535/1 PHYSICS

SCORING GUIDE

Total = 80 scores

SECTION A

Item 1 (Total = 16 Scores)

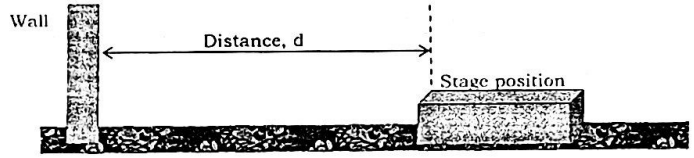
(a) 2 scores for the definition and explanation

Echoes are formed when sound waves hit a hard surface/reflecting surface and reflect back towards the source. For an echo to be perceived distinctly, the reflecting surface must be at least 17 meters or must return to the source in after 0.1 s. This is because the human ear cannot distinguish sounds that return in less than 0.1 seconds.

Importance of Avoiding Echoes: (2 scores for any two correct response)

(i) Echoes can cause sounds to overlap, making it difficult for the audience to understand speech or enjoy music.
(ii) Multiple reflections can distract both performers and the audience.
(iii) Ensuring minimal echoes leads to better sound quality and an overall improved experience.

(b)



Let distance from stage to the wall, d = speed × time
Distance from stage to wall and back to stage = 2d
Toatl time for laser to make a round trip = 0.16 s

$$\text{distance, d} = \frac{\text{speed} \times \text{time}}{2}$$

$= \frac{330 \times 0.16}{2}$ (1 score)

$= \frac{52.8}{2} = 26.4$ m (1 score)

Since the distance of 26.4 m is more than 17 m, the selected position is likely to be affected by interference of echoes. The committee should consider alternative locations or use sound-absorbing materials to minimize echoes. (1 score)

(c) 2 scores for any two correct responses.

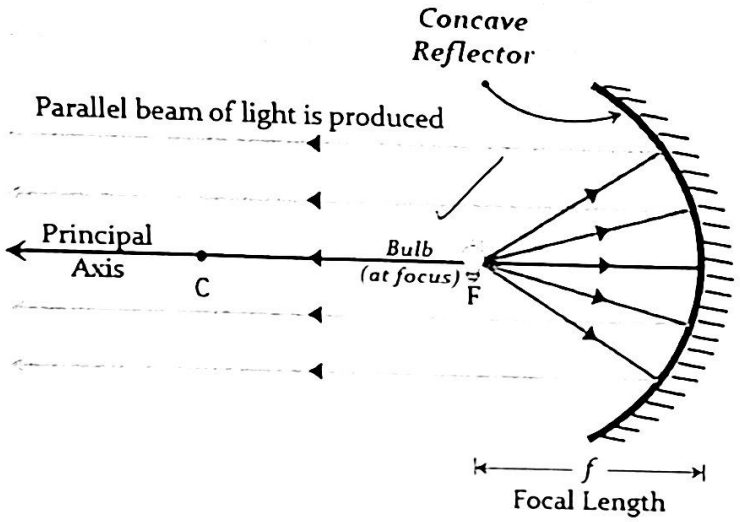
(i) Laser beams are highly directional and can be accurately aimed at specific points, making them ideal for measuring distances.

(ii) Lasers produce coherent light, meaning the light waves are in phase, which reduces scattering and helps in achieving precise measurements.

(iii) Laser beams are easily visible over long distances.

(c) A parabolic mirror is designed to reflect light rays that are parallel to its axis of symmetry When the laser light source is placed at the focal point of a parabolic mirror , it emits light in all directions towards the mirror. The mirror then reflects all the perfectly parallel with one another and can move to a far distance with less interference. (2 scores for the explanation)

(1 score for the diagram)



(b) When red light is shone on a yellow dress with blue spots, it will appear red with black spots. 2 scores

