OVERMUGGED O LEVEL MOCK PAPER 2021
SECONDARY 4 EXPRESS
SECONDARY 5 NORMAL ACADEMIC

PURE PHYSICS **6091/01**
PAPER 1: MULTIPLE CHOICES **September 2021**
1 hour

INSTRUCTIONS TO CANDIDATES

There are **forty** questions in this paper. Answer **all** questions. For each question, there are 4 possible answers, **A, B, C and D**.

Choose the one you consider correct.

Each correct answer wills score one mark. A mark will not be deducted for a wrong answer.

The use of an approved scientific calculator is expected, where appropriate.

**Questions in this mock paper may contain adapted questions from the Ten Year Series and Prelim Papers from various schools in Singapore.*

1. Diagram I shows the vernier calipers **when the jaws are fully closed.** Diagram II shows the same vernier calipers after measuring an object.

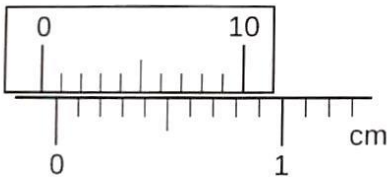


Diagram I

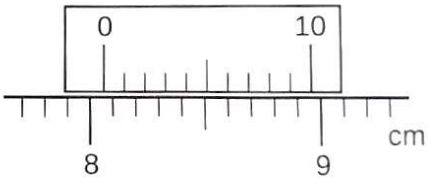


Diagram II

What is the **actual length** of the object?

(A) 8.09cm
(B) 8.13cm
(C) 8.19cm
(D) 8.23cm

Zero error = -0.07cm
Reading = 8.06cm
Actual = 8.06 – (-0.07) = 8.13cm

B

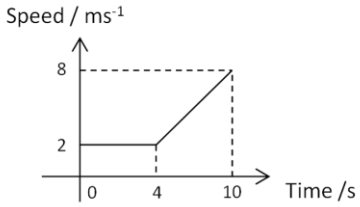
2. Which of the following is **not a vector quantity**?

(A) Displacement
(B) Acceleration
(C) Weight
(D) Speed

D

3. A runner was running at a constant speed of $2ms^{-1}$ for the first 4s and starts accelerating by $1ms^{-1}$ for the next 6s. Calculate his **average speed**.

(A) 2.4 ms^{-1}
(B) 3.8 ms^{-1}
(C) 4.0 ms^{-1}
(D) 5.0 ms^{-1}



Avg speed = Total dist / total time
= (2x4)+(2x6 + ½ x6x6) / 10s

B

4. Which of the following statement is **true** for **terminal velocity**?

(A) An object with greater mass will experience a greater initial acceleration.
(B) Two objects with different mass will experience the same terminal velocity within the same gravitational field.
(C) Air resistance is constant, assuming an object shape is unchanged when undergoing free fall.
(D) The resultant force of an object at terminal velocity is zero.

D

5. A diver is sinking into the water at a **constant speed of 0.4 m/s**. What is the resultant force acting upon the diver if the diver and his gear weigh 100kg?

(A) O N
(B) 40N
(C) 960N
(D) 1000N

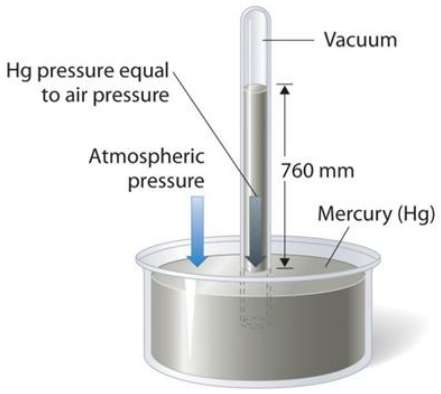
A

6. Which property of an object resists a change in its state of rest or motion?

(A) Acceleration
(B) Weight
(C) Velocity
(D) Mass

D

7. Which statement(s) is **true** for **mercury barometer?**

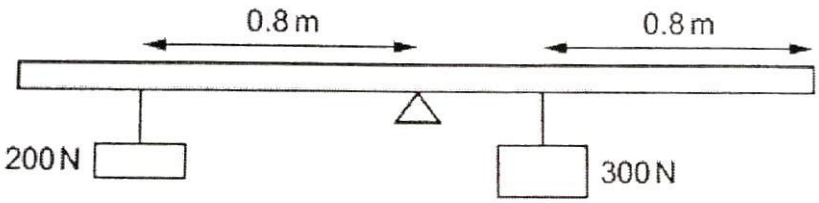


(i) The height of mercury column decreases when atmospheric pressure decreases.
(ii) When the glass is tilted, the vertical height will remain unchanged.
(iii) One unit of atm is the equivalent to 76cmHg.
(iv) If there is gas present in the test-tube, the height of the mercury column will decrease.

