

Aga Khan University Examination Board
Notes from E-Marking Centre on SSC-I Physics Examination May 2017

Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC-I) Physics. It contains comments on candidates' responses to the 2017 SSC-I Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that requires candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the SLOs which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used.

This year candidates performed well on questions related to the physical quantities and measurement, dynamics, gravitation, work and energy, and transfer of heat. Whereas low-scoring candidates did not perform well in questions based on graphical interpretations, understanding and analysing, centre of gravity, equilibrium and stability, word problems based on pressure and thermal conductivity and also had problem in articulating their answers on reasoning and discussion type questions.

Detailed Comments:

Constructed Response Questions (CRQs)

Question 1:

Describe any THREE important contributions of physics in the field of technology.

Better responses correctly described three important contributions of physics in the field of technology. For example, high-scoring candidates wrote about discoveries such as magnetism; electricity; conductors and other man-made modern technologies such as television, mobile phones etc., modern means of transportation, such as aircrafts. They also wrote about the invention of transistors, logic gates, integrated circuits and computers.

Example:

Communication:- The effort of physicists helps us to communicate with peoples all over the world by help of mobile phones, TV, computer etc. Transportation:- with the help of the knowledge of physics vehicles are made which helps us in transport. e.g cars, buses, aeroplanes etc. Electricity is the most important discovery in physics which helps us in given light in dark, easy work by using electric motors.

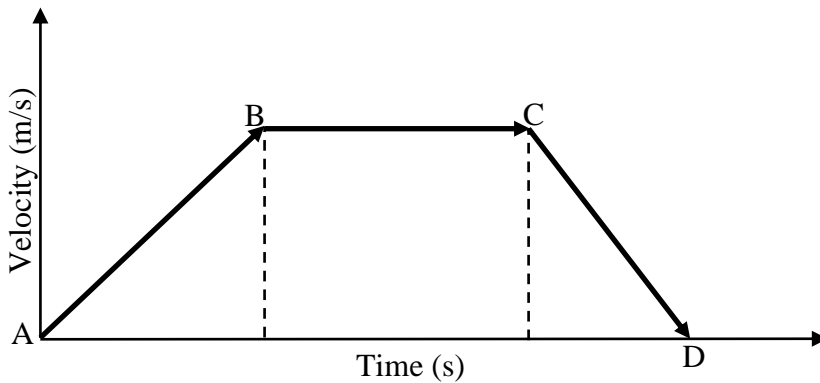
Weaker responses failed to write all three important contributions of physics in the field of technology. Few low-scoring candidates wrote only one correct contribution. They either wrote communication, mode of transportation or discovery of electricity. Some of the candidates wrote about the stone-age of the mankind before the contribution of physics in the field of technology.

Example:

physics play important role in field of technology. Before physics discovery. the people live in world with out any technology they difficult to do work. So, physics help us to help with technology. In old days people journey through animals After many month they get their journey complete.

Question 2:

Consider the given velocity-time graph for a body.



Lead-in:

Interpret the following segments with respect to 'acceleration' from the given graph.

- i. A to B
- ii. B to C
- iii. C to D

Better responses were able to correctly interpret the segments given in the graph with respect to acceleration, i.e. A to B: uniform; constant acceleration, B to C: zero acceleration and C to D: constant deceleration; negative acceleration; retardation.

Example:

- i. A to B (1 Mark)

In A to B, acceleration of the body is uniform because velocity is increasing uniformly

- ii. B to C (1 Mark)

During B to C, there is no acceleration produced because velocity is same or at rest.

- iii. C to D (1 Mark)

During C to D, there is uniform deceleration in the body because velocity is decreasing uniformly.

Weaker responses failed to write the correct interpretation of the segments given in the graph with respect to acceleration. Low-scoring candidates gave answers with respect to velocity or performed numeric calculations to find the value of acceleration which is not the demand of the question.

