The **EXAMINATION PAPER** and **ALL ANSWERS MUST** be kept **SECURE** and **Copies NOT RETURNED** to **STUDENTS** until **MONDAY 3rd SEPTEMBER.** (Week 7 of Term 3.)

Part A – Multiple choice (1 mark each)

1. **C** because the resultant acceleration is constant, as angle tilts from vertical, the *g*-forces will reduce.
2. **D** all these aspects are significant problems for extended space travel considering the enormous distances and the time it would take even if rockets could travel at close to the speed of light.
3. **A** the buoyancy of the water provides an upward force to allow a weightless environment to be simulated.
4. **B** according to Kepler's third law, speed is greater for the smaller radius of orbit, and from the equation for gravitational potential energy, the potential energy is inversely proportional to the distance from the centre of mass of the object about which the satellite orbits, therefore the closer to the earth, the greater the gravitational potential energy.
5. **C** since $s_h = 22.5$ m and $t = 2.5$ s, therefore, $v_h = v\cos 30^\circ = 9.0\ ms^{-1}$, therefore $v = 10.4\ ms^{-1}$
6. **C** According to *RH rule* and motor effect, torque is clockwise, a maximum at the position shown, $= nBIA = 8 \times 10^{-5}$ Nm.
7. **A** while the field is establishing in the electromagnet, the changing flux cuts the conductor and, because there is a closed circuit, the *emf* induced over the conductor causes a current to briefly flow.
8. **B** the North pole is produced to oppose the change that created it, i.e. by becoming a north pole it will be repelling the north pole of the magnet that is approaching it. Lenz's law explains this result.
9. **A** it steps up the voltage, i.e. the voltage from the secondary coil is greater than the voltage attached to the Primary coil
10. **D** by moving a magnet in and out of the solenoid , the magnetic flux will be cutting the coils in different directions giving rise to an *emf* that changes direction, i.e. an AC supply.
11. **D** Einstein proposed the photon, a quantum of light energy, using it to give a mathematical explanation for the photo-electric effect
12. **D** to balance the force from the magnetic field the electric field must be vertically UP to produce a force vertically down on the electrons in the cathode ray, thus the lower plate must be POSITIVE.
13. **B** the wavelength of X-rays are small enough to pass between the atoms, i.e. the spaces are wide enough for X-rays, but too narrow for longer wavelength UV or visible
14. **A** a p-type semi-conductor uses holes as the primary mechanism to transfer charge
15. **B** Metal 1. requires shorter wavelength light to release the photoelectrons and as such has a higher work function.

STANSW Trial HSC **Physics** 2001 Section I - CORE Answers

Question 17 — 7 Marks

Outcomes assessed: H6, H7, H9, H13, H14 Possible Targeted BANDS : 3 to 5

17.	Criteria	Mark
(a)	• Indicates Earth's gravity causes motion with speed depending on radius	1
	• Indicates Earth's gravity creates centripetal force and demonstrates equations involved. Demonstrates suitable attempt to calculate value.	1
	• Indicates Earth's gravity creates centripetal force and demonstrates equations involved. Explains, or by implication shows, centripetal force equal to gravitational force. Describes appropriate technique and substitutes in correctly offering an answer to the calculation.	1
		TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The satellite has a gravitational force creating a centripetal force to maintain the circular orbit, i.e. $F_c = F_g$.
From the equations this means that; $\frac{m_x v^2}{r_x} = \frac{G m_E m_x}{r_x^2}$

Rearranging yields, $v = \sqrt{\frac{G m_E}{r_x}}$. Now $r_x = r_E + 778$ km $= 6360 + 778 = 6438$ km.

Using this radius, and the appropriate information for m_E and G from the data table gives,

$$v = \sqrt{\frac{6.67\times10^{-11} \times 5.98\times10^{24}}{6.438\times10^{6}}} = 7.87\times10^{3}\ ms^{-1}$$