Explanation

Red colour will be reflected since its common to yellow. Red + Green = Yellow

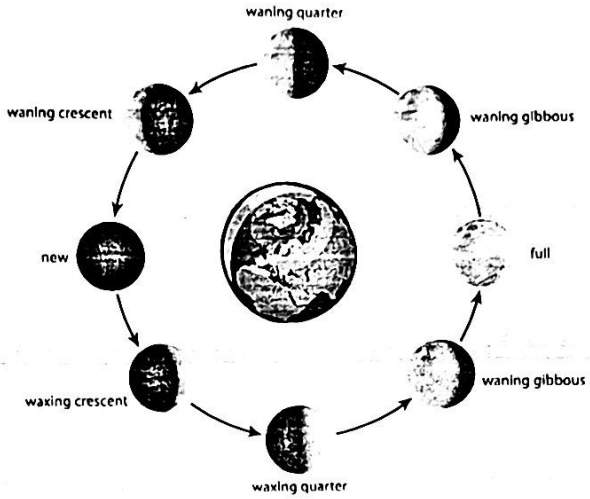
Black spots will appear because blue absorbs all the red colour incident on it and reflects none. (2 scores for explanations)

Item 2 (Total 14 scores)

(a) 3 scores

Days and nights are primarily caused by the Earth's rotation about its axis.The Earth rotates on its axis once every 24 hours. During this time, the side facing the sun is experiencing day time while the one facing away from the sun is experiencing night time.

(b) Phases of the moon (3 scores for any correctly sequenced scores)



(i) New Moon: The moon is between the Earth and the sun, and the side of the moon facing the Earth is not illuminated, making it invisible.
(ii) Waxing Crescent: A small, crescent-shaped portion of the moon becomes visible as a sliver of light on the right side grows.
(iii) First Quarter: Half of the moon is illuminated on the right side, and it is visible as a half-circle. 03
(iv) Waxing Gibbous: More than half of the moon is illuminated as the lighted portion continues to grow towards a full moon.
(v) Full Moon: The entire face of the moon is illuminated as the Earth is between the moon and the sun.

(c) Life cycle for Stars (3 scores for any 4 correctly sequenced stages)

(i) Nebula: Stars begin as a cloud of gas and dust known as a nebula. Gravity pulls the materials together.

(ii) Protostar: As the materials get together, it forms a protostar. The temperature and pressure increase, leading to nuclear fusion. any 3

(iii) Main Sequence: The star enters the main sequence phase, where it spends most of its life fusing hydrogen into helium in its core releasing heat and light. Our sun is currently in this phase.

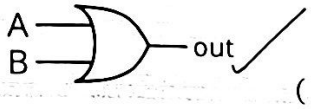
(iv) Red Giant/ Super giant: Once the hydrogen in the core is exhausted, the star expands into a red giant or super giant, depending on its mass. The core contracts, and the outer layers expand and cool.

(v) White dwarf: The core of the star contracts and sheds its outer layers, leaving a hot, compact core.

(vi) Neutron Star/ Black Hole: The star undergoes a supernova explosion, leaving behind a dense remnant.

(d) An OR gate is a logic gate that outputs TRUE (1) if at least one of the inputs is TRUE.

The OR gate is below



01

(1 score for the diagram)

Truth table. (3 scores ; 1 score for each correct column A, B, C)