Example:

i. A to B	(1 Mark)
From A to B the body is showing constant velocity, and no change in acceleration.	
ii. B to C	(1 Mark)
From B to C the body is at rest, and the acceleration is constant.	
iii. C to D	(1 Mark)
From C to D the acceleration is falling down, because the velocity is changing.	

Question 3:

List any THREE methods of reducing friction.

Better responses correctly listed three correct methods of reducing friction. For example, by making the sliding surface smooth or changing with rolling surface, making the fast moving objects a streamline shape such as cars, aeroplanes etc., lubricating the sliding surfaces which slid over each other and using ball bearing or roller bearings in the objects which need to be dragged.

Example:

→ By using lubricants like oil.
→ By reducing the contact areas of the objects.
→ By convert rough surface in to smooth surface using different kind of instrument.

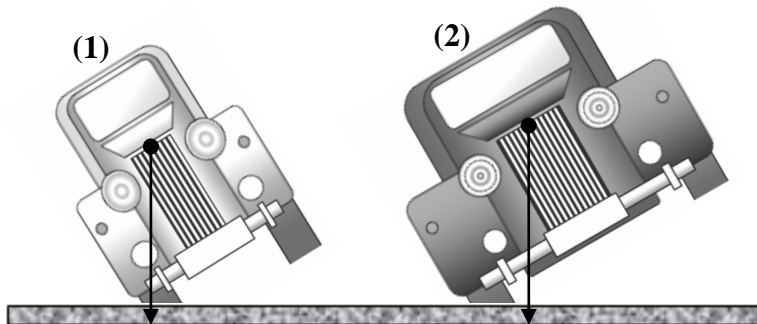
Weaker responses misunderstood the demands of the question and wrongly mentioned methods of reducing friction. Moreover, low-scoring candidates wrote that friction can be reduced by walking, running or wearing joggers on a surface.

Example:

(1) Friction is also a force. if we force applying on a moving body that these object is reducing the friction.
 2) if we through the hand we reducing the friction.
 3) through the foot we reducing friction.

Question 4:

Consider the given figure to answer the following questions.



- i. Identify the car which is more stable with reference to its centre of gravity (●).
- ii. For the car identified as more stable, write an effect of each of the following on its stability.
 - Position of the centre of gravity
 - Area of the base

Better responses correctly identified the car which is more stable with reference to its centre of gravity, i.e. car (2). High-scoring candidates correctly wrote the effects of stability with respect to the position of the centre of gravity, i.e. centre of gravity must lie inside the body; within the base; in the centre; in the middle and with respect to the area of the base as when a car with a big; wide; large base area is less likely to fall or topple over than a car with a small base area.

Example:

i. Identify the car which is more stable with reference to its centre of gravity (●). (1 Mark)

The car 2 is more stable.

ii. For the car identified as more stable, write an effect of each of the following on its stability. (2 Marks)

- Position of the centre of gravity
- Area of the base

The position of centre of gravity is right side or in the middle of both tyres and it is stable.

The area of the base of car 2 is more and more area means more stability.

Weaker responses attempted either part (i); identified the car which is more stable or part (ii); wrote an effect about the stability with respect to the position of the centre of gravity or with respect to the area of the base of the car. Few low-scoring candidates wrote about the push and pull due to the force of gravity on the car and definition of the centre of gravity in their answers which were not the demand of the question.

Example:

i. Identify the car which is more stable with reference to its centre of gravity (●). (1 Mark)

The car one will be more stable rather than car 2.

ii. For the car identified as more stable, write an effect of each of the following on its stability. (2 Marks)

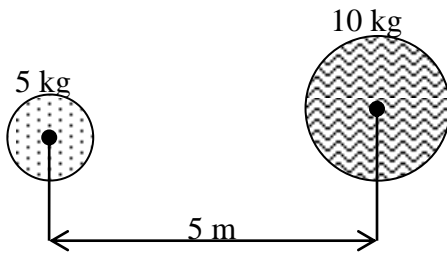
- Position of the centre of gravity
- Area of the base

• Position of the centre of gravity like ~~the~~ the gravity will pull car on fire so it will have be more stable.

