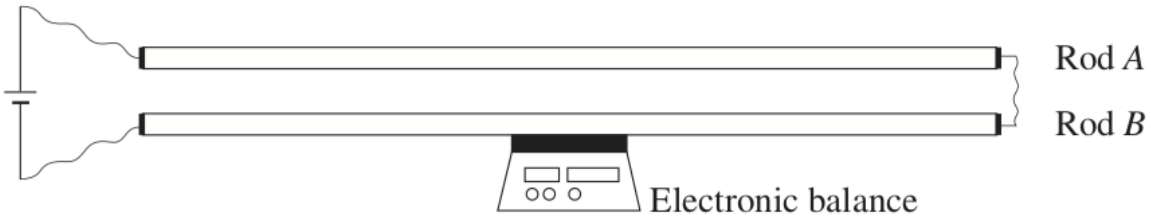
**New Syllabus NESA Questions:**

**1)**

A student performed an experiment using two identical, current-carrying metal rods connected to a power supply. Rod *A* was placed at different distances from Rod *B*, and the measurements on the electronic balance were recorded.




What is the dependent variable in this experiment?

A. The current in Rod *A*

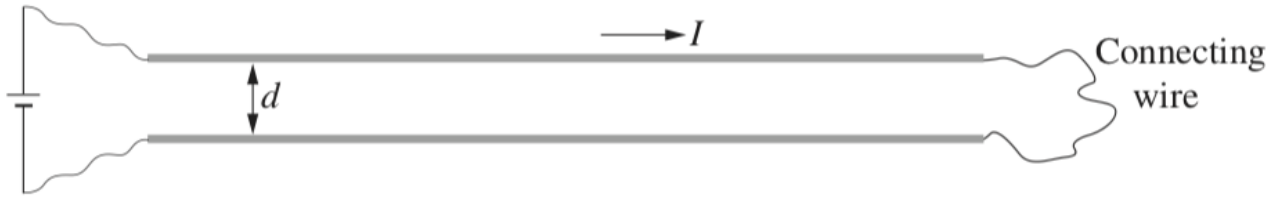
B. The length of the rods

C. The mass recorded on the balance

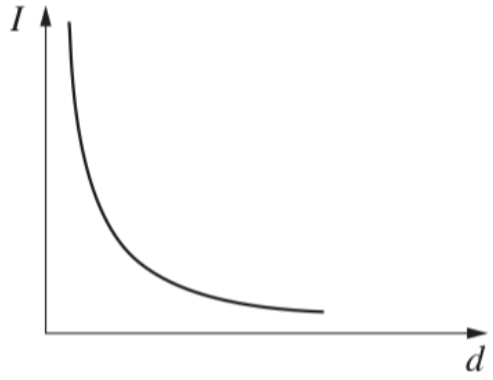
D. The distance between the two rods

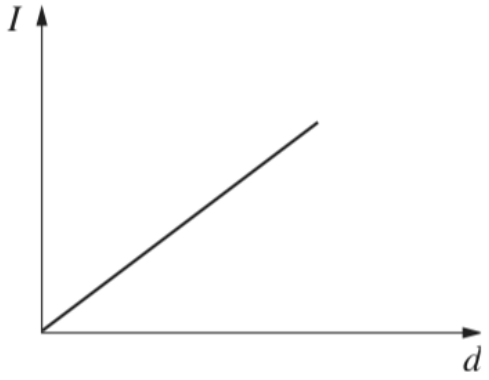
**2)**

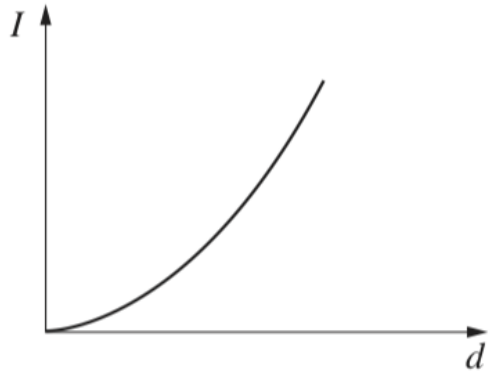
Two parallel conducting rods are connected by a wire as shown and carry current $I$. They are separated by distance $d$ and repel each other with a force $F$.

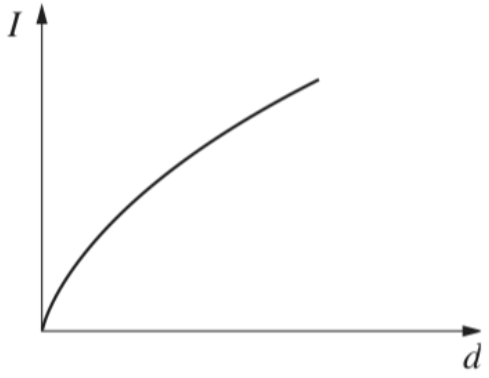



Which graph best shows how the current $I$ would need to be varied with distance $d$ to keep the force $F$ constant?

A. 


B. 

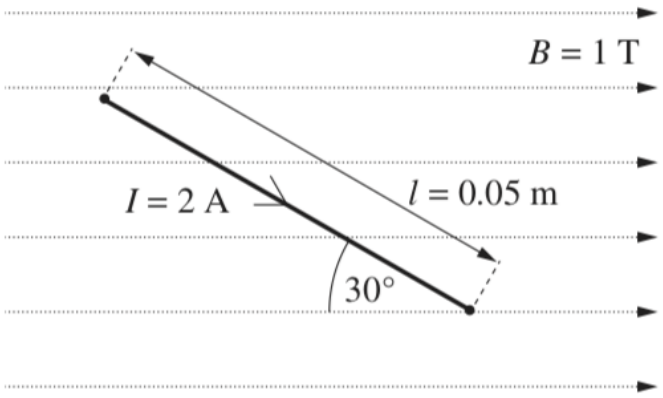

C. 


