

Section I
75 marks

Part A – 20 marks

Attempt Questions 1–20

Allow about 35 minutes for this part

Use the multiple-choice answer sheet for Questions 1–20.

- 1** Some mobile phones are recharged at a power point using a charger that contains a transformer.

What is the purpose of the transformer?

- (A) To convert AC at the power point to DC
 - (B) To convert DC at the power point to AC
 - (C) To increase the AC voltage at the power point
 - (D) To decrease the AC voltage at the power point
- 2** Both Westinghouse and Edison proposed methods for supplying electricity to homes.

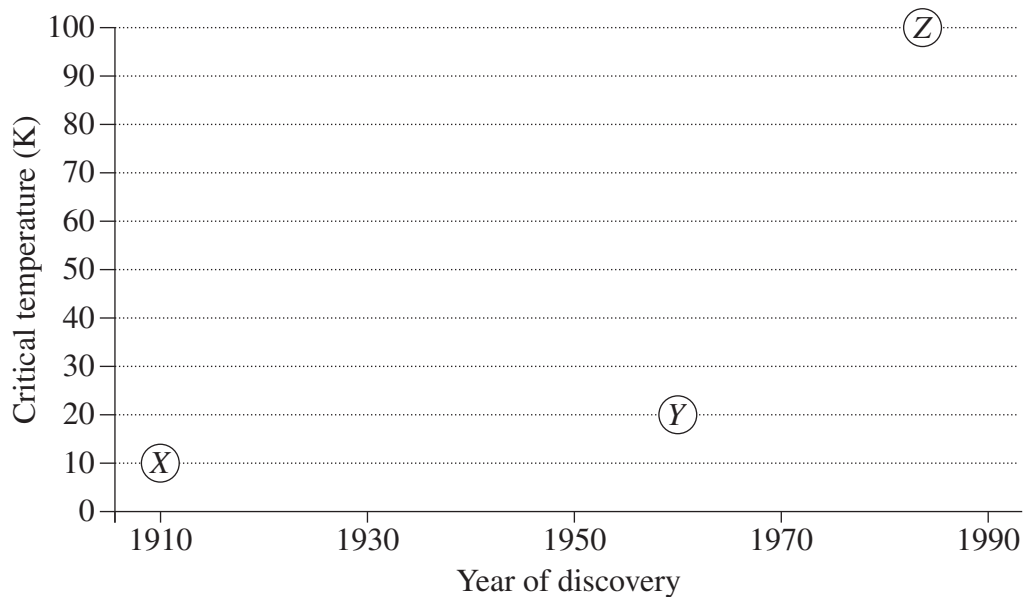
What advantage did Westinghouse's method have over Edison's?

- (A) DC could be supplied at a lower current, making it safer for the consumer.
 - (B) DC could be supplied at a lower voltage, making it safer for the consumer.
 - (C) AC allowed for the use of a lower transmission current, reducing energy losses.
 - (D) AC allowed for the use of a lower transmission voltage, reducing energy losses.
- 3** A region of space contains a constant magnetic field and a constant electric field.

How will these fields affect an electron that is stationary in this region?

- (A) Both fields will exert a force.
- (B) Neither field will exert a force.
- (C) Only the electric field will exert a force.
- (D) Only the magnetic field will exert a force.

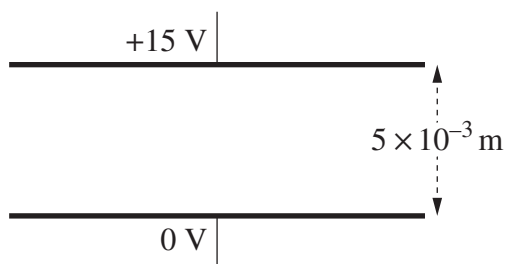
- 4 The graph shows information about three superconductors X, Y and Z including their year of discovery.



Which row of the table correctly classifies X, Y and Z?

	X	Y	Z
(A)	Metal	Metal alloy	Compound
(B)	Metal	Compound	Metal alloy
(C)	Metal alloy	Metal	Compound
(D)	Metal alloy	Compound	Metal

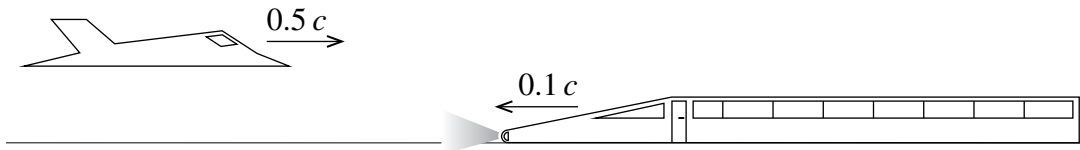
- 5 The diagram shows two parallel charged plates 5×10^{-3} m apart.