Question 5:

Calculate the force of gravitation between the given balls.

(Note: The value of gravitational constant $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$.)



Better responses correctly calculated the force of gravitation between two balls by extracting the correct data (values) of Gravitational constant (G), mass of the first ball (m_1), mass of the second ball (m_2) and radius between the centres of two balls (r) from the question along with the correct formula,

$$F = G \frac{m_1 \times m_2}{r^2} \text{ and correct SI unit (Newton, N).}$$

Example:

$$\begin{array}{l}
 F = G \frac{m_1 m_2}{r^2} \\
 = \frac{6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \times 5 \text{ kg} \times 10 \text{ kg}}{25 \text{ m}^2} \\
 = 13.34 \times 10^{-11} \text{ N} \rightarrow \text{ANS}
 \end{array}
 \quad
 \begin{array}{l}
 G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \\
 m_1 = 5 \text{ kg} \\
 m_2 = 10 \text{ kg} \\
 r = 5 \text{ m} \\
 r^2 = 25 \text{ m}^2
 \end{array}$$

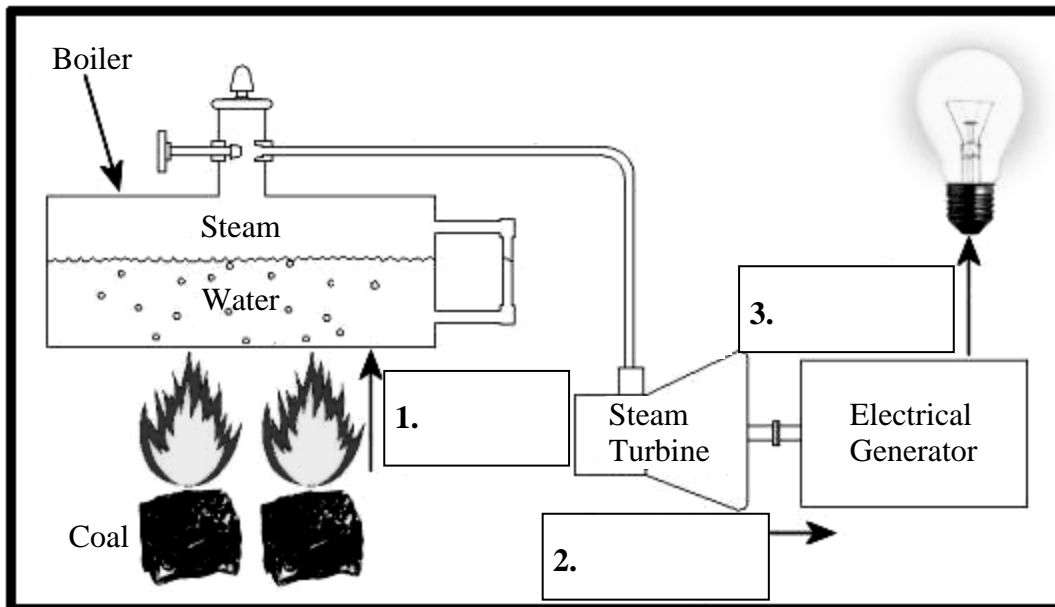
Weaker responses neither extracted the correct data (values) from the question nor applied the correct formula of Newton's Law of Gravitation; therefore, failed to obtain full marks. Some low-scoring candidates only wrote the correct formula but unable to substitute the correct values and hence calculated the wrong answer.

Example:

$$\begin{aligned}
 g &= G \frac{m_1 m_2}{m_1 + m_2} \times h \\
 &= 6.67 \times 10^{-11} \frac{5 \times 10}{5 + 10} \times 5 \\
 &= 200 \quad 6.67 \times 10^{-11} \div 25 \\
 &= 0.2668 \times 10^{-11}
 \end{aligned}$$

Question 6:

Identify the types of energy at positions 1, 2 and 3 in the given illustration of a thermal plant.



Better responses correctly identified the types of energy in the given thermal plant, like heat energy; thermal energy, mechanical energy; kinetic energy and electrical energy.