D. 

**Past HSC Questions:**

**2018:**

**5** The diagram shows a current-carrying conductor in a magnetic field.




What is the magnitude of the force on the conductor?

A. 0 N

B. 0.05 N

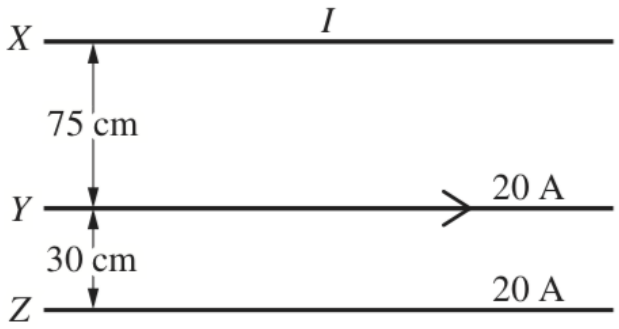
C. 0.09 N

D. 0.10 N

---

**24)**

(b) Three parallel wires *X*, *Y* and *Z* all carry electric currents. A force of attraction is produced between *Y* and *Z*. There is zero net force on *Y*. **3**




What is the magnitude and direction of the current in *X*?

.....

.....

.....

.....

.....

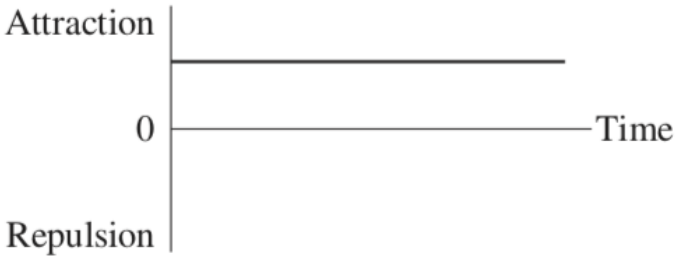
.....

**2017:**

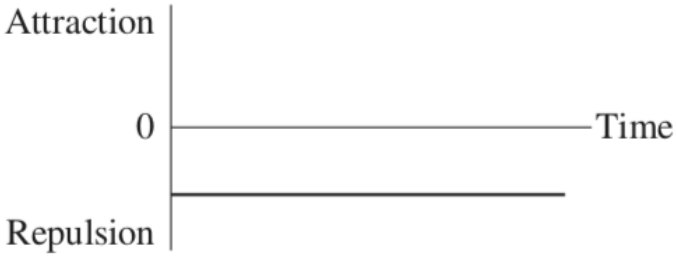
**16** An AC supply is connected to a light bulb by two long parallel conductors as shown.


Which graph shows the variation over time of the magnetic force between the two conductors?

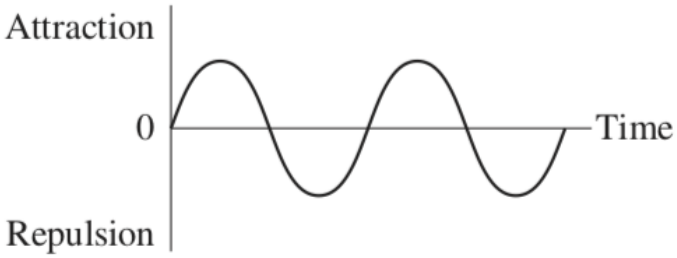
A.



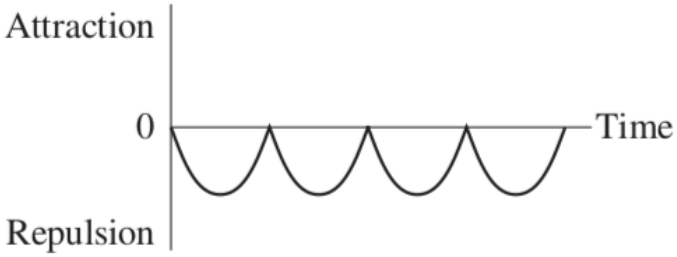

B.




C.




D.

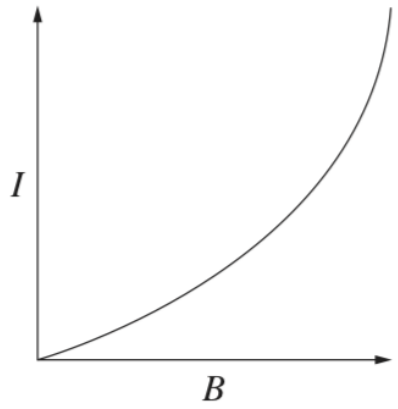


**2015:**

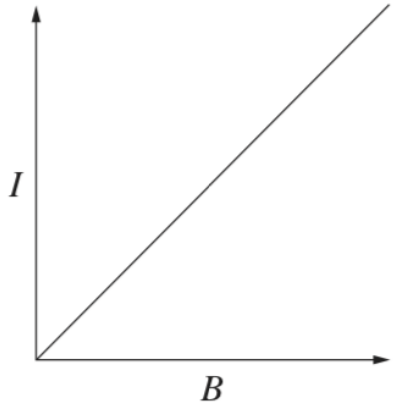
**7** A current-carrying wire is placed perpendicular to a magnetic field.

Which graph correctly shows the relationship between magnetic field strength ($B$) and current ($I$) if the force is to remain constant?