(A) i & ii only
(B) i, ii & iii only
(C) ii & iii only
(D) All of the above

D

8. A uniform bar of length 2.4m is pivoted exactly at its midpoint as shown in the diagram below.

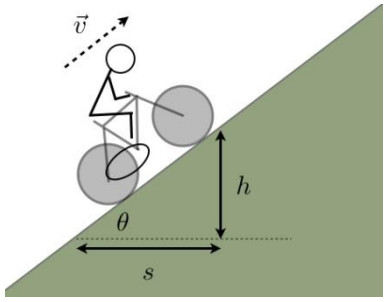


Determine the **resultant moment**.

	Moment /Nm	Direction
(A)	40	Clockwise
(B)	40	Anti-clockwise
(C)	80	Clockwise
(D)	80	Anti-clockwise

B

9. A man rides a bicycle and accelerates up a slope.



How does the man's kinetic and gravitational potential energy change as he goes up the slope?

	Kinetic Energy	Gravitational Potential Energy
(A)	Decrease	Increase
(B)	Increase	Increase
(C)	Decrease	Decrease
(D)	Increase	Decrease

B

10. A ninja van driver with mass of 60kg carries a delivery package of mass 25kg up a flight of stairs that has a vertical height of 30m in exactly 2 minutes.

Find the **power** produced by the man.

(A) 213W
(B) 440W
(C) 9380W
(D) 93800W

A

11. A student uses a microscope to observe the behaviour of smoke particles that are placed in an air-filled container. He observes bright specks of light.

What is **causing this phenomenon**?

(A) The smoke particles are moving randomly
(B) Uneven bombardment by the air particles on the smoke particles
(C) Air particles are less dense than the smoke particles
(D) The smoke particles are gaining kinetic energy

B

12. What is the amount of **heat energy** required to turn **500g of pure ice** at **-20°C** to **steam** at **100°C**?

(C_{ice} = 2100Jkg^{-1}°C^{-1}, C_{water} = 4200Jkg^{-1}°C^{-1}, L_{fusion} = 336kJkg^{-1}, $L_{vaporisation}$ = 2260kJkg^{-1})

(A) 2.32 x 10^2 J
(B) 2.32 x 10^5 J
(C) 1.53 x 10^5 J
(D) 1.53 x 10^6 J

Total heat energy = (0.5 x 2100 x 20) + (0.5 x 336 000) + (0.5 x 4200 x 100) + (0.5 x 2 260 000) = 1.53 x 10^6 J

D

13. Refer to the table below. Which of thermometric property is **incorrectly matched** to the thermometer?

	Thermometric Property	Thermometer
(A)	Volume of fixed mass of liquid	Mercury-in-glass thermometer
(B)	Volume of fixed mass of liquid	Alcohol-in-glass thermometer
(C)	Resistance of wire	Resistance thermometer
(D)	Current	Thermocouple

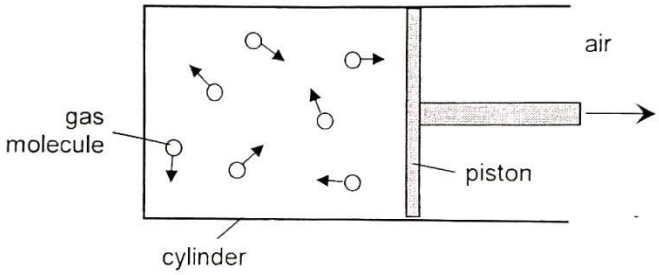
D

14. A fixed mass of gas is **heated** while kept at **constant volume**. How do the **properties of the gas molecules change**?

	Average Speed	Frequency of collision with walls	Pressure
(A)	Increase	Unchanged	Unchanged
(B)	Unchanged	Unchanged	Increase
(C)	Unchanged	Increase	Unchanged
(D)	Increase	Increase	Increase

D

15. Gas inside a cylinder is heated slowly. The pressure inside the cylinder remains constant as the piston moves outwards.