What is the magnitude of the electric field between the plates in V m^{-1} ?

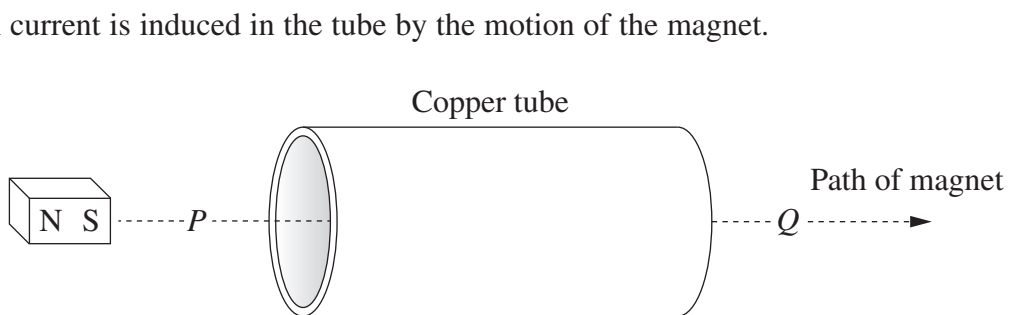
- (A) 3.3×10^{-4}
 (B) 0.33
 (C) 3
 (D) 3000

- 6 In a thought experiment, a jet is travelling at $0.5c$ relative to the ground, towards a train that is travelling at $0.1c$ relative to the ground, as shown.



What is the speed of the light emitted from the train's headlight, as measured by a pilot in the jet?

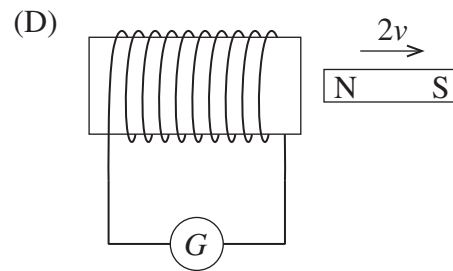
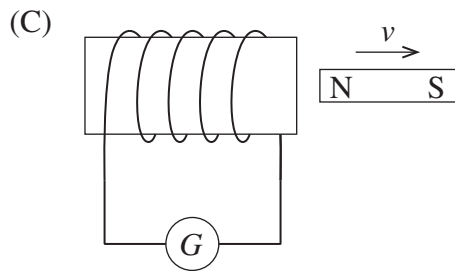
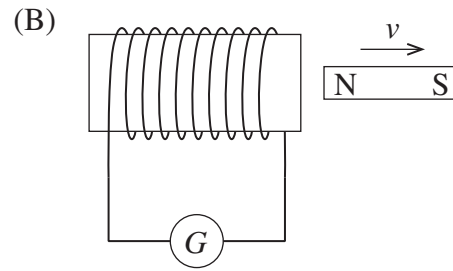
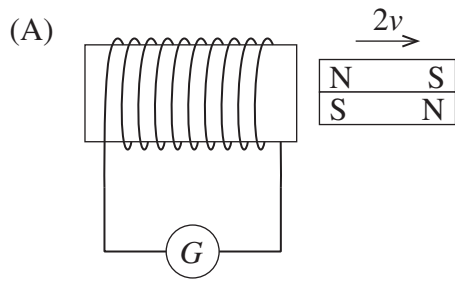
- (A) $0.1c$
 (B) $0.4c$
 (C) $0.6c$
 (D) $1.0c$
- 7 A magnet passes through a copper tube at constant velocity along the path shown.



Which row of the table correctly describes the forces acting between the tube and the magnet at points P and Q ?