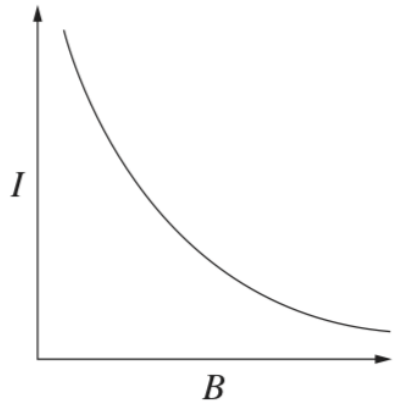
(A)



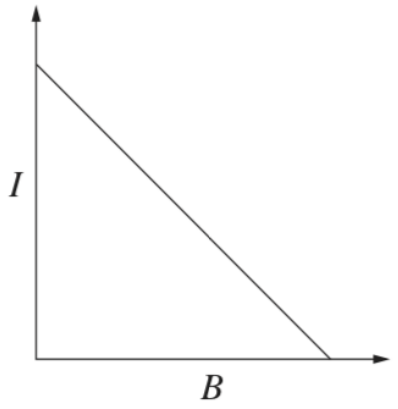

(B)



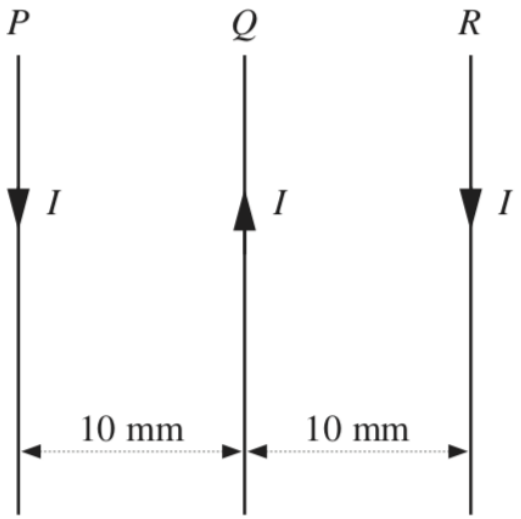

(C)




(D)



**9** $P$, $Q$ and $R$ are straight, current-carrying conductors. They all carry currents of the same magnitude ($I$). Conductors $P$ and $Q$ are fixed in place. The magnitude of the force between conductors $Q$ and $R$ is $F$ newtons.




What is the net force on conductor $R$ when it is in the position shown?

(A) $\frac{F}{2}$ newtons to the left

(B) $\frac{F}{2}$ newtons to the right

(C) $\frac{3F}{2}$ newtons to the left

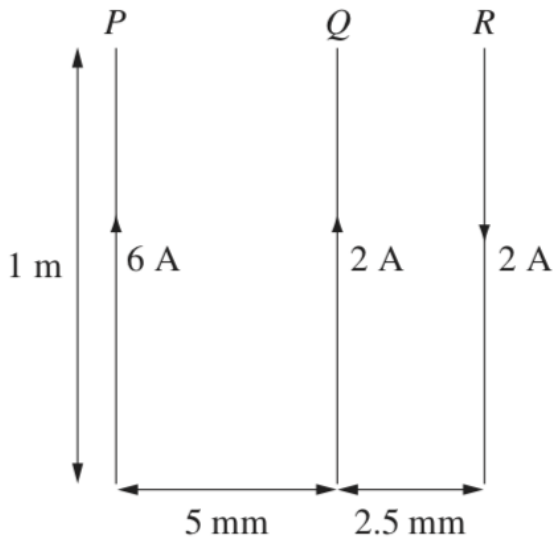
(D) $\frac{3F}{2}$ newtons to the right

**2013:**

**Question 25** (4 marks)

*P*, *Q* and *R* are straight current-carrying conductors.

Conductors *P* and *R* are fixed and unable to move. Conductor *Q* is free to move.




(a) In which direction will the conductor *Q* move as a result of the current flow in *P* and *R*? **1**

.....

.....

(b) Calculate the magnitude of the force experienced by *Q* as a result of the currents through *P* and *R*. **3**

.....

.....

.....

.....

.....

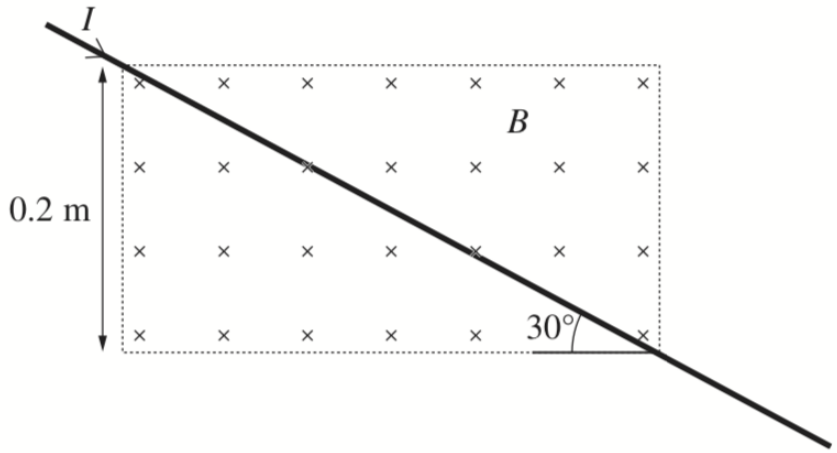
.....

.....

.....

**2012:**

**8** A current-carrying wire passes through a region of uniform magnetic field, magnitude 0.05 T, and as a result experiences a force of magnitude 0.03 N.




What is the current $I$?