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1

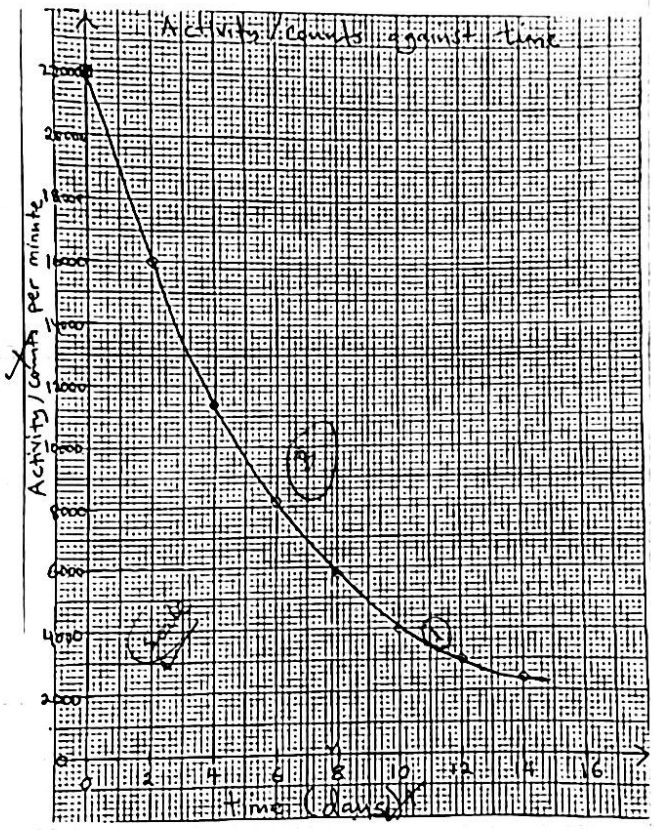
03

If A is FALSE (0) and B is TRUE (1), the output of the OR gate is TRUE (1). Therefore, the satellite will transmit a signal back to Earth. (1 mark)

01

Item 3. (Total = 18 scores)

(a) 3 scores for any three correctly plotted points
1 score for correct axes
1 score for correct scale
1 score for the curve



05

From the graph, 6000 counts per minute correspond 7.8 days. This implies that the milk will be safe for human consumption after 8 days from the time when the tracer was introduced in the milk. (1 score for conclusion) 01

(b) Dangers of Radioactive Exposure 3 scores for any two correct danger

(i) Radioactive materials emit ionizing radiation, which can damage living tissues and increase the risk of acquiring diseases.

(ii) Prolonged exposure to radiation can lead to cancer. 3

(iii) Radiation can alter DNA, causing genetic mutations that can be passed on to future generations.

(iv) High levels of radiation can cause nausea, vomiting, diarrhea, fatigue, and even death.

Safety Precautions 3 scores for any two correct precaution

(i) Wear protective gears such as gloves, lab coats, safety glasses, and masks to prevent skin contact and inhalation of radioactive particles.

(ii) Handle radioactive materials with tongs or other tools to minimize direct contact. 3

(iii) Store properly the radioactive materials in designated areas, such as lead-lined containers.

(iv) Monitor radiation levels using devices such as Geiger muller counters to monitor radiation levels and ensure they remain within safe limits.

(v) Adhere to established protocols/procedure for handling radioactive materials, and dispose of them properly.

(vi) Ensure that the personnel handling radioactive materials receive proper training and education on radiation safety.

(vii) Regularly monitor workers' health and provide medical attention if radiation exposure occurs.

(c) Background radiation refers to the ionizing radiation present in the environment, originating from various natural and artificial sources. It is always present and can be detected even when there is no specific source of radiation nearby. (1 score)

Common Sources of Background Radiation: 2 scores for any two correct source

(i) Cosmic Rays: High-energy particles from outer space that strike the Earth's atmosphere
(ii) Terrestrial Radiation: Naturally occurring radioactive materials found in the earth crust, such as uranium, thorium, and radon. 02
(iii) Internal Radiation: Radioactive isotopes naturally present in the human body, such as potassium-40 and carbon-14, contribute to background radiation through their decay processes.
(iv) Man-Made Sources: Radiation from human activities such as medical procedures (X-rays, CT scans), nuclear power plants, and fallout from nuclear weapons testing.
(v) Food and Water: Small amounts of radioactive isotopes, like potassium-40, are present in food and water.

(ɸ) 2 scores for any two correct comparisons

Category	Cathode rays	X rays
Nature	Streams of fast moving electrons emitted from the cathode (negative electrode) in a vacuum tube.	Electromagnetic waves (photons) with high energy and no mass or charge.
Generation	Generated in a cathode ray tube (CRT) when a high voltage is applied across electrodes in a vacuum.	Produced when high-energy electrons strike a metal target (such as tungsten) in an X-ray tube, causing the sudden deceleration of electrons.
Penetration power	Low; they are easily absorbed by matter.	High; they can penetrate most materials, including human tissue.
Detection	Easily detected by devices that respond to charged particles, such as the GM tube.	Not easily detected with devices like the GM tube, which are better suited for charged particles. X-ray detection often requires

02

specialized detectors like scintillation counters or photodiodes.