Example:

1. Heat energy.
2. Kinetic energy.
3. Electrical energy.

Weaker responses failed to identify all three types of energy. Low-scoring candidates wrote potential, kinetic and chemical energy in their answers.

Example:

1. ~~potential energy~~, chemical energy
2. potential energy
3. kinetic energy.

Question 7:

Calculate the pressure due to fluid at a depth of 10 cm in still water.

(**Note:** The density of water is 1000 kg/m^3 and the value of acceleration due to gravity is 10 m/s^2 .)

Better responses correctly extracted the correct data (values) from the question, converted the unit of the depth of the fluid from 'cm' into 'm', wrote the correct formula, $P = \rho g h$ and calculated the correct answer $P = 1000 \text{ pa}$.

Example:

Data:- $\rho = 1000 \text{ kg/m}^3$ $h = 10 \text{ cm} = 0.1 \text{ m}$ $g = 10 \text{ m/s}^2$

pressure ?

$$P = \rho g h$$

By putting values

$$P = (1000 \text{ kg/m}^3)(10 \text{ m/s}^2)(0.1 \text{ m})$$
$$P = 1000 \text{ pa.}$$

Weaker responses neither applied the correct formula of pressure nor were able to convert the unit from 'cm' into 'm' and hence, calculated the wrong answer.

Example:

Data 1-

depth = 10 cm

density of water = 1000 kg/m³

gravity = 10 m/s²

$$\frac{1000 \times 10}{10} = \frac{9990}{10} \quad \text{Ans}$$

Question 8:

A 4 cm thick cast iron sheet has a cross-sectional area of 10,000 cm². If one side of the sheet is at 500°C and the other is at 600°C, then how much amount of heat passes through the sheets in each second?

(Note: The thermal conductivity 'k' of cast iron is 85 W/m.K)

Better responses started with extracting the correct data (values) from the question, conversion of length and area from 'cm' to 'm' and 'cm²' to 'm²', used the correct formula, $\frac{Q}{t} = k \frac{A(\Delta T)}{L}$; substitution and hence calculated the correct answer, Q = 212500 kJ/s.

Example:

<u>Data</u>	<u>SoL</u>
length(L) = 4cm = 0.04m	$\frac{\Delta Q}{t} = \frac{K(A)}{L} (T_1 - T_2)$
Area (A) = 10,000 cm ² = 1 m ²	$\frac{\Delta Q}{t} = \frac{85 \cdot 1 \cdot (100K)}{0.04}$
T ₁ = 500°C, T ₂ = 600°C	$\frac{\Delta Q}{t} = \frac{85 \times 100}{0.04}$
ΔT = 100°C = 100K	$\frac{\Delta Q}{t} = 212500 \text{ J/s}$
$\frac{\Delta Q}{t} = ?$, K = 85 W/mK	$\frac{\Delta Q}{t} = 2.125 \times 10^5 \text{ J/s}$ Ans
<u>Formulae:</u>	
$\frac{\Delta Q}{t} = \frac{K A (\Delta T)}{L}$	

Weaker responses wrote the data but were unable to convert 'cm² into m²'. Some of the low-scoring candidates tried to convert the units but failed to convert them into SI units. Some also wrote the formula wrong as $k \frac{(\Delta T)}{A}$ or $t \alpha \frac{1}{d}$ to calculate the amount of heat.

Example:

$Q = \frac{k \Delta T A t}{L}$	<p style="text-align: center;"><u>Data</u></p> $\Delta T = 873 - 773 = 100K$ $\therefore 10,000 \text{ cm}^2 = 1 \text{ m}^2$
$= \frac{0.5 \times 100 \times 1 \times 1s}{0.04 \text{ m}^2}$	
$Q = \frac{5000}{0.04 \text{ m}^2}$	
$Q = 212500 \text{ w/s}$	

Extended Response Questions (ERQs)

These questions offered a choice between part **a** and **b**

(Note: Majority of the candidates attempted Question **9b** and they scored well in this part.)