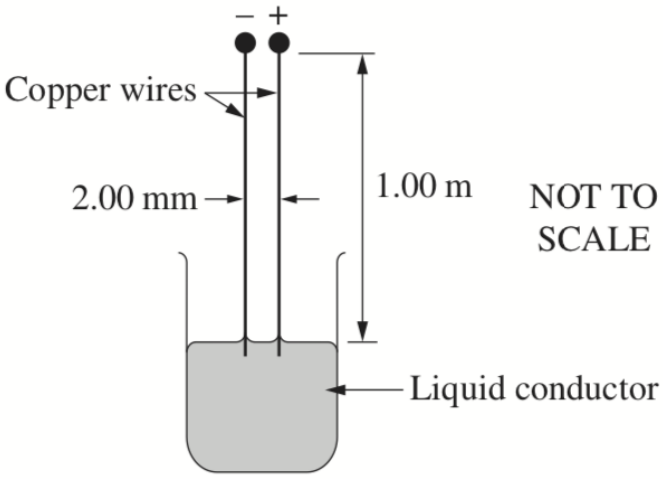
(A) 1.5 A

(B) 1.7 A

(C) 3.0 A

(D) 6.0 A

**17** The following equipment is attached to a DC power supply.




What current must be flowing through the wires to result in a force of $2.50 \times 10^{-3}$ N between them?

(A) 0.224 A

(B) 5.00 A

(C) 12.5 A

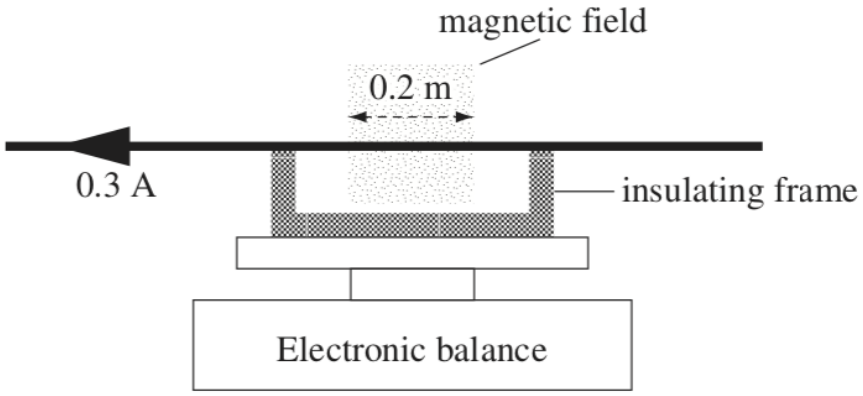
(D) 25.0 A

---

**2010:**

**Question 28** (4 marks)

A copper rod is placed on a wooden frame, which is placed on an electronic balance. A length of 0.2 m of the rod passes at right angles to a horizontal magnetic field. **4**




When a current of 0.3 A is passed through the rod, the reading on the balance increases by $7.5 \times 10^{-4}$ kg.

What is the strength and direction of the magnetic field?

.....

.....

.....

.....

.....

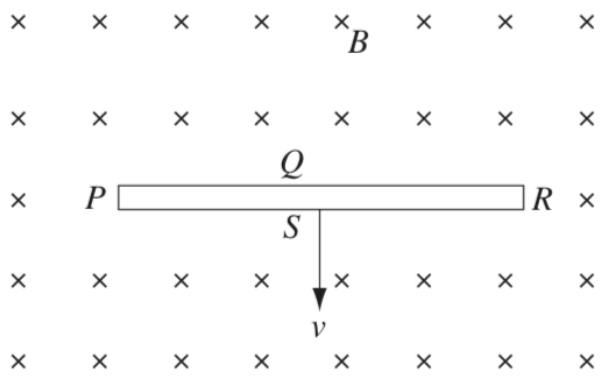
.....

.....

.....

**2009:**

**9** A thin solid conductor with sides *PQRS* is moving at constant velocity *v*, at right angles to a uniform magnetic field *B*, directed into the page as shown.




Which side of the conductor has the greatest concentration of electrons?

(A) *P*

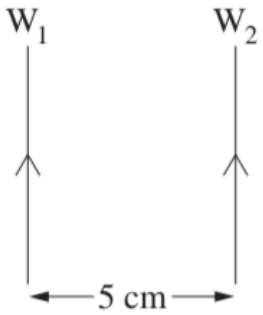
(B) *Q*

(C) *R*

(D) *S*

**Question 23** (6 marks)

Two identical wires, $W_1$ and $W_2$, each 2.5 m in length, are positioned as shown. They carry identical currents in the direction indicated.




NOT TO SCALE

(a) Identify the direction of the force which $W_2$ experiences as a result of the current in $W_1$. **1**

.....

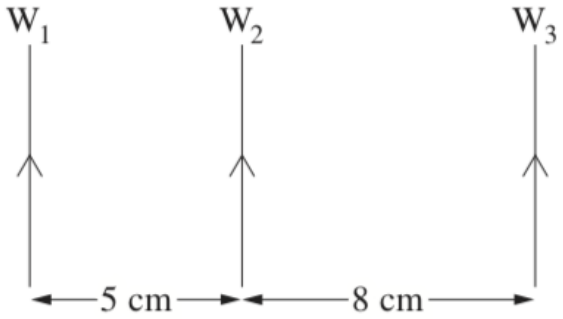
(b) Calculate the current in each wire, given that the two wires experience a force of $6.9 \times 10^{-4}$ N. **2**

.....

.....

.....

(c) A third wire, $W_3$, carrying a smaller current, is now placed as shown. **3**




NOT
TO
SCALE

Explain qualitatively the forces on $W_2$ as a result of the currents in $W_1$ and $W_3$.

.....

.....

.....

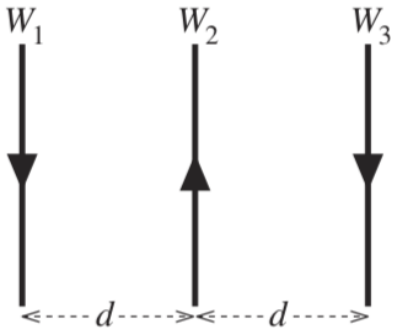
.....

.....

.....