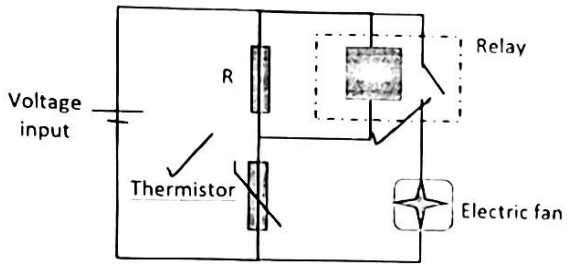
SECTION B

PART 1

Item 4 (**Total marks = 16 scores**)

02 (a) Direction is' A to B to C to D (1 score)

(b) . 2 scores for correct circuit



a) When the rectangular coil ABCD rotates the magnetic flux linking the coil changes and an emf is induced in the coil causing current to flow in the coil.
› When the coil passes over the vertical position, the slip rings change contacts from one carbon brush to another. This reverses the direction of current in the coil.
› Therefore, the direction of current flowing through the coil also changes.

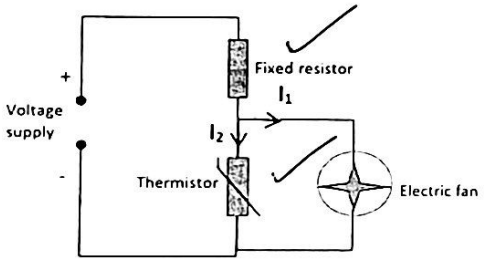
A thermistor can either be a positive temperature coefficient (PTC) Or A Negative Temperature Coefficient (NTC). The thermistor is connected in series with a fixed resistor to form a voltage divider across a d.c source.

Note: A student can either explain the part when its ON or when its OFF. Asses one of the two.

2 scores for explanation of one of the states

When the temperature rises, the resistance of the thermister falls and so does the p.d across it. The voltage across resistor R and the relay increases. When the voltage across the relay reaches its operating p.d, the *normally* open contacts close so that the circuit to the electric fan closes or is completed hence switching it on.

Alternatively Circuit;



02

During high temperatures

When temperature of the surrounding is high, the resistance of the PTC thermistor is also high compared to the resistance of the electric fan. This implies that I_1 is greater than I_2, i.e more current flows through the fan hence switching it ON. On contrary, less current flows through the thermistor which is not enough to switch it on.

02

During LOW temperatures

When temperatures are low, the resistance of the PTC thermistor is low compared to the resistance of the electric fan. This implies that I_2 is greater than I_1, I.e more current flows through the the thermistor than the one flowing through the electric fan. With this minimal current, the electric fan will be OFF.

(c) Calculating the total kilowatthours (kWh)

1 kW = 1000 watts

TV : $300 \times 14 = 4200\text{wh} = 4.2\ \text{kWh}$

Refrigerator : $3000 \times 5 = 15000\ \text{wh} = 15\ \text{kWh}$

5 Energy saving bulbs : $15 \times 5 \times 12 = 900\ \text{wh} = 0.9\ \text{kWh}$

Loudspeaker: $50 \times 8 = 400\ \text{wh} = 0.4\ \text{kWh}$

Automatic electric fan : $75 \times 14 = 1050\ \text{wh} = 1.05\ \text{kWh}$

Total kWh consumed per day = 4.2 + 15 + 0.9 + 0.4 + 1.05 (1 score)

= 21.55 kWh (1 score)

Total kWh consumed in five days; $21.55 \times 5 = 107.75$ kWh (1 score)

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1.8 kWh are produced by 0.4 litres of diesel.

107.75 kWh are produced by $\frac{0.4}{1.8} \times 107.75 = 23.94$ litres (1 score)

One litre costs shs 4950

23.94 litres cost shs $23.94 \times 4950 =$ shs 118,503 (1 score)

Since the available budget for five days is shs 100,000 and the total amoumt needed is shs 118,503, it implies that your friend will not be able to run the generator for all the five days. She needs an extra shs 18,503 to fully run the five days. (1 score)

(d) Dangers of Electricity: (2 scores for correct danger explained)

(i) Electric Shock: Can cause injury or death.
(ii) Electrical Burns: Caused by electric currents passing through the body.
(iii) Fires: Faulty wiring or overloads can cause electrical fires.
(iv) Explosions: Improper handling of electrical equipment in explosive atmospheres.

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(v) Equipment Damage: Power surges can damage electrical appliances and systems.