Question 9a:

A boat travels toward south with a steady velocity of 30 m/s through a river in which there is a steady flow of water in the direction of the east at a velocity of 15 m/s.

- Illustrate the given situation using a labelled vector diagram.
- Show the direction of the motion of the boat in the diagram.
- Calculate the resultant velocity of the boat.

Better responses correctly illustrated the direction of boat by taking an appropriate scale. The second part of the question is the essential part e.g. if the candidates correctly illustrated the direction of the boat, they easily identified the final direction of the boat, i.e. South-East. In the final part of the question, high-scoring candidates calculated the correct resultant velocity, $v_R = 33.5$ m/s of the moving boat.

Example:

(i)

Scale: 2cm = 10m/s

(ii) In the diagram, the ^{resultant} vector shows the direction of motion of boat, which is South-East.

(iii) Solution: By Pythagoras' theorem $h = \sqrt{b^2 + p^2}$.
here, p = velocity of boat, b = velocity of river
& h = direction of motion of boat.

$$h = \sqrt{b^2 + p^2} \Rightarrow h = \sqrt{(15)^2 + (30)^2} \Rightarrow h = \sqrt{225 + 900}$$
$$\Rightarrow h = \sqrt{1125 \text{ m}^2/\text{s}^2} \Rightarrow h = 33.5 \text{ m/s}.$$

Weaker responses neither illustrated the given situation using labelled diagram nor correctly showed the direction of the boat. Some low-scoring candidates wrote the correct Pythagoras theorem $h^2 = p^2 + b^2$ for finding the correct value of resultant velocity but unable to substitute the correct values in the formula also wrongly mentioned the direction of the motion of the boat as southward.

Example:

~~the~~ boat will move in ^{South} direction ~~boat~~ boat
~~the~~ ~~river~~ is ~~moving~~ ~~to~~ ~~is~~ ~~South~~ east direction

$$h^2 = p^2 + b^2$$

~~h = 30 + 15~~ $h = p + b$
 $h = 30 + 15$
 $h = 45 \text{ m/s}^2$

The resultant velocity is 45 m/s^2

Question 9b:

An object of mass m is given an upward acceleration \vec{a} by pulling a rope.



Lead-in:

- i. Label the following points in the given diagram.
 - The direction of weight of the object
 - The direction of tension in the rope
- ii. If the object is moving upward and the weight is given by $F_w = mg$, then derive a simplified expression for the tension in the rope.

Better responses correctly labelled the direction of the weight of the object (downward, F_w) and tension in the rope (upward, F_T). Some of the high-scoring candidates marked the directions on the given diagram and derived a simplified expression for the tension in the rope up till $\therefore F_T = m(g + a)$ or $T = m(g + a)$.

Example:

b.i. • The direction of weight ~~is~~ ~~of~~ of the object is downwards.

• The direction of Tension in the rope is upwards

ii. here, weight = $F_w = -mg$.

~~as tension~~ As the body is accelerating upwards, Tension in the rope will be greater than the weight of object, so

$$F = T - F_w$$

here, $F_w = -mg$

$$F = T - (-mg)$$

As $F = ma$, so, $ma = T - (-mg)$

$$T = ma + mg$$

$$T = m(a + g).$$

Tension produced will be equal to mass of the object multiplied by ~~acceleration~~ ~~p~~ sum of acceleration produced due to pulley pulling and acceleration produced due to gravity.

Weaker responses correctly labelled the direction of the weight of the object and tension in the rope but were unable to derive the simplified form of the expression $\therefore F_T = m(g + a)$ or $T = m(g + a)$.

Example:

~~t~~ $\propto F_w$ data
~~t~~ Tension = t
weight = F_w
mass = m

$t \propto F_w$
 $t = k F_w$
k = mass of a body = m
 $t = m \times F_w$
 $F_w = mg$
 $t = m^2 g$
~~t~~
tension = $\text{kg}^2 \text{m/s}^2$

(Note: Majority of the candidates attempted Question 10b and they scored well in this part.)