**2008:**

**6** Three identical wires $W_1$, $W_2$ and $W_3$ are positioned as shown. Each carries a current of the same magnitude in the direction indicated.



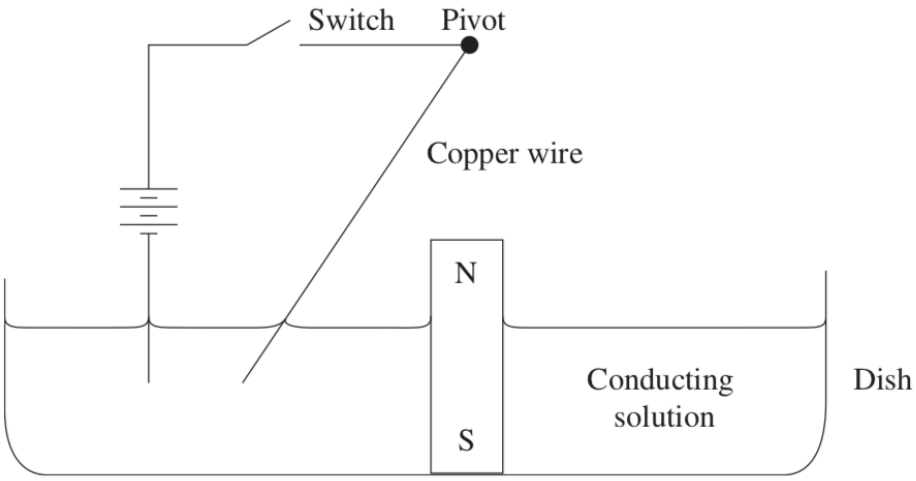

What is the magnitude and direction of the resultant force on $W_2$?

| | *Magnitude* | *Direction* |
|---|---|---|
| (A) | Zero | None |
| (B) | Non zero | To the left |
| (C) | Non zero | To the right |
| (D) | Non zero | Out of the page |

---

**2006:**

**6** The diagram shows a magnet standing on the bottom of a dish filled with a conducting solution. A copper wire is suspended freely from a point above the magnet with its tip in the conducting solution. It is held in the position shown.




The switch is closed and the wire released.

Which of the following will be observed?

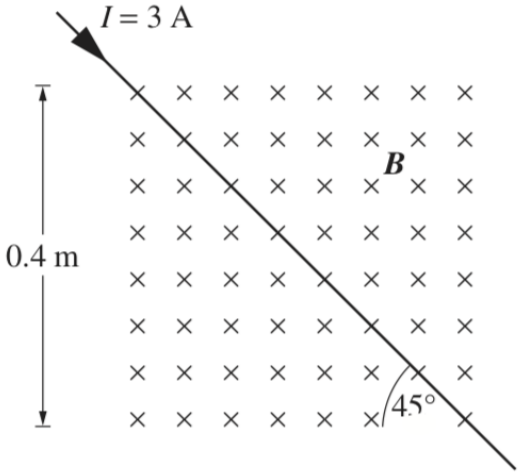
(A) The wire will rotate about the magnet.

(B) The wire will be attracted to the magnet.

(C) The magnet will rotate about its vertical axis.

(D) The solution in the dish will rotate about the magnet.

**7** A current-carrying conductor passes through a square region of magnetic field, magnitude 0.5 T, as shown in the diagram. The magnetic field is directed into the page.




What is the magnitude of the magnetic force on the conductor?

(A) 0.170 N

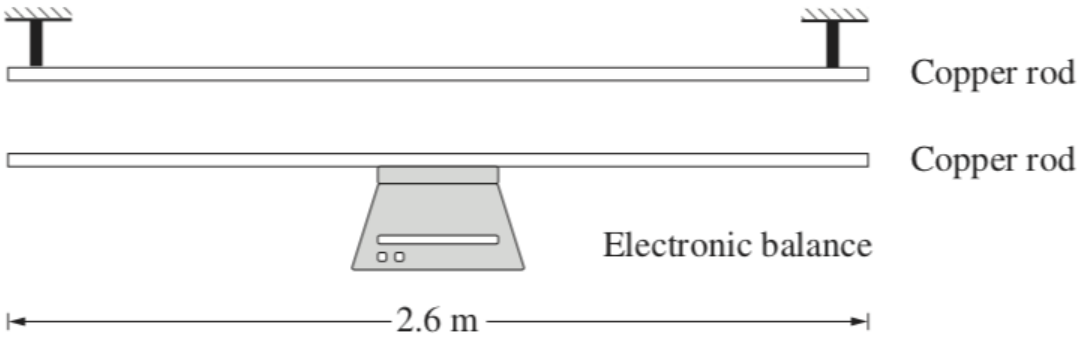
(B) 0.424 N

(C) 0.600 N

(D) 0.849 N

**Question 20** (8 marks)

A balance was used to investigate the relationship between current and force. The balance was set up with one copper rod fixed to it and a second rod fixed above it, as shown in the diagram. Each rod was connected to a source of current. The diagram is not to scale.




The copper rods were rigid, each was 2.6 m long, and they were parallel. The current in the upper rod was kept constant at 50 A. Different currents were passed through the lower rod and the balance reading recorded for each current. The readings are given in the table below.

| *Current in lower rod* (A) | *Balance reading* (kg) |
|---|---|
| 2.8 | 0.5485 |
| 8.0 | 0.5480 |
| 12.2 | 0.5474 |
| 16.8 | 0.5470 |
| 20.0 | 0.5465 |

(a) Identify the relative directions of the currents in both rods, and justify your answer. **2**

.....