Safety Precautions: (3 scores for any three explained precaution)

(i) Insulation: Ensure wires and cables are properly insulated to prevent contact with live wires.
(ii) Grounding: Properly ground electrical systems to prevent shock hazards
(iii) Circuit Breakers and Fuses: Use these devices to prevent overloads and short circuits.
(iv) Personal Protective Equipment: Use rubber gloves, insulating mats,, etc other when working with electricity. 03
(v) Regular Maintenance: Inspect and maintain electrical systems regularly to identify and fix faults.
(vi) Avoid Water: Keep electrical appliances and equipment away from water to prevent shocks.
(vii) Education and Training: Ensure individuals working with or around electricity are properly trained and aware of safety protocols.

ITEM 5 (Total = 16 scores)

(a) Safety during lightning (3 scores for any three correct safety measure)

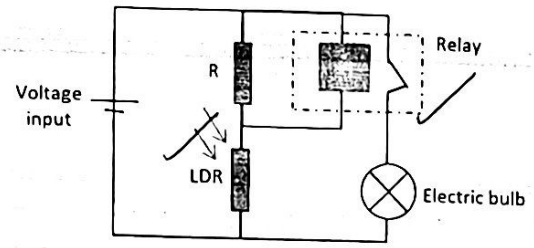
(i) Seek Shelter Indoors: The safest place during a lightning storm is inside a well-constructed building. Avoid open fields, tall trees, and metal structures.
(ii) Avoid Water: Do not bathe, shower, or use plumbing during a storm. Water is a good conductor of electricity.
(iii) Stay Away from Electrical Appliances: Avoid using electrical appliances, corded phones, and computers during a storm as lightning can cause power surges. 03
(iv) Avoid Windows and Doors: Stay away from windows, doors, and porches.
(v) Lightning can travel through metal pipes and wiring.
(v) Use Surge Protectors: Install surge protectors to protect electronic devices from power surges caused by lightning strikes.
(vi) Outdoors Precautions: If caught outside, seek shelter in a car with a metal roof and avoid open fields, tall trees, and hilltops.
(vii) Lightning Rods: Install lightning rods on buildings to provide a path for lightning to reach the ground without causing damage.

(b) 2 marks for any two correct reason for earthing
Earthing (Grounding) is a crucial safety feature in household electrical systems. Purposes for earthing include:

(i) Provides a safe path for fault currents to flow to the ground, reducing the risk of electric shock.
(ii) Protects electrical appliances from damage due to power surges or lightning strikes by providing a path to dissipate excess electricity. 02
(iii) Ensures that circuit breakers or fuses operate properly by providing a low-resistance path to ground, allowing fault currents to be detected and interrupted.

(c) Light Dependent Resistor (LDR) and a relay canl be used. The LDR changes its resistance based on the light intensity.

Circuit is shown below. (2scores for a correct circuit)



04

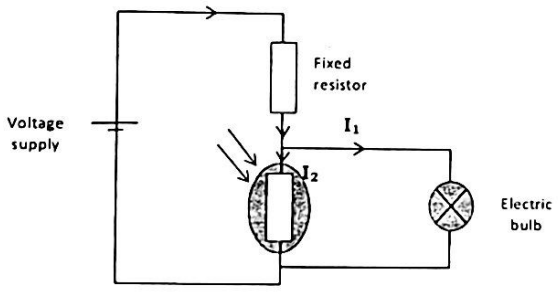
Note: A student can either explain the part when its ON or when its OFF. Asses one of the two.

2 scores for explanation of either when the bulb is ON or for when the bulb is OFF.

When there is no light falling on the LDR, its resistance and hence voltage across it increases. There is a corresponding decrease in the voltage across resistor R and the relay. When the voltage across the relay is below its operating p.d, the *normally* closed contacts remain closed; thus the bulb remains ON.

However, when light falls on the LDR, its resistance and hence voltage across it decreases. There is a corresponding increase in the voltage across resistor R and the relay. When the voltage across the relay reaches its operating p.d, the normally closed contacts open; disconnecting the current from flowing through the bulb thus no light is produced.

Alternatively:



During Day time.

Light intensity is high during day time. At this moment, the resistance of the LDR is low compared to the resistance of the electric bulb. This implies that I_2 is greater than I_1, I.e more current flows through the LDR and very little to flow through the electric bulb. The bulb will not light.

