## Fields and their patterns

### Multiple Choice Questions

**Question 1**

The force between two isolated positive point charges will always be repulsive. The force is due to the second charge being in the electric field of the first charge.

**∴ D (ANS)**

**Question 2**

The two positive charges will always have a force of repulsion between them.
The best answer is

**C (ANS)**

**Question 3**

We draw the field around an imaginary magnetic monopole so that it looks like the field around an isolated point charge, in that it can have two directions.
C is the best answer, even though the (gravitational) field around a point mass is always attractive.

**∴ C (ANS)**

**Question 4**

We are yet to find a magnetic monopole.

**∴ C (ANS)**

**Question 5**

All fields are vectors.

**∴ D (ANS)**

**Question 6**

We model the electric field between two large charged plates as uniform.

**∴ A (ANS)**

**Question 7**

**D (ANS)**

**Question 8**

The direction and magnitude of the fields for A, B and C will change in time.

**∴ D (ANS)**

**Question 9**

Like charges will always repel each other.

**∴ B (ANS)**

**Question 10**

The gravitational field at P will not be zero, as the field drops off inversely with $d^2$, so the field associated with the mass (2m) will be smaller than the field associated with the mass (m).

The two isolated point charges will both produce a field in the opposite direction and of the identical magnitude at the point P.

**∴ B (ANS)**

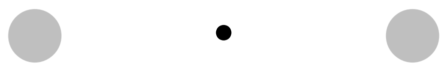
The field associated with C will be from the right to the left at the point P.
The field associated with D will be from the right to the left at the point P.

### Extended Questions

**Question 11 (2017 Question 1, 63%)**

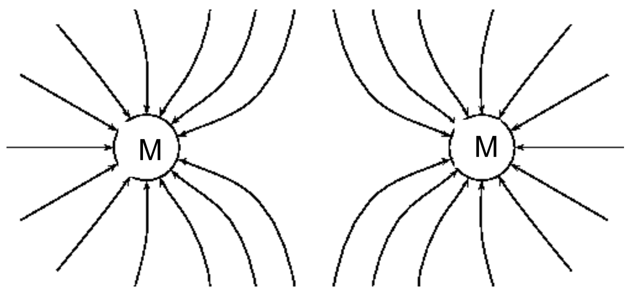
The resultant field will be the vector addition of the fields associated with the three charges.
The electric field is the direction of the force on a unit positive charge.
The field from the left hand -Q, will be to the left.
The field from the right hand -Q, will be to the right, but smaller.
The field from the left hand +Q, will be to the left.
∴ net force to the left.


**Question 12a**

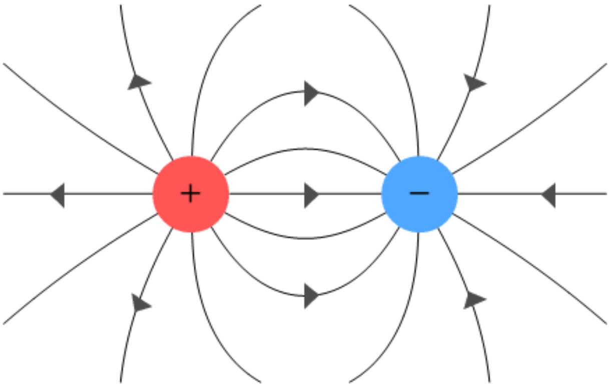


Exactly in the middle of the two masses, the force of attraction will be equal and opposite from the two masses.

**Question 12b**



### Question 13a

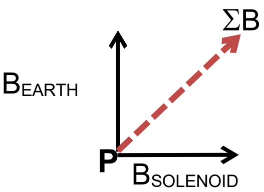


### Question 13b

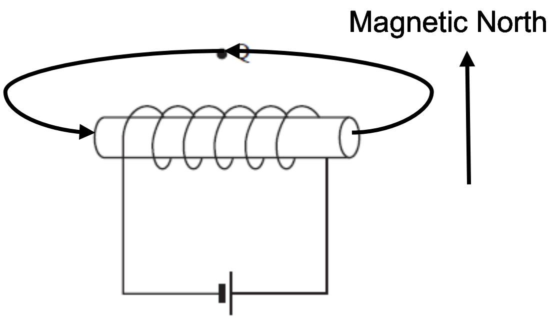
The field is not zero, it is from the left to the right as indicated by the arrow in the previous diagram.