Speed of satellite is 7.87 km s^{-1} **3 marks**

Outcomes assessed: H2, H6, H9, H13 Possible Targeted BANDS : 3 to 6

17.	Criteria	Mark
(b)	• Indicates geostationary satellite orbit much more distant from Earth than satellite in question and mentions at least one other difference regarding motion	1
	• Indicates geostationary satellite orbit much more distant from Earth than satellite in question, mentions at least one other difference regarding motion, and that potential energy is lower for more distant satellite.	1
	• Indicates geostationary satellite orbit much more distant from Earth than satellite in question, mentions at least two other differences regarding motion, and that potential energy is lower for more distant satellite	1
	• Indicates geostationary satellite orbit much more distant from Earth than satellite in question, mentions more than two other differences regarding motion, and that potential energy is lower for more distant satellite with reasoning.	1
		TOTAL : 4 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

When comparing a Geostationary satellite of similar mass with this satellite;
- the geostationary satellite will be much more distant from Earth and, since the gravitational potential energy, E_P, is inversely proportional to the distance from the Earth, the geostationary satellite will have a lower gravitational potential energy than this satellite.

Because the geostationary satellite is relatively distant from the Earth compared to this satellite, the geostationary satellite would,
- travel at a lower speed through space
- have a longer orbital period of 24 hours
- be restricted to an equatorial orbit
- be much more exposed to radiation from space
- not suffer drag effects due to tenuous atmospheric gases

4 marks

Question 18

5 Marks

Outcomes assessed: H1, H2, H10, H12, H13, H14 Possible Targeted BANDS : 2 to 6

18.	Criteria	Mark
	• Describes ether as medium to transmit light , states Michelson and Morely failed to detect the ether, states Einstein proposed ether was not required.	1
	• Describes ether, infers all pervading, as medium required by classical theory to transmit light waves, gives some outline of experiment and states Michelson and Morely failed to detect the ether, states Einstein proposed ether was not required.	1
	• Describes ether, infers all pervading, as medium required by classical theory to transmit light waves, gives clear outline of experiment and reasoning. States Michelson and Morely failed to detect the ether wind, states Einstein proposed suggested ether was not required.	1
	• Describes ether, infers all pervading, as medium required by classical theory to transmit light waves through free space, gives clear outline of experiment and reasoning. States Michelson and Morely failed to detect the ether wind, states Einstein proposal suggested ether was not required.	1
	• Describes ether, infers all pervading, as medium required by classical theory to transmit light waves through free space, gives clear outline of experiment and reasoning. States Michelson and Morely failed to detect the ether wind, states Einstein proposal suggested velocity of light would be the same irrespective of the frame of reference from which it is measured inferring that the ether is not required.	1
		TOTAL : 5 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The ether was an all pervading, invisible, massless medium that occupied all free space, required by the classical wave theory for light, being proposed as the medium to transmit light waves through free space. The Michelson-Morely experiment used a very sensitive interferometer, mounted so that it could be rotated, with the expectation that an ether wind, due to the motion of the Earth through space, would be detected, and the existence of the ether verified. With two perpendicular paths for the same ray of light creating an interference pattern, Michelson and Morely expected to see a change in the pattern due to the ether wind but, no change was detected. Despite many meticulous attempts to detect an ether wind, the experiment continued to produce a *null* result. Einstein proposed that the velocity of light would be the same irrespective of the frame of reference, supported by the Michelson-Morley result, further suggesting that the speed of light was the ultimate terminal velocity, with the ether not required for it to travel through free space.

5 marks

Question 19

4 Marks

Outcomes assessed: H6, H7, H9, H13, H14 Possible Targeted BANDS : 3 to 4

19.	Criteria	Mark
(a)	• Explains that conservation of momentum is involved and impulse to fuel is equal to impulse to rocket. Demonstrates how *g*'s of acceleration would be calculated.	1
	• Explains that conservation of momentum is involved and impulse to fuel is equal to impulse to rocket. Explains average acceleration equivalent to change in velocity over one second. Describes process to obtain *g*'s of acceleration and shows correct substitution into equation.	1
		TOTAL : 2 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Conservation of momentum applies and average acceleration of rocket , $a_{av} = {}^{\Delta v}/_{\Delta t}$, with the impulse, $\Delta p = m\,\Delta v$. Considering the impulse to the exhausted fuel is equal and opposite to the impulse to the rocket vehicle, then $m_f \Delta v_f = - m_R \Delta v_R$. Now over the time of ONE second, the fuel consumed and exhausted is 32.2 kg and, because $\Delta t = 1.0$ second and $a_{av} = {}^{\Delta v}/_{\Delta t}$, then $a_{av} = \Delta v$. Substituting into impulse equation yields, $32.2 \times 2340 = 1280\ \Delta v_R$, where Δv_R is the change in velocity of the rocket vehicle in one second, being equivalent to the average acceleration experienced by the scientist over that period.