During night time.

Light intensity is low during night time. At this moment, the resistance of the LDR is high compared to the resistance of the electric bulb. I_1 is greater than I_2 That means that more current flows through the electric bulb and very little flows through the LDR. With this sufficient current, the bulb will light.

Note: Allow students who use a transistor switch in their circuit. Read through it.

(d) Calculating primary (input) voltage

$\frac{N_P}{N_S} = \frac{V_P}{V_S} \Longrightarrow \frac{1500}{500} = \frac{V_P}{240} \Longrightarrow V_P = \frac{1500 \times 240}{500} = 720\,V$ (1 score)

$Power\ Input = I_P V_P = 28.7 \times 720 = 20664\,W$ (1 score)

$Efficiency = \frac{power\ output}{power\ input} \times 100\%$

$Efficiency = \frac{20000}{20664} \times 100\%$ (1 score)

$= 96.7\%$ (1 score)

05

Since the efficiency is within the acceptable ranges, the transformer would be considered good for use. (1 score)

(e) 2 scores for any two responses with their minimisation technique

any 2

(i) Hysteresis Losses: Occur due to the repeated magnetization and demagnetization of the core material.
Minimization: Use core material that can easily be magnetised and demagnetised.to reduce hysteresis losses.
(ii) Eddy Currents: Circulating currents induced in the core material due to changing magnetic fields.
Minimization: Use laminated cores to restrict eddy currents and reduce their losses.
(iii) Copper Losses (I^2R losses) Occur due to the resistance of the windings/wires.
Minimization: Use conductors with lower resistance, such as copper with larger cross sectional areas, to reduce resistance and subsequent losses.
(iv) Flux leakage; Not all the flux produced at the primary reaches the seconday coils. Minimization: Winding the seconsary and primary together

Part II

Item 6 **(Total = 16 scores)**

(a) hydraulic press uses the principle of Pascal's law, which states that pressure applied to a confined fluid is transmitted equally in all directions. (1 score)
When force is applied to the small piston, it creates pressure in the fluid, which is

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transmitted equally to the large piston, multiplying the force and generating a large output force. (1 score)

(b) Oil is used instead of air because: (2 scores for any two well explained response)

(i) Incompressibility: Oil is almost incompressible, ensuring a consistent performance under varying temperatures and pressure.
(ii) Viscosity: Oil's viscosity helps to reduce friction and wear on moving parts.
(iii) Lubrication: Oil lubricates the system, reducing friction and wear.
(iv) Heat Dissipation: Oil can absorb and dissipate heat generated by the hydraulic system, preventing overheating.

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Air, on the other hand, is compressible, which would lead to inconsistent pressure transfer and reduced efficiency.

(b) Calculating the mass of the fluid
mass = density × volume
mass = 800 × (10 × 0.001)
mass = 8 kg (1 score)

heat generated by the fliuid = mass × shc × temp change
$340000 = 8 \times 1750 \times \Delta\theta$ (1 score)
$\Delta\theta = \frac{340000}{14000} = 24.3^0C$ (1 score)

04

Since the change in temperature (24.3^0C) is higher than the recommended change of 20^0C for an effective machine, the hydraulic press will not remain effective. (1 score)

(c) Given;
Efficiency = 80%
Work output = 2000 J
$\text{Efficiency} = \frac{\text{work output}}{\text{work input}} \times 100\%$
$80 = \frac{2000}{\text{work input}} \times 100$ (1 score)
$\text{work input} = \frac{200000}{80} = 2500\ J$ (1 score)

03

The hydraulic machine will be able to start operating since its input energy (2500 J) is higher than the minimum required for it to start operating. (1 score)

(d) 2 scores for any two components
(i) Cement: The binding agent.
(ii) Aggregates: Sand, gravel, or crushed stone.
(iii) Water: Hydrates the cement.