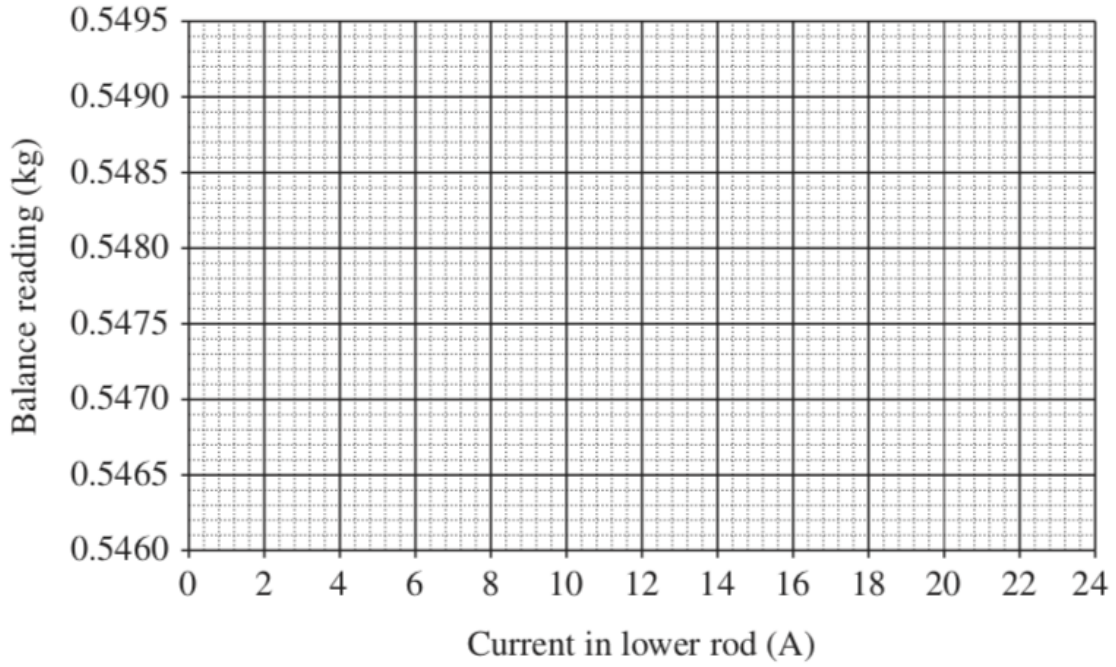
.....

.....

.....

Question 20 (continued)

(b) Plot the data from the table onto the graph, using the scales and axes as indicated, and add the line of best fit (trend line). **2**




(c) Find the mass of the copper rod on the balance. **1**

.....

.....

(d) Calculate the distance between the two copper rods. **3**

.....

.....

.....

.....

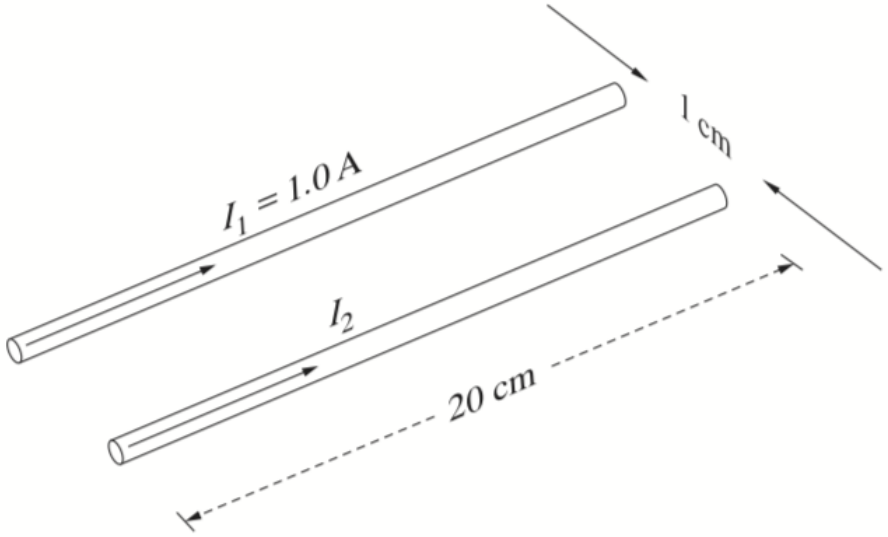
.....

.....