Now *g*'s of acceleration = average acceleration divided by gravitational acceleration,

$$g\text{'s of acceleration} = \frac{a_{av}}{g} = \frac{32.2 \times 2340}{1280 \times 9.8} = 6.0\ g\text{'s}$$

During this period the scientist experienced 6.0 *g*'s of acceleration.

2 marks

Outcomes assessed: H2, H6, H9, H14 Possible Targeted BANDS : 3 to 4

19.	Criteria	Mark
(b)	• Explains large accelerations have medical implications.	1
	• Clearly indicates medical implications of large accelerations and the requirement for this to be considered if space flights carrying humans are to be undertaken in the future.	1
		TOTAL : 2 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

This research would have provided important information on the ability of humans to withstand the large accelerations produced by rockets, and led to a greater understanding of the requirements to avoid the medical problems associated with high *g*-forces. This information is of vital importance to ensure that spacecraft design and flights, makes special provisions for the requirements of humans to survive the forces involved , particularly during launch, re-entry and landing.

2 marks

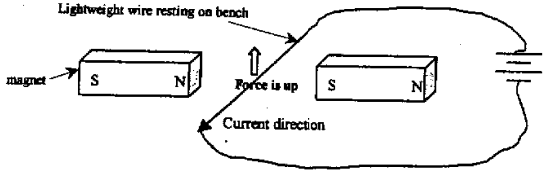
Question 20

5 Marks

Outcomes assessed: H7, H9, H11, H13. Possible Targeted BANDS : 2 to 4

20.	Criteria	Mark
(a)	• Draws a simple diagram including a pair of magnets and a wire with a current	1
	• Draws an accurate, labelled diagram of an appropriate experiment with some description of result.	1
	• Draws an accurate labelled diagram of an appropriate experiment and includes instructions or explanation, (maybe on the diagram) of how the experiment illustrates the motor effect	1
		TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.



When a current flows through the lightweight wire that passes through the magnetic field, the wire experiences a force upwards. It will be observed to jump up from the bench. This illustrates the motor effect, describing the effect whereby, a current-carrying wire passing through a region of magnetic field will experience a force that is perpendicular to both, the direction of the magnetic field, and the component of the current direction perpendicular to the field.

3 marks

Outcomes assessed: H3, H7, H9, H13 Possible Targeted BANDS : 4 to 5

20.	Criteria	Mark
(b)	• Indicates the parts of a galvanometer relating to motor effect and offers some description of the features in operation	1
	• Indicates the features of a galvanometer and clearly describes how the motor effect is illustrated in the operation of the galvanometer with reference to appropriate terms.	1
		TOTAL : 2 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

A galvanometer consists of a coil of fine wire wrapped around an iron core. A pointer and coiled spring are attached to the coil. The spring produces a restoring force on the coil to return it to its original position after the pointer is deflected. The coil is in a radial magnetic field. When a current flows through the coil, the coil experiences a force that causes it to rotate, with the torque turning the coil, proportional to the current entering the coil. The torque on the coil moves the pointer around the scale of the galvanometer while the spring opposes the motion. The response of the current-carrying coil of wire in the magnetic field is an example of the motor effect, here used in a galvanometer.

2 marks

Question 21

4 Marks

Outcomes assessed: H3, H4, H7, H9, H13 Possible Targeted BANDS : 3 to 6

21.	Criteria	Mark
	• Indicates *AC* can be efficiently converted to different voltages by transformers	1
	• Indicates *AC* can be efficiently converted to different voltages by transformers and offers supporting argument.	1
	• Indicates *AC* can be efficiently converted to different voltages by transformers and describes advantages in production and transmission inferring convenience and energy efficiency	1
	• Indicates *AC* can be efficiently converted to different voltages by transformers and explains advantages in production and transmission referring directly to convenience, energy efficiency, and the advantages for consumers compared to *DC* systems.	1
		TOTAL : 4 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Compared to *DC*, the use of *AC* has several significant advantages. An *AC* generator is the simplest, most energy efficient form of generator with the potential easily transformed to very high voltages to allow efficient transfer of the electrical energy over long distances to where it is needed. With transformers easily and efficiently converting an *AC* supply to any required voltage, and *AC* motors being highly versatile and energy efficient, it can be seen that when compared to rather inefficient *DC* systems ; using an *AC* generator (alternator) minimises energy loss in the production of electricity; Transmitting the energy at high voltage minimises energy loss as heat in the wires; *AC* is needed for the voltage to efficiently converted by transformers to the desired voltages for use by consumers.