How did the speed of the gas molecules and the rate of collision with the piston change?

	Speed of molecules	Rate of collision
(A)	Increase	Increase
(B)	Increase	Decrease
(C)	Increase	Remain constant
(D)	Remain constant	Remain constant

B

16. Refrigerator usually has the freezer compartment at the top as shown in the diagram below.

Determine the **effect of the air** particles in the freezer compartment.

	Air particles	Density of air
(A)	Become smaller	Increase
(B)	Become smaller	Decrease
(C)	Move closer together	Increase
(D)	Move closer together	Decrease

C

17. Which statement(s) is **true** for **boiling and evaporation?**

(i) Boiling occurs at the surface of the liquid.
(ii) Evaporation occurs at any temperature.
(iii) Boiling will result in bubbles being formed.
(iv) Evaporation requires a source of energy.

(A) i & ii only
(B) i, ii & iii only
(C) ii & iii only
(D) ii, iii & iv only

C

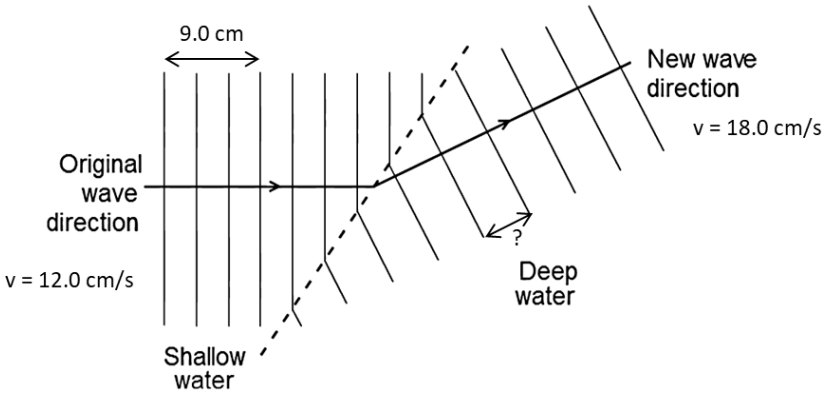
18. The same amount of thermal energy is supplied to four blocks of different mass.

Which block has the **highest specific heat capacity**?

	Mass of block / kg	**Increase in temperature / °C**
(A)	4.0	6.0
(B)	5.0	5.0
(C)	6.0	4.0
(D)	7.0	3.0

D

19. A wave in the ripple tank is travelling from a shallow region to a deeper region.

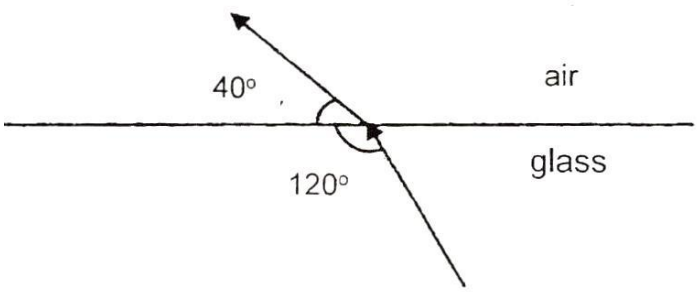


What is the **wavelength** in the deep water?

(A) 3.0 cm
(B) 4.5 cm
(C) 9.0 cm
(D) 13.5 cm

B

20. The diagram below shows a ray of light passing from glass into air.



Determine the refractive index of the glass.

(A) 0.75
(B) 1.2
(C) 1.5
(D) 4.0

C

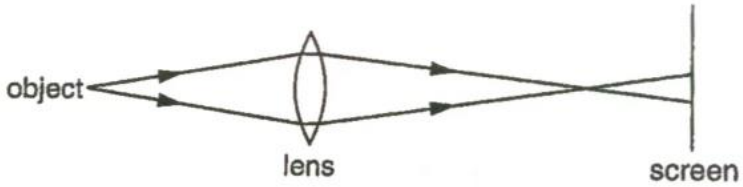
21. Which statement(s) is **true** for **total internal reflection**?

(i) Total internal reflection only occurs when light travels from an optically denser medium to air/vacuum.
(ii) Total internal reflection occurs when incident angle is greater than critical angle.
(iii) Critical angle is the angle of incidence when the refracted ray is 90 degrees.
(iv) Light rays have to travel from a denser medium to a less dense medium for total internal reflection to occur.