**2004:**

**Question 26** (7 marks)

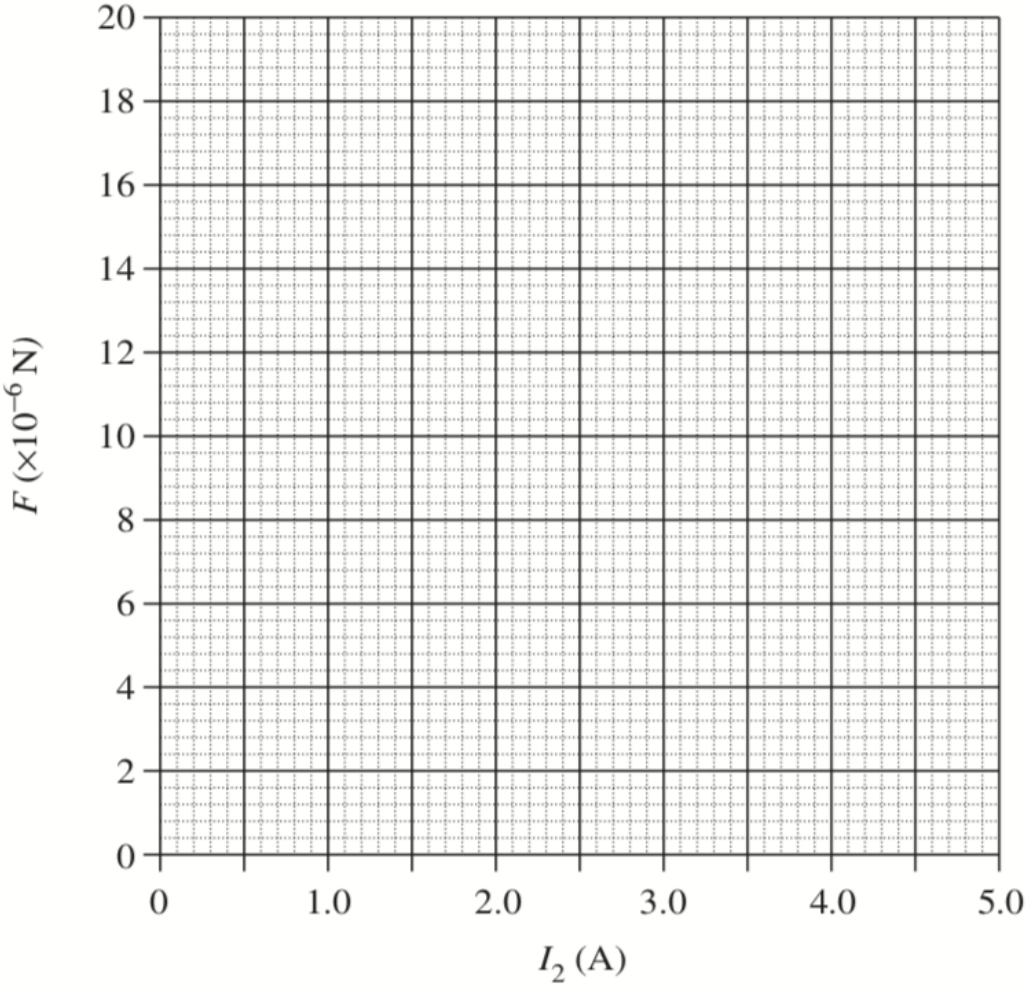
The diagram shows part of an experiment designed to measure the force between two parallel current-carrying conductors.




The experimental results are tabulated below.

| $I_2$ (A) | Force ($\times 10^{-6}$ N) |
|---|---|
| 0 | 0 |
| 2.0 | 7 |
| 3.0 | 11 |
| 4.0 | 14 |
| 5.0 | 18 |

(a) Plot the data and draw the line of best fit. **3**




(b) Calculate the gradient of the line of best fit from the graph. **1**

.....

.....

(c) Write an expression for the magnetic force constant $k$ in terms of the gradient and other variables. **2**

.....

.....

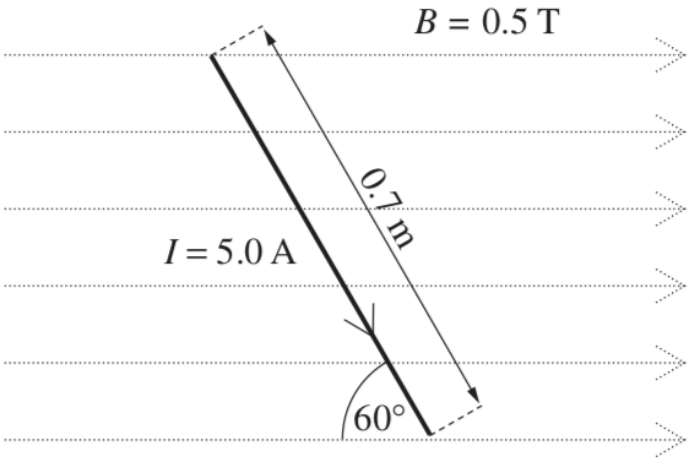
(d) Use this expression and the gradient calculated in part (b) to determine the value of the magnetic force constant $k$. **1**

.....

.....

**2003:**

**9** A current of 5.0 A flows in a wire that is placed in a magnetic field of 0.5 T. The wire is 0.7 m long and is at an angle of 60° to the field.




What is the approximate magnitude of the force on the wire?

(A) 0 N

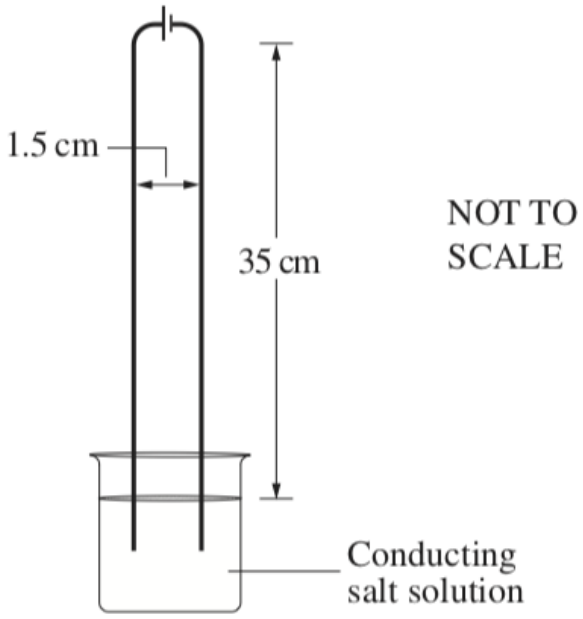
(B) 0.9 N

(C) 1.5 N

(D) 1.8 N

**Question 19** (3 marks)

Two straight copper wires are suspended so that their lower ends dip into a conducting salt solution in a beaker as shown. The length of the straight section of each wire above the conducting salt solution is 35 cm and they are placed 1.5 cm apart. The ends of the wire do not touch the bottom of the beaker. The two wires are connected to a DC power supply. **3**




A current of 2 amperes flows from the battery. Calculate the magnitude and direction of the initial force on each wire.

.....

.....

.....

.....