	<i>Force at P</i>	<i>Force at Q</i>
(A)	Attraction	Repulsion
(B)	Repulsion	Attraction
(C)	Attraction	Attraction
(D)	Repulsion	Repulsion

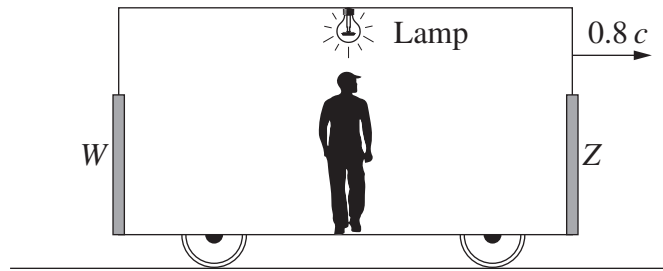
8 Which movement of the magnet(s) will produce the greatest deflection of the galvanometer?



9 How does back emf affect a DC motor?

- (A) It creates heat in the iron core.
- (B) It limits the speed of the motor.
- (C) It reverses the current in the coil.
- (D) It increases the torque of the motor.

- 10 In a thought experiment, a train is moving at a constant speed of $0.8c$. A lamp is located at the midpoint of a carriage. There are doors W and Z at each end of the carriage which open automatically when light from the lamp reaches them.

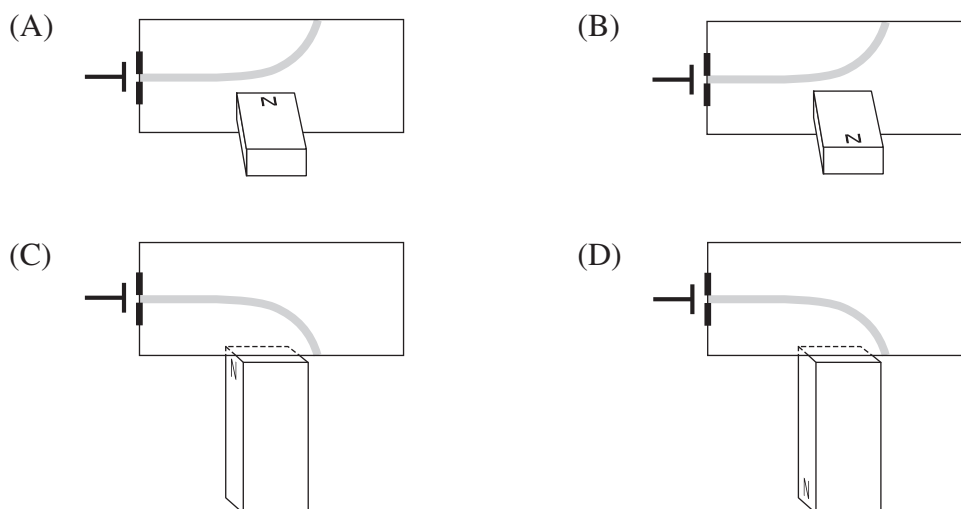


The passenger standing at the midpoint of the carriage switches on the lamp.

Which statement best explains what the passenger observes about the doors?

- (A) Z opens before W because the lamp is moving towards Z .
 - (B) W opens before Z because W is moving towards the lamp.
 - (C) W and Z open simultaneously because the lamp is placed at an equal distance from both.
 - (D) W and Z open simultaneously because the distance from the lamp to each door has contracted by the same amount.
- 11 What is the wavelength, in metres, of a photon with an energy of 3.5 eV ?
- (A) 1.2×10^{-6}
 - (B) 3.5×10^{-7}
 - (C) 1.18×10^{-15}
 - (D) 5.67×10^{-26}

12 Which diagram correctly shows the deflection of a cathode ray by a bar magnet?

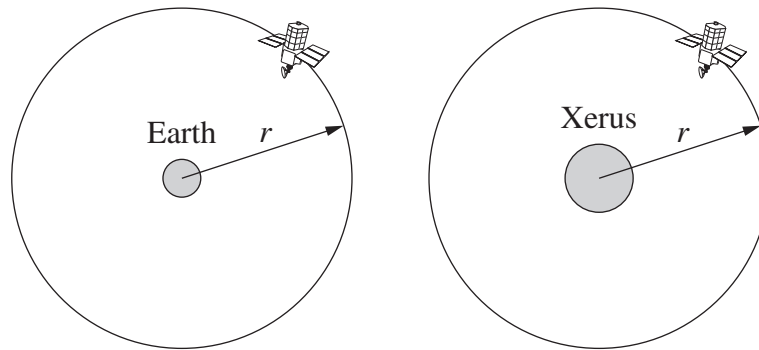


13 When light of a specific frequency strikes a metal surface, photoelectrons are emitted.

If the light intensity is increased but the frequency remains the same, which row of the table is correct?