(A) i & ii only
(B) i, ii & iii only
(C) ii & iii only
(D) ii, iii & iv only

C

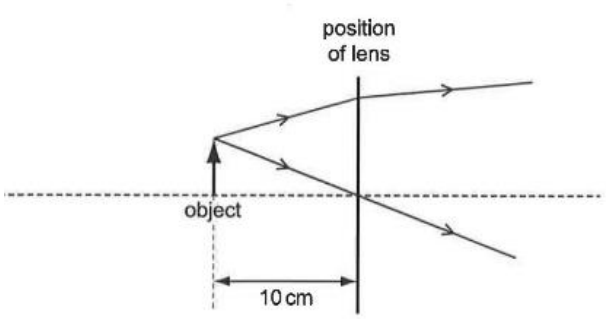
22. A blurred image of the object is formed on the screen.



How can an in-focus image be captured on the screen?
(A) Use a brighter object
(B) Move the screen away from the lens
(C) Use a lens of longer focal length
(D) Move the object away from the lens

C

23. The diagram below shows the paths of two rays of light from an object. The object is 10cm from the lens as shown in the diagram below.



What type of lens and what is the focal length and the type of image formed?

	Lens	Focal length	Type of image
A	Diverging	Less than 10cm	Real
B	Diverging	More than 10cm	Virtual
C	Converging	Less than 10cm	Real
D	Converging	More than 10cm	Virtual

D

24. Two notes of **different loudness** but the **same pitch** were played on a musical instrument.

The two sound waves produced will have:

(A) Same amplitude and the same speed
(B) Same frequency and different speed
(C) Different amplitude and same speed
(D) Different amplitude and different speed

C

25. The **correct definition** for the term *'wavefront'* is:

(A) An imaginary line joining all points in phase on a wave
(B) The distance between successive peaks of a wave
(C) A line joining the crests and the troughs of a wave
(D) The distance between the trough and the peak of a wave

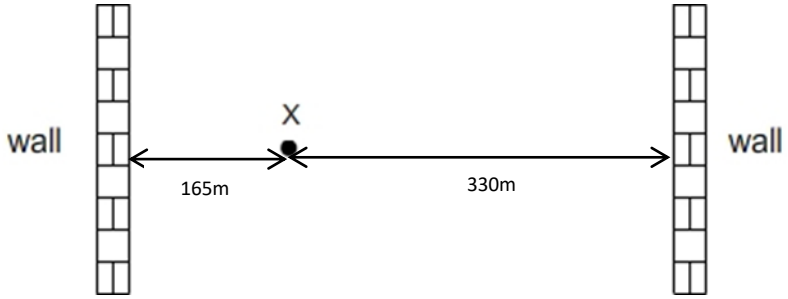
A

26. Which statement about the properties of EM waves is **false**?

(A) EM waves are transverse waves
(B) Travel at the speed of 3.0×10^{8} in vacuum
(C) Possess sound properties like compression and rarefaction
(D) Obey the wave equation, velocity = frequency × wavelength

C

27. Refer to the diagram below.



(Speed of sound in air is $330ms^{-1}$)

When Jung Kook claps his hand at point X, he hears a total of 2 echoes. Calculate the **time interval between the 2 echoes.**

(A) 0s
(B) 0.5s
(C) 1s
(D) 2s

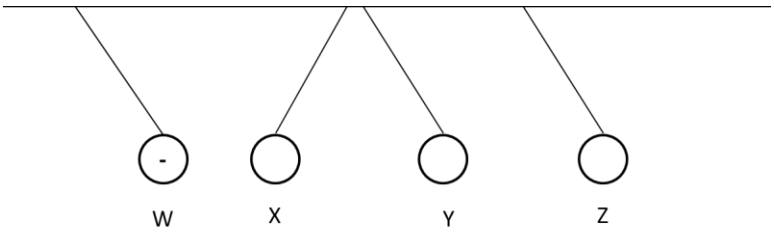
Time taken for first echo = Distance / speed
= (165m x 2) / 330 = 1s

Time taken for second echo = Distance / speed
= (330m x 2) / 330 = 2s

Time interval = 2s- 1s = 1s

C

28. Four charged ely charged.



What are the charges on X, Y & Z?

