

# The Motor Effect

## Mark Scheme

|                         |                                     |
|-------------------------|-------------------------------------|
| <b>Level</b>            | GCSE (9-1)                          |
| <b>Subject</b>          | Combined Science: Trilogy - Physics |
| <b>Exam Board</b>       | AQA                                 |
| <b>Topic</b>            | 6.7 Magnetism and Electromagnetism  |
| <b>Sub-Topic</b>        | The Motor Effect                    |
| <b>Difficulty Level</b> | Gold Level                          |
| <b>Booklet</b>          | Mark Scheme                         |

**Time Allowed:** 37 minutes

**Score:** /36

**Percentage:** /100

**Grade Boundaries:**

- M1.(a)** thumb, index finger and third finger are held mutually at right angles 1
- index finger shows the direction of the magnetic field from North to South, third finger shows the direction of the current from positive to negative terminal 1
- the thumb then shows the direction of the force acting on the copper rod 1
- so the copper rod will move from left to right 1
- (b) any **one** from:
- use a stronger magnet
  - increase the magnetic flux density
  - increase the length of the copper rod in the magnetic field
  - coil the copper rod
- 1
- (c)  $W = 9.8 \times 4 \times 10^{-4} = 3.92 \times 10^{-3}$  1
- conversion of the length 7cm to 0.07m 1
- $3.92 \times 10^{-3} = B \times 1.12 \times 0.07$  1

$$B = 3.92 \times 10^{-3} / 0.0784$$

1

$$B = 0.05 \text{ (T)}$$

1

*allow 0.05 (T) without working shown for the 5 calculation marks*

[10]

**M2.(a)** north (pole)

*accept N*

north (pole)

*both needed for mark*

1

(b) reverses

*accept changes direction*

1

(c) (i) first finger:  
(direction of) (magnetic) field

1

second finger:  
(direction of) (conventional) current

1

(ii) into (plane of the) paper

1

- (iii) less current in wire

*accept less current / voltage / more resistance / thinner wire*

1

weaker field

*allow weaker magnets / magnets further apart*

*do **not** accept smaller magnets*

1

rotation of magnets (so) field is no longer perpendicular to wire

1

- (d) (i) reverse one of the magnets

*do **not** accept there are no numbers on the scale*

1

- (ii) systematic or zero error

*accept all current values will be too big*

*accept it does not return to zero*

*accept it does not start at zero*

1

[10]

- M3.(a)** (i) the greater the speed (of a centrifuge), the greater the force

*answers must be comparative*

*accept velocity for speed*

*accept positive correlation between speed and force*

*speed and force are not proportional – treat as neutral*

1

the smaller the radius, the greater the force (at a given speed)

*allow (**G machine**) 1 has / produces a greater force (than*

**G machine 2** ) at the same speed

*must be comparative, eg a small radius produces a large*

*force = 0 marks on own*

1

as the speed increases the rate of change in force increases  
*accept force is proportional to the square of the speed*  
**or**  
*doubling speed, quadruples the force*  
*accept any clearly correct conclusion*

1

(ii) 12000 (N)

**or**

12 k(N)

1

(b) (i) the current (in the coil) creates a magnetic field (around the coil)  
*accept the coil is an electromagnet*

1

so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)  
*accept the two magnetic fields interact (producing a force)*  
*if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max 1 mark*

1

(ii) vertically downwards arrow on side A  
*one arrow insufficient*

**and**

vertically upwards arrow on side C

1

(iii) the current is parallel to the magnetic field  
*allow the current and magnetic field are in the same direction*  
*allow it / the wire is parallel to the magnetic field*

1

- (c) increase the current / p.d. (of the coil)  
*accept decrease resistance*  
*accept voltage for p.d.*  
*accept increase strength of magnetic field / electromagnet*

1

- (d) yes with suitable reason **or** no with suitable reason  
**eg**  
**yes** – *it has increased our knowledge*  
**yes** – *It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples*  
**no** – *the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)*  
**no** mark for just **yes** / **no**  
*reason must match **yes** / **no***

1

[10]

**M4.** (a) motor (effect)

1

- (b) (i) wire kicks further (forward)  
*accept moves for kicks*  
*accept moves more*  
*accept 'force (on the wire) increased'*

1

- (ii) wire kicks back(wards) / into (the space in) the (horseshoe) magnet  
*accept moves for kicks*  
*accept 'direction of force reversed'*

1

[3]

**M5.** (i) away from magnet

*arrow should be perpendicular to field lines and current as judged by eye*

1

(ii) current in wire creates magnetic field around wire

1

two fields interact **or** combine giving a resultant force (on the wire)

1

**[3]**