	<i>Number of photoelectrons emitted</i>	<i>Maximum kinetic energy of the photoelectrons</i>
(A)	Remains the same	Remains the same
(B)	Remains the same	Increases
(C)	Increases	Remains the same
(D)	Increases	Increases

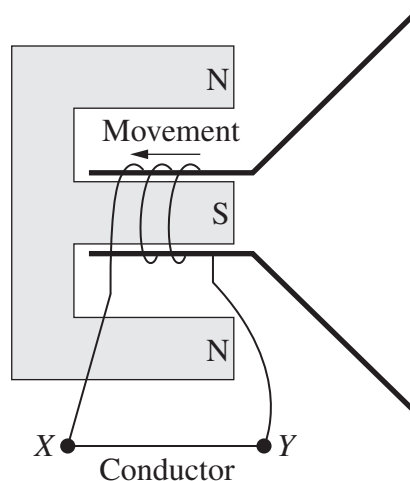
- 14 A satellite orbits Earth with period T . An identical satellite orbits the planet Xerus which has a mass four times that of Earth. Both satellites have the same orbital radius r .



What is the period of the satellite orbiting Xerus?

- (A) $\frac{T}{4}$
- (B) $\frac{T}{2}$
- (C) $2T$
- (D) $4T$
- 15 Which of the following statements correctly describes the effect of light in a solar cell?
- (A) The light produces electron-hole pairs.
- (B) The light causes pure silicon to become n -type silicon.
- (C) The light increases the potential difference across the p - n boundary.
- (D) The light transfers energy to electrons in the conduction band of the p -type semiconductor.

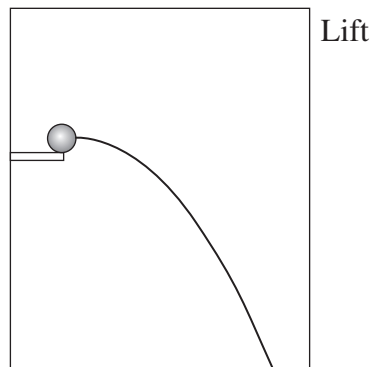
- 16 The cone of a speaker is pushed so that the coil moves in the direction shown.



Which row of the table correctly identifies the behaviour of the speaker and the direction of the current through the conductor?

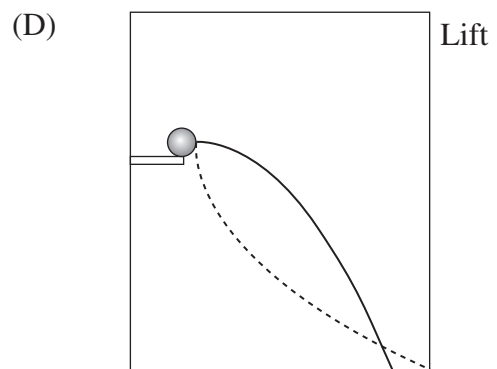
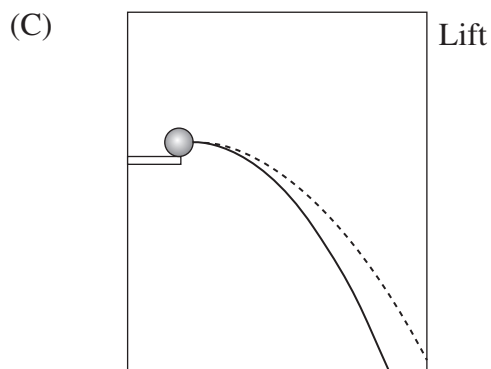
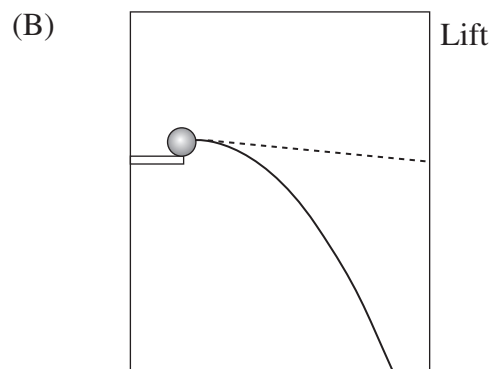
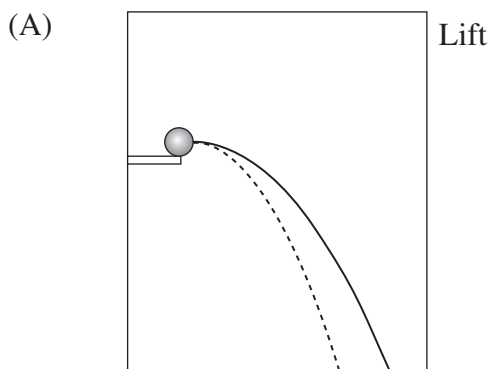
	<i>The speaker behaves like a ...</i>	<i>The direction of the current is from ...</i>
(A)	generator	X to Y
(B)	generator	Y to X
(C)	motor	X to Y
(D)	motor	Y to X