Question 10a:

'A working system cannot have an efficiency of 100%.'

Justify the given statement with reference to heat expels, heat transfers or Carnot limit.

Better responses correctly justified that a working system cannot have an efficiency of 100% by providing references for either heat expels and heat transfers or Carnot limit. High-scoring candidates wrote that a system which works by transferring heat into the surrounding cannot achieve 100% efficiency theoretically. Some of the high-scoring candidates also wrote about the heat flow from high temperature to low temperature (i.e. from heat source to heat sink) therefore, unable to achieve 100% efficiency. Moreover, if there is no heat sink, then there will be no motive force for heat transfer, hence, unable to utilise the energy via a heat engine. Some candidates also wrote that there are many other constraints such as friction, dumping energy as sound, dumping energy as pressure, etc. but even by reducing these constraints to zero, it can never pass the Carnot limit.

Example:

Yes a working system cannot have an efficiency of 100%.
When we give energy to any system it doesnot show 100% efficiency because some of energy is lost due to friction or any other factor.
For example a car has fuel in it, the chemical energy of ^{the} fuel is converted into kinetic energy and the body ~~ke~~ moves. Thus the energy of the fuel is ~~tran~~ transferred from one form to another.
And from the remaining energy most of the energy is used as sound energy, light energy. Due to friction most of the energy expels as heat, which transfers to the surrounding.
From this we come to know that no system has efficiency of 100%. B/c most of the energy expels as heat and some is used

Weaker responses failed to provide the correct justification for the given statement with the mentioned references and hence, scored low. Some low-scoring candidates wrote about three modes of transfer of heat i.e. conduction, convection and radiation in solid, liquid and gases which were not the demand of question.

Example:

No working system can give you 100% results.
When we put something to freeze like water the heat is lost and at 0°C its freezing point it changes its state from liquid to solid. Though this is a freezing process there are still few droplets of water which doesn't freeze. They condense the vapour in atmosphere and it changes from gaseous state to liquid state.
Not all mediums transfer heat in same way. Like solid transfer heat by conduction. Liquid and gas transfer heat by convection and radiation do not need any medium.
These things tell us that a working system cannot have an efficiency of 100% even if you use most advanced technologies.

Question 10b:

Describe why the atmospheric pressure falls at a height above the sea level. Give your answer with reference to gravity, air compression and temperature of the surrounding.

Better responses correctly described the reason that the atmospheric pressure falls at a height above the sea level by providing the aforementioned reference in the question. Some of the high-scoring candidates wrote that the gravitational attraction between the earth and air molecules is greater for those molecules nearer to earth than those farther away. Some candidates compared the weight on the surface of the Earth and at some height; this difference of weights dragged the air molecules closer together and increased the pressure between them. Candidates also wrote that all the molecules which are further away from the earth surface have less weight.

Example:

Atmospheric pressure is due to the collision and random motion of air particles like gases. It falls at a height above the sea level because;

(i) Decrease in gravity: In an altitude above earth surface gravity decrease due to less number of particles are present which result in less collision and force exerted by the particles.

(ii) Air compression decreases due to low gravity. This results in greater space among particles which decrease the collision and the molecules move farther apart which decrease the atmospheric pressure.

(iii) Temperature of the surrounding: In higher altitude the surrounding temperature is low. Due to low temperature the kinetic energy of the molecules decreases and this decreases the atmospheric pressure.

So the main reasons of decrease in atmospheric is the increase in inter spaces, decrease in collision and random motion.

Weaker responses failed to provide the correct reason by addressing all the references in their answers. Some low-scoring candidates tried to write the correct reason by explaining with respect to gravity, gravitational force and change in temperature.

Example:

Atmospheric pressure falls above the sea level. Because if we move upwards as the atmospheric pressure will decrease so therefore the earth can attracts the object toward itself by gravitational force. And as we move upwards the efficiency of air is decreasing therefore atmospheric pressure fall because it is totally depends on air. If efficiency of air is high it will also be high. The atmospheric pressure will high if the temperature will high. It is directly proportional to temperature. As we go above sea level the temperature will be low. So therefore atmospheric pressure falls above sea level.