	X	Y	Z
A	Positive	Negative	Positive
B	Positive	Positive	Positive
C	Positive	Positive	Negative
D	Negative	Positive	Positive

B

29. Wire X has a resistance of 4.0 Ω. Wire Y is made of the same material but it is twice as long and has a diameter than is half of that of Wire X.

Calculate the resistance of Wire Y.
(A) 4.0 Ω
(B) 16.0 Ω
(C) 24.0 Ω
(D) 32.0 Ω

Wire X's resistance = $\rho L / A = \rho L / \pi r^2 = 4.0\ \Omega$
Wire Y's resistance = $\rho L / A = \rho(2L) / \pi(0.5r)^2 = (2/0.25)\ \rho L / \pi r^2 = 8 \times 4.0\ \Omega = 32\ \Omega$

*Note that when diameter is halved, radius is also halved and since cross sectional area is πr^2, **the area will be decreased by 4 times since $(1/2r)^2$.**

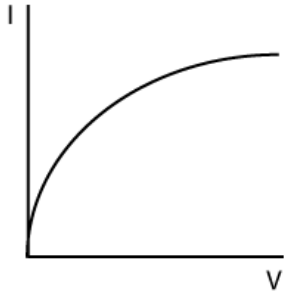
D

30. Which quantity is equal to **the electromotive force (emf)** for a circuit?

(A) The power used by the source in driving one electron around the complete circuit.
(B) The power used by the source in driving one coulomb of charge around the complete circuit.
(C) The work done by the source in driving one electron around the complete circuit.
(D) The work done by the source in driving one coulomb of charge around the complete circuit.

D

31. Refer to the I-V graph below.

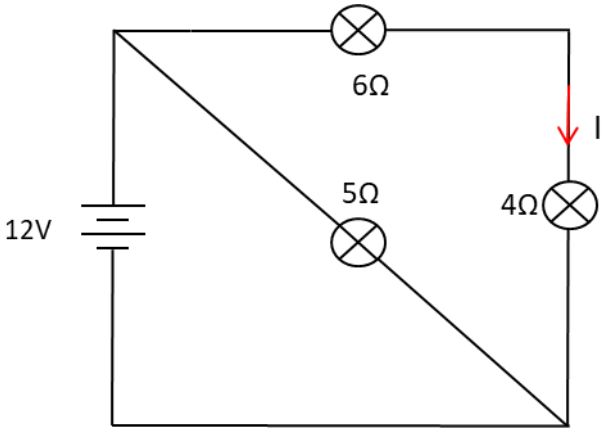


What **electronic component** could it be?

(A) Thermistor
(B) Filament lamp
(C) Semi-conductor diode
(D) Rheostat

B

32. The diagram below shows a circuit with 3 light bulbs of different resistances.



What is the current flowing through the 4Ω light bulb?

(A) 048A
(B) 1.2A
(C) 2.4A
(D) 3.6A

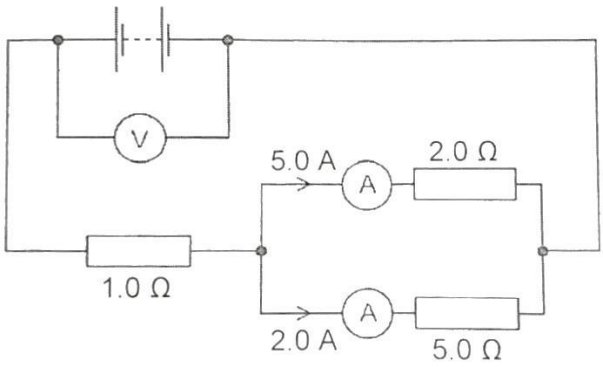
B

33. A kettle with a heating component of 120 Ω is connected to a 480W power supply. What is the amount of charge that passes through the kettle in 4 minutes?

(A) 16C
(B) 120C
(C) 480C
(D) 640C

C

34. Refer to the circuit diagram below.



Determine the reading in the voltmeter.

(A) 10V
(B) 17V
(C) 27V
(D) 56V

B

35. Which statement(s) is **true**?

(i) Resistance for thermistor decreases when temperature decreases.
(ii) Resistance for light-dependent resistor increases when light intensity decreases.
(iii) An appliance with double insulation does not require an earth wire.
(iv) The live wire and neutral wire will be at high voltage while the earth wire will have zero voltage if the circuit is functioning normally.