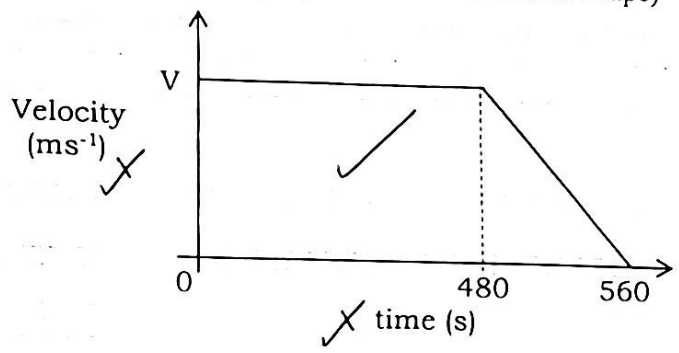
02

Why Concrete is Preferred: (3 scores for any three well explained reason)

(i) Strength: Concrete is strong in compression, making it ideal for structural applications.
(ii) Durability: It is resistant to weathering, chemical attack, and wear, ensuring long-lasting structures.
(iii) Versatility: Can be molded into various shapes and sizes, suiting a wide range of construction needs.
(iv) Economical: The raw materials for concrete are widely available and relatively inexpensive.
(v) Fire Resistance: Concrete is non-combustible and can withstand high temperatures, enhancing the safety of buildings.

Item 7 (Total = 16 scores)

(a) 2 scores for graph (1 for axes and one for shape)



$lw + \frac{1}{2}bh = 5300$

$480\,V + \frac{1}{2}V \times 80 =$ 5300 (1 score)

$520\,V = 5300$

$V = \frac{5300}{520} = 10.2\ m/s$ (1 score)

Or:

$\frac{1}{2}h(a+b) = 5300$

$\frac{1}{2}V(480+560) = 5300$

$V = \frac{10600}{1040} = 10.2\ m/s$

Since the speed computed (10.2 m/s) is below the maximum speed of the area, then the insurance company will compensate for the damages. (1 score for conclusion)

(b) Possible reasons for failure to stop in time include;

3 scores for any three well explained reasons

(i) Inertia: A loaded bus has significant mass, and according to Newton's first law of motion, an object in motion tends to stay in motion unless acted upon by an external force. The greater the mass, the greater the inertia, and the more force is required to stop it.

(ii) Momentum: The momentum (mass times velocity) of a loaded bus is high, requiring more braking force and time to bring it to rest.

(iii) Braking Efficiency: If the brakes are not adequately maintained or are less efficient, it will take longer for the bus to stop.

(iv)Road Conditions: Slippery or wet roads reduce the friction between the tires and the road, increasing stopping distance. 03

(v) Driver Reaction Time: The time taken for the driver to react and apply the brakes also contributes to the total stopping distance.

(c) Using;

heat gained by brakes = mass × shc × (final temp − initial temp) (1 score)

$7000000 = 25 \times 470 \times (\theta - 20)$ (1 score)

$7000000 = 11750 \times (\theta - 20)$

$7000000 = 11750\,\theta - 235000$

$7000000 + 235000 = 11750\,\theta$

$\theta = \frac{7235000}{11750} = 615.74^{o}C$ (1 score) 04

Since the final temperature of $615.74^{o}C$ is in the range recommended for efficient brakes, then the brakes were appropriate for use. (1 score)

(c) Safety precautions that should be followed to minimise road accidents
4 scores for any 4 well explained precautions

(i) Regular Maintenance: Ensure that all vehicles undergo regular maintenance checks for brakes, tires, lights, and other critical components to ensure they are in good working condition.

(ii) Driver Training: Provide comprehensive training for drivers on safe driving practices, defensive driving techniques, and the importance of adhering to traffic laws. 04

(iii) Speed Limits: Enforce speed limits and encourage adherence to them to reduce the likelihood of accidents.

(iv) Road Conditions: Maintain road infrastructure, ensuring roads are free from potholes, properly marked, and well-lit to enhance visibility and safety.

(v) Seat Belts and Restraints: Ensure all passengers and drivers wear seat belts to minimize injuries in case of an accident.

(vi) Avoid Distractions: Educate drivers on the dangers of using mobile phones or other distractions while driving. Encourage focused and attentive driving.

over speeding

(vii) Alcohol and Drugs: Strictly enforce laws against driving under the influence of alcohol or drugs. Conduct regular checks and implement strict penalties for violations.

(viii) Weather Conditions: Encourage cautious driving during adverse weather conditions such as rain pr fog.

END