclei when a radioactive element $^{230}X_{90}$ emits each of the following particles. **[2]**

Types of particles	Mass number	Atomic number	
α-decay	i. ……	ii. ……..	
β-decay	iii. ……..	iv. ……..	

c) Study the following diagrams and classify them into types of equilibrium and state the centre of gravity. **[2]**

Case I Case II

Cases	Equilibrium	Position of C.G	
I			
II			

d) A spacecraft is continuously orbiting around the Earth. Is the motion of this spacecraft an example of free fall? Justify your answer with **ONE** reason. **[2]**

e) A student did an experiment to calculate the efficiency of a machine as shown in the table. **[3]**

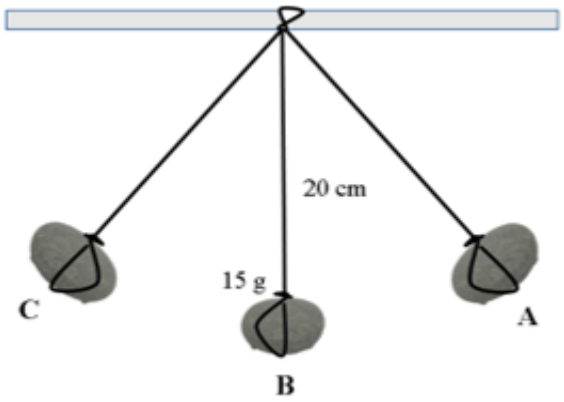
Sl. No	**Input energy energy(J)**	**Output energy(J)**
1	100	20
2	200	30
3	300	40
4	400	50

Calculate the energy supplied to the machines to produce 400 J of useful energy.

Question 9

a) Substances with different specific heat capacities are used for different purposes. Write **TWO** applications of water which has a high specific heat capacity. **[2]**

b) A stone of mass 15 g suspended from a string of length 20 cm is fixed from a pivot. When the stone is displaced to a certain angle and released, it swings back and forth in a periodic motion as shown in the figure below.



i. At which position will the stone possess maximum kinetic energy? **[1]**

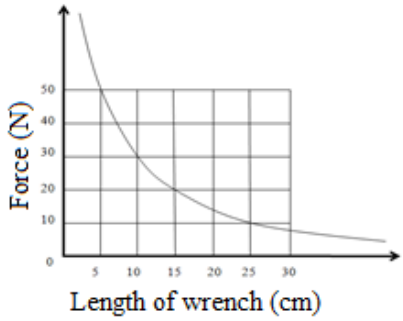
ii. Name and state the law demonstrated. **[1]**

c) You are provided with the following materials. **[2]**

1. Soft iron core
2. Thick copper wire
3. Thin copper wire
4. 50 V (a.c source)

Design a conceptual prototype of a transformer using the given materials that will convert 50 V to 20 V. Take the number of turns in the primary coil to be 10 turns.

d) The following graph shows the relationship of force applied and the length of wrenches used to open a nut bolt from a tyre.



What conclusion can you draw from the graph? What is the force required if the length of the wrench is 25 cm?

[2]

e) C represents an electromagnetic wave. Write **TWO** uses of the wave C. **[2]**