4 marks

Question 22

7 Marks

Outcomes assessed: H7, H9, H14 Possible Targeted BANDS : 3 or 4

22.	Criteria	Mark
(a)	• Shows appropriate equation with correct substitution of the data supplied and calculates an answer	1
		TOTAL : 1 mark

Example of SPECIMEN ANSWER worthy of FULL marks.

Using equation and substituting in data , i.e.

$$\frac{V_P}{V_S} = \frac{n_P}{n_S} \quad \therefore \quad \frac{10^4}{V_S} = \frac{50000}{12000} \quad \therefore \quad V_S = 2400 \text{ volts}$$

For an *ideal* transformer the voltage from the secondary coil would be **2400 V** or **2.40 kV**.

1 mark

Q22 continues on next page

Question 22 cont'd

Total : 7 Marks

Outcomes assessed: H3, H4, H7, H9, H13, H14 Possible Targeted BANDS : 3 to 5

22.	Criteria	Mark
(b)	• Suggests energy lost as heat and proposes technique to improve efficiency	1
	• Suggests energy lost as heat due to induced currents created by changing magnetic fields and proposes technique to improve efficiency.	1
	• Suggests energy lost as heat in components making up transformer due to currents created by changing magnetic fields and proposes and describes appropriate technique to improve efficiency.	1
		TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The changing magnetic fields required to allow a transformer to operate, induce eddy currents in the conductive components of the transformer. These eddy currents produce heat in the components of the transformer and energy is lost, resulting in less energy being available for the charges from the secondary coil. By lamunating the core of the transformer, the size of the eddy currents are reduced, reducing the heating and energy losses, thus allowing the transformer to be more efficient.

3 marks

Outcomes assessed: H3, H4, H7, H9, H13, H14, H16 Possible Targeted BANDS : 4 to 6

22.	Criteria	Mark
(c)	• Comments directly on statement and indicates a role for transformers in making the situation possible	1
	• Comments directly on statement and gives reasons for the role of transformers outlining reason why situation in statement is now possible giving some support for their answer.	1
	• Comments directly on statement and gives reasons for the role of transformers, outlining the possibility of efficient transfer over long distances using high voltages and then stepping down to safe voltages for use by varied consumer devices. Refers directly to efficient means for mass consumption of electrical energy.	1
		TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The statement can be considered an appropriate comment on the situation made possible by transformers. By using transformers to convert the power generated to very high voltages for transmission to distant locations, the energy losses in the wires are significantly reduced and large amounts of energy can be efficiently transferred. The transformer then allows the voltage to be stepped down, close to the location of use, allowing the consumer to safely use the electrical energy . Further transformers provide the voltages needed within the modern electrical appliances. As the transformer became more efficient, the situation where very large, remote power stations can supply the needs for distant consumers, has become a feasible proposition to efficiently supply all the electrical energy requirements for modern consumers.

3 marks

STANSW Trial HSC **Physics** 2001 Section I - CORE Answers

Question 23

4 Marks

Outcomes assessed: H3, H4, H7, H8, H9, H13, H14 Possible Targeted BANDS : 3 to 6

23.	Criteria	Mark
	• Offers some description of principles employed in induction motor and provides reason for their widespread use.	1
	• Gives simple description of principles employed in induction motor and provides reason for their widespread use with some support.	1
	• Gives accurate description of principles employed in induction motor using appropriate terminology mentioning current induced in rotor and provides reason for their widespread use indicating an advantage.	1
	• Gives accurate description of principles employed in induction motor using appropriate terminology mentioning current induced in rotor and provides clear outline of a reason for their widespread use indicating a clear advantage and why they have become popular.	1
		TOTAL : 4 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The *AC* induction motor is based on the principle that a rotating magnetic field will exert a torque on a stationary coil. The majority of motors are *AC* induction motors because this form of motor is electrically simple and operates with low power demands. The motor requires no electrical contact with the rotor, the rotating core, hence the motor is less inclined to wear due to friction, e.g. between a commutator and brush. The coils of wire in this rotor are surrounded by the stationary stator, consisting of three electromagnets, connected to the *AC* power supply. The changing magnetic field when an *AC* current flows in the stator induces current in the rotor. This induced current sets up a magnetic field around the rotor. This magnetic field interacts with the magnetic field of the stator causing a torque to act on the rotor, making it rotate. Since induction motors are versatile, simple, and operate well at low power, they allow the safe use of many domestic electrical appliances and are ideally suited for modern consumers.