### Question 14a

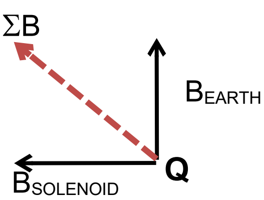
The field from the solenoid is given by the right hand rule. The current goes up the right hand side and behind the cylinder. With the thumb pointing up, the fingers will curl around to point to the right.
Both fields are approximately the same size, so vector addition gives.

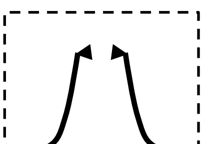



### Question 14b



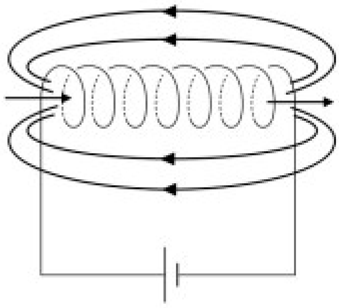

Therefore



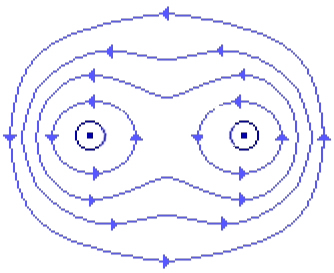
### Question 15

### Question 16

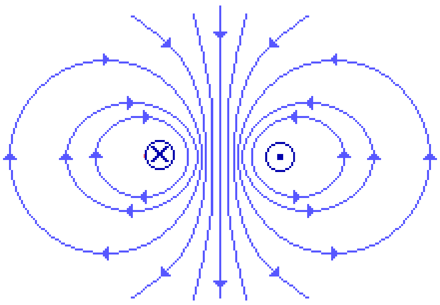


The current is up the left hand wire, so it goes down at the front of the solenoid

### Question 17a



### Question 17b



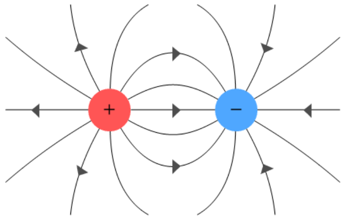
### Question 18a

See answer to 16a or 16b.

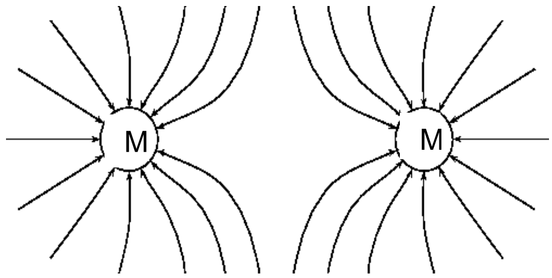


**Question 18b**

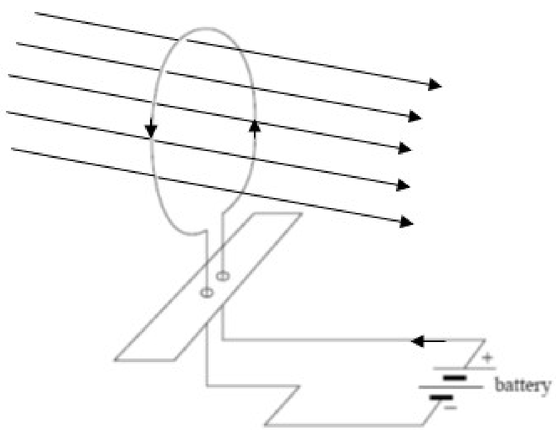
The field around two point charges




**Question 18c**




**Question 19**




**Question 20a**

The electric field is defined as the direction of the force on an isolated positive charge.
At point A, the field is vertically down.
At point E, the field is also vertically down.

**Question 20b**

At point B, the field is horizontal to the left.
At point C, the field is horizontal to the right.

**Question 20c**

The strength of the field is given by the closeness of the field lines. The closer the field lines – the stronger the field.
The field lines are closer together at B than D, therefore the field is stronger at B than D.

**Question 21** **(2016 question 12, 73%)**