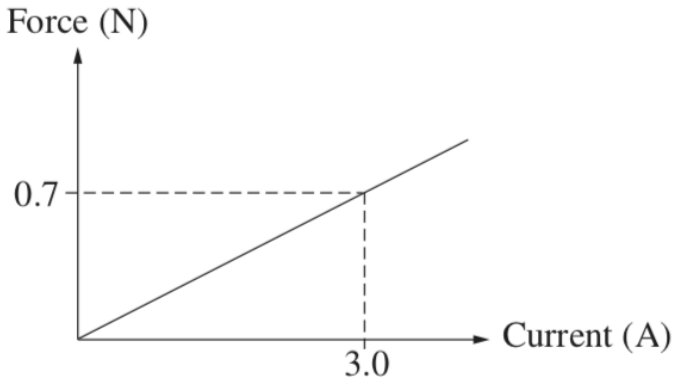
.....

.....

**2002:**

**7** A student performed an experiment to measure the force on a long current-carrying conductor placed perpendicular to an external magnetic field.

The graph shows how the force on a 1.0 m length of the conductor varied as the current through the conductor was changed.




What was the magnitude of the external magnetic field in this experiment?

(A) 0.23 T

(B) 1.1 T

(C) 2.1 T

(D) 4.3 T

**2001:**

**14** Two straight metal rods, *P* and *Q*, have the same length. They are each pivoted at one end and rotated with the same angular velocity so that they sweep out horizontal circular paths as shown in diagrams *X* and *Y*. A constant current *I* is flowing along each rod, as shown.

In diagram *X*, a constant magnetic field is applied *at right angles to the plane* of the circular path. In diagram *Y*, a uniform magnetic field of the same magnitude is applied *in the plane* of the circular path.

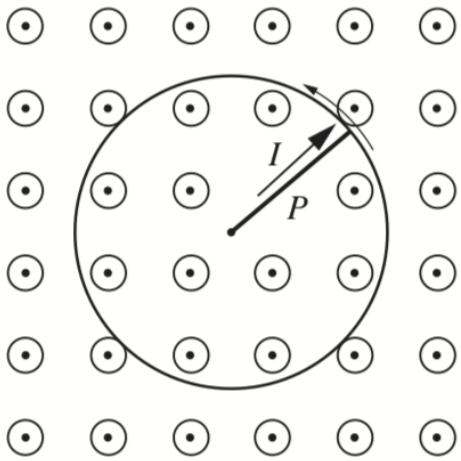



Diagram *X*

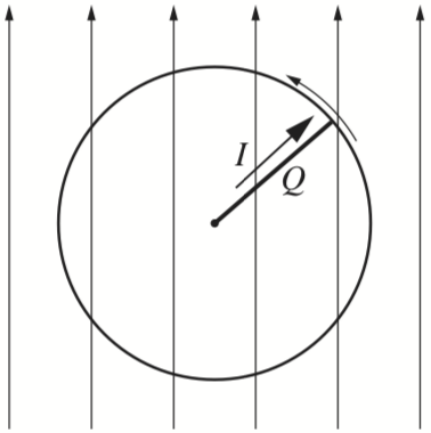



Diagram *Y*

Which of the following statements about the forces acting on rod *P* and rod *Q* is correct?

(A) The magnitude of the force on *P* is exactly the same as the magnitude of the force on *Q* at all times.

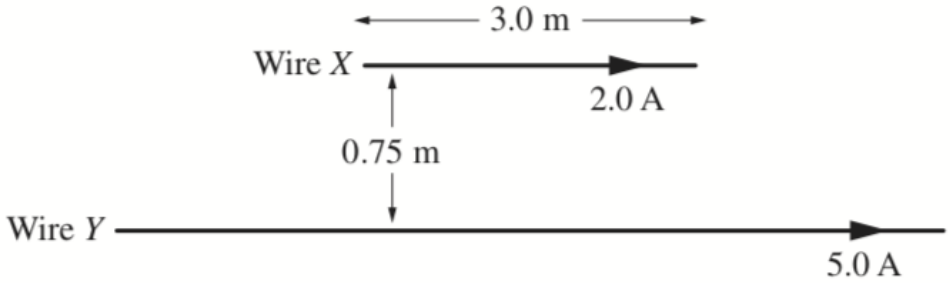
(B) The magnitude of the force on *P* is constant and the magnitude of the force on *Q* is zero.

(C) The magnitude of the force on *P* is constant and the magnitude of the force on *Q* varies with time.

(D) The magnitude of the force on *P* varies with time and the magnitude of the force on *Q* is constant.

**Question 22** (7 marks)

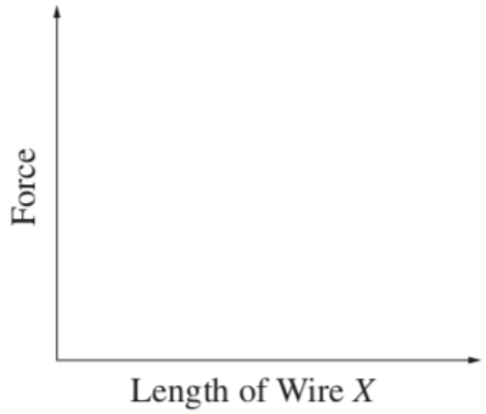
Two parallel wires are separated by a distance of 0.75 m. Wire $X$ is 3.0 m long and carries a current of 2.0 A. Wire $Y$ can be considered to be infinitely long and carries a current of 5.0 A. Both currents flow in the same direction along the wires.




(a) What is the direction of the force that exists between the two wires? **1**

.....

(b) On the axes, sketch a graph that shows how the force between the two wires would vary if the length of Wire $X$ was increased. **2**




(c) In your Physics course you have performed a first-hand investigation to demonstrate the motor effect. Explain how your results demonstrated that effect. **4**

.....

.....

.....

.....

.....

.....

.....

.....