4 marks

Question 24

5 Marks

Outcomes assessed: H3, H9, H10, H13 Possible Targeted BANDS : 2 or 3

24.	Criteria	Mark
(a)	• Clearly indicates role of fluorescent screen.	1 TOTAL : 1 mark

Example of SPECIMEN ANSWER worthy of FULL marks.

The fluorescent screen acts to allow the path of the cathode rays to be seen, the screen producing light where the electrons in the cathode ray strike it.

1 mark

Outcomes assessed: H2, H9, H11, H13, H14 Possible Targeted BANDS : 3 to 6

24.	Criteria	Mark
(b)	• Indicates use of electric and magnetic fields and using equations to calculate result	1
	• Indicates following features; deflection by single field (accept electric or magnetic), followed by balancing path using both electric and magnetic field, then using equations to calculate result	1
	• Indicates following features; deflection by single field (accept electric or magnetic) is measured and recorded, followed by balancing path using both electric and magnetic field together, then used equations to calculate result.	1
	• Indicates following features; deflection by single field (accept electric or magnetic) is measured and recorded, followed by same field but balancing path using both electric and magnetic fields together, then using equations to calculate result by combining the information from the two parts.	1 TOTAL : 4 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Thomson used a cathode ray tube with a pair of parallel metal plates to create an electric field, and coils to produce a magnetic field. He used a single field and measured the deflection of the cathode ray, using the result to calculate the radius of the path followed by the cathode ray while travelling through the field. With this field the same, he then brought the cathode ray back to a straight line path, as would be followed with no fields, by balancing the force from the electric and magnetic fields so that they were equal and opposite. With the results from both parts he was able to use the known equations for forces acting on charged particles travelling through magnetic and electric fields to calculate the q/m ratio, verifying that the cathode rays were particles, electrons, with a negative charge.

4 marks

Question 25

8 Marks

Outcomes assessed: H2, H8, H9, H13, Possible Targeted BANDS : 3 to 4

25.	Criteria	Mark
(a)	• States light was viewed as a transverse electromagnetic wave with perpendicular electric and magnetic fields	1
	• Indicates model proposed a self-propagating system of perpendicular, transverse waves of electric and magnetic field travelling through the ether	1 TOTAL : 2 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The model of light supported by the Hertz experiment was based on Maxwell's electromagnetic theory, where light was described as "a self-propagating system of perpendicular, transverse waves of electric and magnetic field travelling through the ether."

2 marks

Outcomes assessed: H2, H3, H8, H9, H10, H12, H13 Possible Targeted BANDS : 3 to 5

25.	Criteria	Mark
(b)	• Indicates photon ejects electron from material and shows equation for calculation of photon energy with some attempt to solve.	1
	• Indicates photon energy completely absorbed in emitting electron from material **or** shows Einstein's equation for photoelectric effect and shows equation for calculation of photon energy, recognising that wavelength has been provided in information	1
	• Indicates Einstein explained the photoelectric effect as the photon energy completely absorbed in emitting electron from material with the work-function overcome, the excess energy represented in the kinetic energy of the photoelectron, **or** shows Einstein's equation for photoelectric effect with appropriate explanation and shows equation for calculation of photon energy, recognising that wavelength has been provided in information and showing correct substitution into equation and an answer	1 TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Einstein suggested that in the photoelectric effect, a quantum of light energy, the photon, having an energy proportional to its frequency, gave up all its energy to an electron orbiting one of the metal atoms, releasing the electron from the atom. He described the effect using an equation to predict the kinetic energy of the emitted photoelectrons, i.e. $E_K = hf - \phi$, Where hf is the photon energy, h being Planck's constant, and ϕ is the work function, representing the energy required to remove the electron from the atom.