(A) i only
(B) i & iii only
(C) ii & iii only
(D) All of the above

C

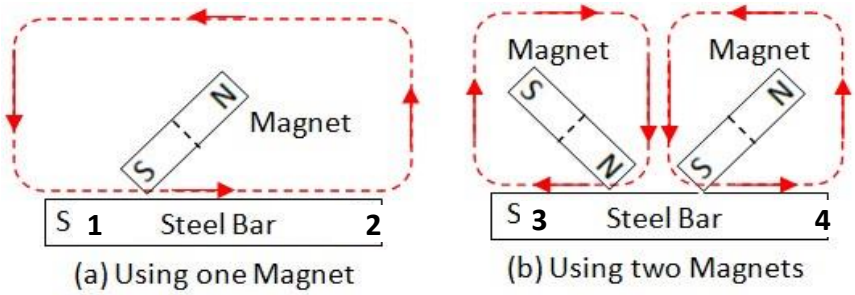
36. The power of an electrical heater is 3.0kW. The heater is switched on for 2.5 hours. The cost for using this heating was $1.20.

Determine the **cost of 1kWh** of electrical energy.

(A) 16 cents
(B) 17 cents
(C) 40 cents
(D) 48 cents

A

37. Refer to the set-up below.

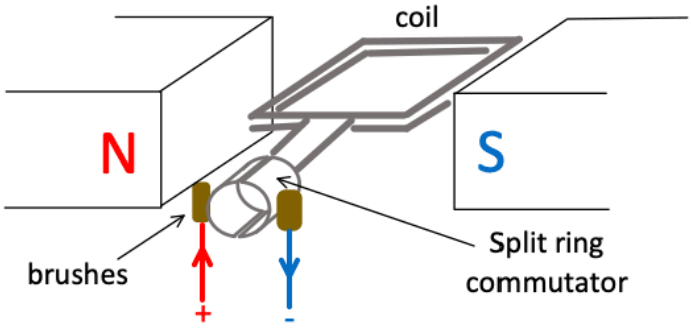


Determine the polarity at each ends of the steel bar.

	1	2	3	4
A	South	North	South	North
B	South	North	North	South
C	North	South	North	South
D	North	South	South	North

A

38. Refer to the set-up for a D.C motor.



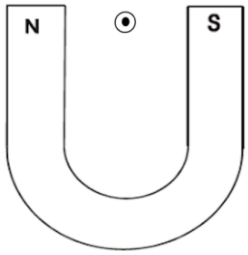
Which of the following statement(s) is/are **true**?

(i) The left side of the coil will experience a downward force.
(ii) The coil will rotate in an anti-clockwise manner.
(iii) The coil experiences the greatest force at the vertical position.
(iv) The split ring commutator will reverse the direction of the current in the coil every one full rotation.

(A) i only
(B) i & ii only
(C) i & iii only
(D) All of the above

B

39. A straight current carrying conductor is placed between a U-shaped magnet as in diagram below.

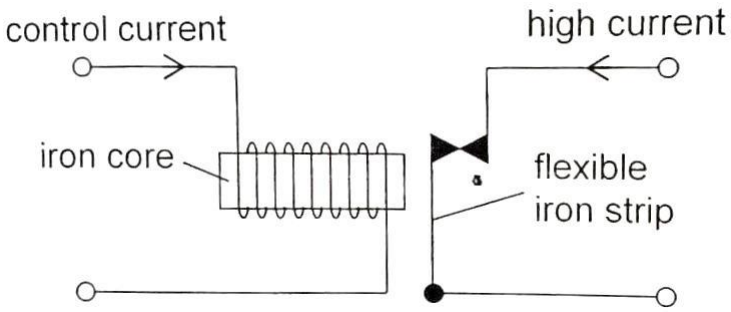


What will **happen** to the current carrying conductor?

(A) It will move towards the left.
(B) It will move towards the right.
(C) It will move upwards.
(D) It will move downwards.

C

40. In the circuit shown, a control current in the primary circuit is used to switch off a secondary circuit with high current.



When the control current in the primary circuit is switched on, the high current in the secondary circuit does not switch off.

What change must be made for the secondary circuit to switch off?

(A) Switch to a alternating current
(B) Reduce the number of coil around the iron core
(C) Replace the iron core with a steel core
(D) Use a stronger control current

D