- 17 A projectile was launched horizontally inside a lift in a building. The diagram shows the path of the projectile when the lift was stationary.

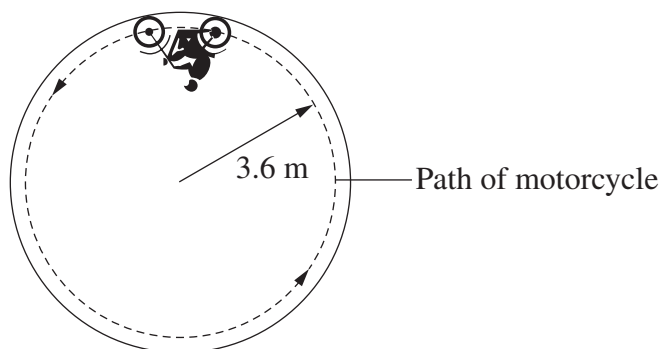


The projectile was launched again with the same velocity. At this time, the lift was slowing down as it approached the top floor of the building.

Which diagram correctly shows the new path of the projectile (dotted line) relative to the path created in the stationary lift (solid line)?



- 18 A motorcycle travels around a vertical circular path of radius 3.6 m at a constant speed. The combined mass of the rider and motorcycle is 200 kg.



What is the minimum speed, in m s^{-1} , at which the motorcycle must travel to maintain the circular path?

- (A) 0.42
 (B) 1.9
 (C) 5.9
 (D) 35
- 19 Muons are subatomic particles which at rest have a lifetime of 2.2 microseconds (μs). When they are produced in Earth's upper atmosphere, they travel at $0.9999c$.

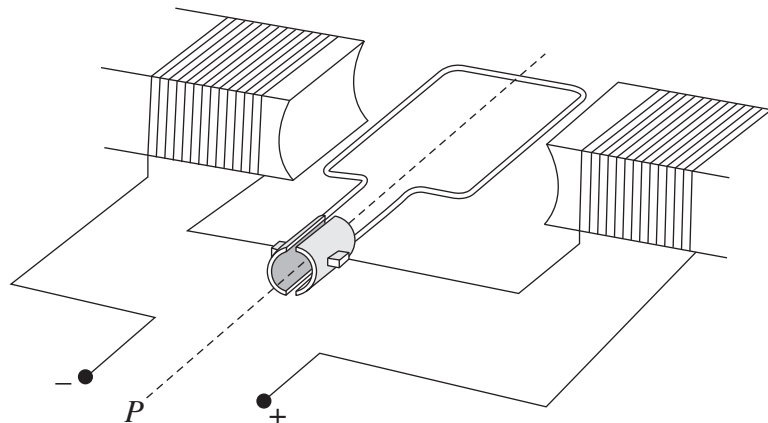
Using classical physics, the distance travelled by a muon in its lifetime can be calculated as follows:

$$x = vt \\ = 660 \text{ m}$$

Which row of the table correctly summarises the behaviour of these muons?

Muon's reference frame		Earth's reference frame	
<i>Distance travelled</i> (m)	<i>Lifetime</i> (μs)	<i>Distance travelled</i> (m)	<i>Lifetime</i> (μs)
(A) 660	2.2	> 660	> 2.2
(B) > 660	> 2.2	660	2.2
(C) 660	2.2	< 660	< 2.2
(D) < 660	< 2.2	660	2.2

- 20 In the motor shown, the rotor spins clockwise, as viewed from point P , when connected to a DC supply.



What happens when the motor is connected to an AC supply?

- (A) There is no movement of the rotor.
- (B) The rotor produces clockwise movement only.
- (C) The rotor vibrates at the frequency of the AC supply.
- (D) The rotor continuously turns half a rotation clockwise, then half a rotation anticlockwise.