(Note: Majority of the candidates attempted Question 11a and they scored well in this part.)

Question 11a:

Explain with a daily life example how evaporation causes cooling effect.

Better responses correctly explained more than one daily life example for evaporation causing cooling effect, e.g. a person after swimming or after taking shower feels cold. Some of the high-scoring candidates also wrote about kinetic energy of molecules, escaping of the high energy molecules, decreasing in the body temperature, or energy of the remaining molecules which produce cooling effect.

Example:

Evaporation the process of changing of liquid molecules into vapours at any temperature is called as ^{evaporation} ~~cooling~~.

Evaporation causes a cooling effect

- As we know that the temperature of liquid depends upon the kinetic energy of the molecules. as high kinetic energy molecules are escape from the surface of liquid. the remaining are left with low kinetic energy of molecules as a result the temperature of the body falls.
- Humans normal temperature is maintained through the process of evaporation. as in sunny day the molecules ^{of H₂O} in body move with very fast speed and gains more temperature ^{through pores} as a result ~~and~~ the high kinetic energy molecules escape from the skin and left with low kinetic energy of molecules as a result we feel cooling.
- when a swimmer comes out after swim he/she feel cooling because the rate of evaporation is increased ~~use~~ by the surrounding medium.
- A glass with hot water left for an hours become cold because the high kinetic energy molecules are escape from the surface and temperature of remaining falls.

Weaker responses mentioned irrelevant ideas like the requirement of heat to the water for evaporation or they described the factors affecting evaporation.

Example:

(a) A daily life example of evaporation cause cooling effect of air in the form of oxygen gas are formed in due to its normal way of expression are reduce in physical state of radiation in the daily life of example of evaporation it the physical state of evaporation- A working system cannot have a efficiency of 100% statement with reference to evaporation cause cooling effect method of radiation application of heat-

Question 11b:

Discuss any FIVE applications of heat transfer by the method of radiation.

Better responses correctly discussed more than five applications of heat transfer by the method of radiation. Some of the responses from the high-scoring candidates wrote the applications as follows.

Dark, dull colour dresses should be worn in winter because they radiate less heat, e.g. people living in cold areas usually wear dark, shiny dresses; a fire-fighting suit is bright and shiny so that it does not absorb much energy; the cooling fans on the back of refrigerators and in vehicle radiators painted dull black colour so that they will radiate away energy at a faster rate; kettles and teapots have brightly polished inner surfaces, so that they will not be able to lose much energy by radiation; based in the bottom of the kitchen utensils are dull black, so that they will be able to absorb more heat energy, the solar panel has a dull black surface to absorb more heat energy from the sun and produce more electricity.

Example:

In winters we wear dull coloured clothes because ^{more} heat radiates in the clothes which keep us warm.

Fire fighters wear brightly coloured uniforms for the extreme heat, because less heat is absorbed in.

Thermos and kettles are brightly coloured so that they keep the liquid inside them warm because heat doesn't escape much from there.

The pipes behind refrigerators and the radiator of vehicles are ~~are~~ dark coloured, because they don't let the heat to radiate away fastly.

The base of food utensils are coloured black so that more heat could radiate in.

Weaker responses failed to provide the correct applications. Low-scoring candidates wrote about modes of transferring of heat conduction, convection and radiation. Some of the candidates also discussed about combustion, pollution, types of pollution and environmental issues related to pollution which were completely irrelevant.

Example:

- ① When there will be radiation there will be heat and that heat will be transferred.
- ② When there will be radiation there will be emission of ray - through those rays we can get energy or transfer of heat energy.
- ③ When there will be radiation many chemical reactions will take place and those reactions will provide heat and that heat will be converted into heat energy.
- ④ ~~the~~ Sometimes when there will be radiation there will be combustion and through combustion the energy can be transferred.
- ⑤ If there will be radiation radioactive rays will be emit through through there will be transfer of heat.