Energy of photon of 420 nm given by, $E = hf = \frac{hc}{\lambda} = \frac{6.602 \times 10^{-34} \times 3.0 \times 10^{8}}{4.2 \times 10^{-7}} = 4.73 \times 10^{-19}$ J.

Light of wavelength 420 nm has energy per photon of 4.73×10^{-19} J = 2.95 eV

3 marks

Question 25 Part (c) ***on next page.***

Question 25 Part (c)

Outcomes assessed: H3, H4, H9, H11, H13, H16 Possible Targeted BANDS : 3 to 5

25.	Criteria	Mark
(c)	Syllabus indicates Breathalyser, Photocell and Solar cells • Indicates appropriate item and comments on contribution to modern humans • Indicates appropriate item indicating how photoelectric effect is involved and comments on contribution to modern humans indicating impact. • Indicates appropriate item giving a clear outline of how the photoelectric effect is involved and comments on contribution to modern humans indicating impact with clear supporting statement.	1 1 1 TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

The solar cell consists of wafers of semiconductor. The photoelectric effect is involved in the release of electrons within the semiconductor. When photons are absorbed, the electrons liberated flow across the p-n junction in the semiconductor wafers, causing a flow of electrons and providing a *DC* power supply. The solar cell is having a positive effect on the lives of modern humans, in particular in remote locations where supply of electrical energy is difficult. They are also contributing to a reduction in greenhouse emissions as they find wider acceptance and greater use in providing electrical energy to the community

3 marks

Question 26 7 Marks

Outcomes assessed: H1, H3, H4, H9, H12, H13, H14 Possible Targeted BANDS : 3 to 5

26.	Criteria	Mark
(a)	• Indicates two advantages with some support • Indicates two advantages, with clear explanation for only one advantage as to why this led to solid-state devices replacing the thermionic devices • Indicates two advantages with clear explanation of why these advantages led to solid-state devices replacing thermionic devices	1 1 1 TOTAL : 3 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Solid-state devices are tiny and robust compared to the fragile thermionic devices allowing modern devices to be far smaller and more widely used . The solid-state devices are also far more energy efficient with thermionic devices producing large amounts of heat in their operation and consuming much more energy. With solid-state devices able to be incredibly small and requiring only small power supplies they became the dominant form in use and have allowed the development of many important modern devices.

3 marks

Question 26 (b) *on next page*

Question 26 cont'd

Total : 7 Marks

Part (b) - Total : 4 Marks

Outcomes assessed: H1, H3, H4, H5, H9, H13. Possible Targeted BANDS : 3 to 6

26.	Criteria	Mark
(b)	• States superconductors offer negligible resistance to current, describes need for low temperature, offers an advantage of superconductors. • States superconductors offer negligible resistance to current and thus no energy is lost, describes need for low temperature, offers an advantage of superconductors giving reasons. • States superconductors offer negligible resistance to current and thus no energy is lost by charges whereas interactions in usual conductors produce heat, describes need for low temperature, offers an advantage of superconductors with description of reasons. • States superconductors offer negligible resistance to current and thus no energy is lost by charges whereas interactions in usual conductors produce heat, explains need for low temperature to achieve critical temperature and produce superconductivity, offers TWO advantages of superconductors with description of reasons.	1 1 1 1 TOTAL : 4 marks

Example of SPECIMEN ANSWER worthy of FULL marks.

Superconductors offer negligible resistance to the flow of charge through them and thus no energy is lost from the charges, whereas electrons in the usual conductors lose energy in interactions with the nuclei of the conductor and heating is produced. Superconductors are limited in their use because of the extremely low temperatures required for the present superconductors to reach their critical temperature and become superconductive. The resistance of the material reduces as the temperature cools but it is not until the critical temperature, which is usually less than 100 K, that the property of superconductivity is exhibited and the resistance reduces to zero.
When superconductors do become readily available there will be distinct advantages in;
- the strength of magnetic fields that will be possible by electromagnets, with applications in the development of nuclear fusion reactors and magnetic levitation trains.
- the energy efficiency that will be gained with little heat produced and allowing bigger, more powerful electrical motors to be constructed.

4 marks

End of CORE Answers

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