ISESE PHYSICS.
FORM IV MARKING SCHEME.

01.

i	ii	iii	iv	v	vi	vii	viii	ix	x.
C	C	A	B	B	B	D	A	C	D

@ 1 = 10 marks.

02.

i	ii	iii	iv	v	vi
B	A	E	C	F	D

@ 1 = 6 marks.

SECTION B:

03. (a) The roads on hill are gently sloping in order to reduce the effect of steepness which causes more downward gravitational pull on the vehicle, A steeper sloped road would slow the car down to a greater extent that an gently sloping one. 4.5 marks.

(b) The overtaking car accelerates to catch up to the car infront. Once it reaches a constant speed, it maintains that speed to stay at the same distance behind the leading car. This situation demonstrates uniformly accelerated motion for the overtaking car and uniform motion for the car infront. 4.5 marks.

04. (a) The fundamental interval of your colleague's thermometer, if larger can lead to less precise temperature measurements in the lab. This might introduce errors into your experimental data, making it crucial to use thermometer with smaller fundamental intervals for accurate results. (5 marks)

(b) Advantages of tidal energy are:-

(i) Environmental friendly.
(ii) A highly predictable energy source.
(iii) Operational and maintanance costs are low.
(iv) An inexhaustible source of energy.

Disadvantage of tidal energy are:-

(i) High tidal power plant constructions costs.
(ii) Negative influence on marine life forms.
(iii) Location limits.
(iv) The variable intensity of sea waves.

@ 0.5 marks.

05. (a) Resultant force, $\vec{F} = \sqrt{(H_x)^2 + (H_y)^2}$

Resultant force, $\vec{F} = \sqrt{(50000)^2 + (100000)^2}$.

Resultant force, $\approx$ 51,478N. 04 marks.

Direction

$$\theta = \tan^{-1}\left(\frac{\text{vertical component}}{\text{Horizontal component}}\right).$$

$$\theta = \tan^{-1}\left(\frac{100000\,N}{50000\,N}\right) = 11.31^\circ$$

Hence the force is 51,478N and acts at 11.31° to the horizontal. 01 marks.

- This information could influence the design of safety system by guiding the development of features, that can absorb and dissipate energy effeciently in both horizontal and vertical directions.

(b) Yes, dew will form, when the air temperature drops to the dew point temperature or below, the air becomes saturated and excess moisture condenses on surfaces.

06. (a) When I spilled cooking oil on the hot counter top, it quickly spread out into a thin layer, This happens because the heat from the counter top reduces the oil's density. As a result, the oil becomes less dense and more likely to spread out covering a larger surface area. 04 marks.

(b) Data given:-

$V_1 = 4.35L$, $P_1 = 1.16$ atm, $P_2 = ?$, $V_2 = 9.3L$

Apply Boyle's law

$$P_1V_1 = P_2V_2$$

Then $$P_2 = \frac{P_1V_1}{V_2} = \frac{1.16 \times 4.35}{9.3}$$

$$P_2 = 0.544 \text{ atm}.$$

Hence the new pressure in the car tire, when inflated to a volume of 9.3L while keeping the temperature constant is approximately to 0.544 atm. 05 marks.

07 (a) To minimize heat loss by convection in an industrial setting, consider installing air curtains or partition walls to create thermal barriers, Additionally insulating ductwork and using high efficiency heaters can help maintain the desired temperature without excessive energy consumption. 04 marks.

(b) Data given:-

$C_w = 4186\ J/kg°C$.

$C_s = 390\ J/kg°C$.

$M_w = 800g$.

$\theta_w = 20°C$

$\theta_s = 90°C$.

From Conservation of energy.

Heat lost by shot = Heat gained by water.

$M_s C_s \Delta\theta_s = M_w C_w \Delta\theta_w$. 04 marks.

$M_s C_s (80°C - 40°C) = M_w C_w (40°C - 20°C)$.

$M_s \times 390 J/kg°C \times 40°C = 0.8kg \times 4200 J/kg°C \times 20°C$.

$M_s = \frac{67200}{15600 J/kg}$.

$M_s = 4307.79$. 04 marks.

∴ Hence the mass of shot is 4307.79.

08. (a) The strategic placement of reflective surface in concert hall design ensure that sound waves reflect appropriately, preventing excessive absorption. This enhances the clarity and richness of the music by allowing multiple reflections of sound waves to reach the audience creating a more immersive and enjoyable acoustic experience. 4.5 marks.

(b) The colleague is exposing themselves to the risk of an unmonitored dose of ionizing radiation. The radiation monitoring badge measures the amount of radiation exposure ensuring that it stays within safe limits. and preventing potential health hazards such as radiation sickness. 4.5 marks.

SECTION C:

09. (a) A single-stage amplifier would boost the weak audio signals from the audio source, ensuring that the music is delivered with increased power to the speakers, resulting in a louder and more impactful sound for the party. 03 marks.

(b) (i) NPN transistor.

- Emitter (N-type): This is where majority charge carriers are electrons.
- Base (P-type): This is the thin middle layer. It's relatively lightly doped and this is where electron-hole pairs can be created.
- Collector (N-type): This is where electrons, the majority charge carriers are collected. @ 2marks.

(ii) PNP transistor.

- Emitter (P-type):- This is where majority charge carriers are holes.
- Base (N-type):- Similar to the NPN case, this is where electron-hole pairs can be created.
- Collector (P-type):- This is where holes, the majority charge carriers are collected. @ 2 marks.

⇒ The key feature here is that both types of charge carriers (electron and holes) are involved in the operation of the transistor, hence the term "bipolar". The transistor operates based on the movement of charge carriers across the semiconductor layers, allowing for current amplification.

10. (a) To prevent accidents and ensure the rides smooth operation, magnetic brakes can be incorporated using the principles of magnetic field. These brakes can control the rotation speed of the platform. 05 marks

(b) In the design of electrical generator for a renewable energy project, the following key elements are considered:-

(i) Rotating coil: A coil of wire is mounted on a shaft and is free to rotate within a magnetic field.

(ii) Magnetic field: A strong and consistent magnetic field is established, typically using permanent magnets or electromagnets.

(iii) Rotational motion:- The coil is mechanically connected to a source of rotational motion, such as a turbine driven by wind, water or steam.

(iv) Electricity generation:- As the coil rotates the magnetic flux through it changes inducing an EMF according to Faraday's law.

(v) Efficiency optimization; The design aims to maximize the efficiency of energy conversion by considering factors such as the strength of the magnetic field, the number of turns in the coil and the speed of rotation.

@ 2 marks = 10 marks.

11. (a) Orion

→ Orion is the prominent constellation known for the three bright stars forming orion's belt. The spacecraft could use orions distinctive pattern to establish a reference point for orientation.

(b) Ursa Major

→ Ursa major contains the well known big dipper, a group of seven bright stars that form a ladle like shape. The spacecraft could use the orientation of the big dipper to determine its position in relation to this recognizable constellation.

(c) Cassiopeia.

→ Cassiopeia is a dinstictive W-shaped constellation. By identifying cassiopeia's pattern, the spacecrafts navigators system could confirm its orientation and make adjustment if necessary.

(d) Scorpius:

→ Scorpius is a constellation that resembles a scorpion and contains the bright red star antares. The spacecraft could use scorpius to confirm its direction and make course corrections based on this celestrial marker.

(e) Gemini.

→ Gemini is a constellation representing the twins castor and pollux. The spacecrafts navigation system could utilize the position of gemini to ensure that it is following the correct trajectory especially during specific milestones in the mission.

@ 3marks = 15 marks.