2 **(a)** State what is meant by a *field of force*.

...………………………………………………………………………………………..

...…………………………………………………………………………...………… [1]

(b) State one similarity and one difference between gravitational field and electric field.

Similarity: …..…………………………………………………………………………..

...…………………………………………………………………………………………..

Difference: …………………………………………………………………………...…

...……………………………………………………………………………...………… [2]

(c) Fig. 2.1 shows the variation of the gravitational potential ϕ between the Moon and the Earth with distance from the centre of the Moon.
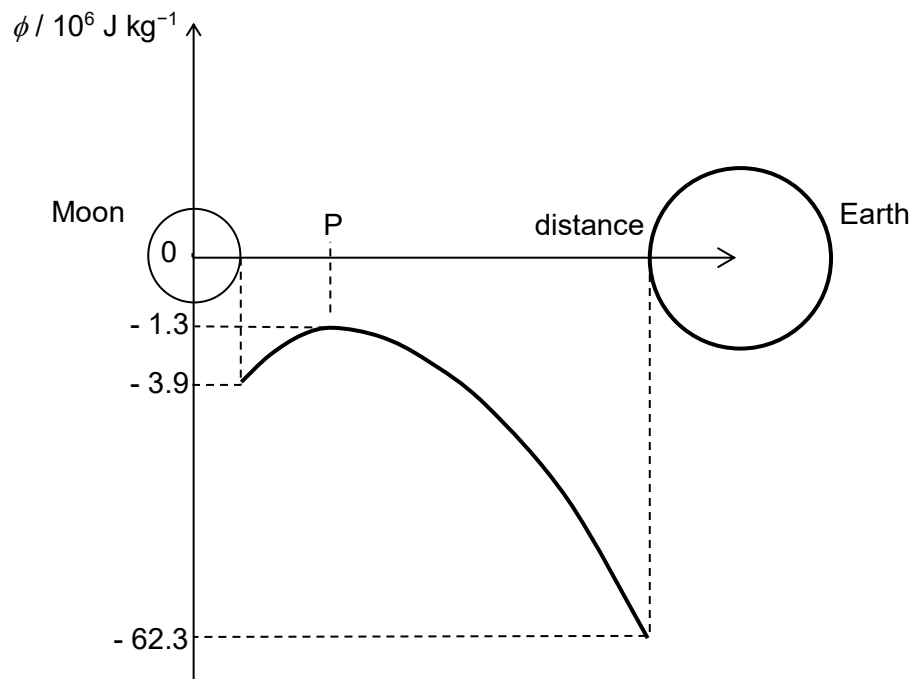

Fig. 2.1

(i) Point P is a point along the line between the centres of the Moon and the Earth.

Explain why point P is closer to the Moon than to the Earth.

……………………………………………………………………………………………..

……………………………………………………………………………………………..

……………………………………………………………………………………………..

.... [2]

(ii) The distance between the centres of the Earth and the Moon is 3.80×10^8 m.

Fig. 2.2 shows the values of the radius R and mass M of the Earth and Moon.

	R / m	M / kg
Earth	6.37×10^6	5.98×10^{24}
Moon	1.74×10^6	7.35×10^{22}

Fig. 2.2

Show that the distance from the centre of the Moon to point P is 3.79×10^7 m.

[2]

(iii) NASA intends to project a space probe from the Earth to the Moon.

Determine the minimum projection speed.

Explain your answer.

speed = ……….……………… m s^{-1}

…………………………………………………….…………………………..

…………………………………………………….…………………………..

…………………………………………………….…………………………..

.... [3]

(d) Two small spherical charged particles P and Q are fixed in their positions at 5.0 cm apart in a vacuum. An electron is moved along the line joining the two charges as shown in Fig. 2.3.
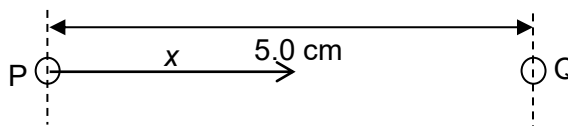

Fig. 2.3

The variation with the displacement x of electron from P of the electric potential energy E_p of the electron is shown in Fig. 2.4.
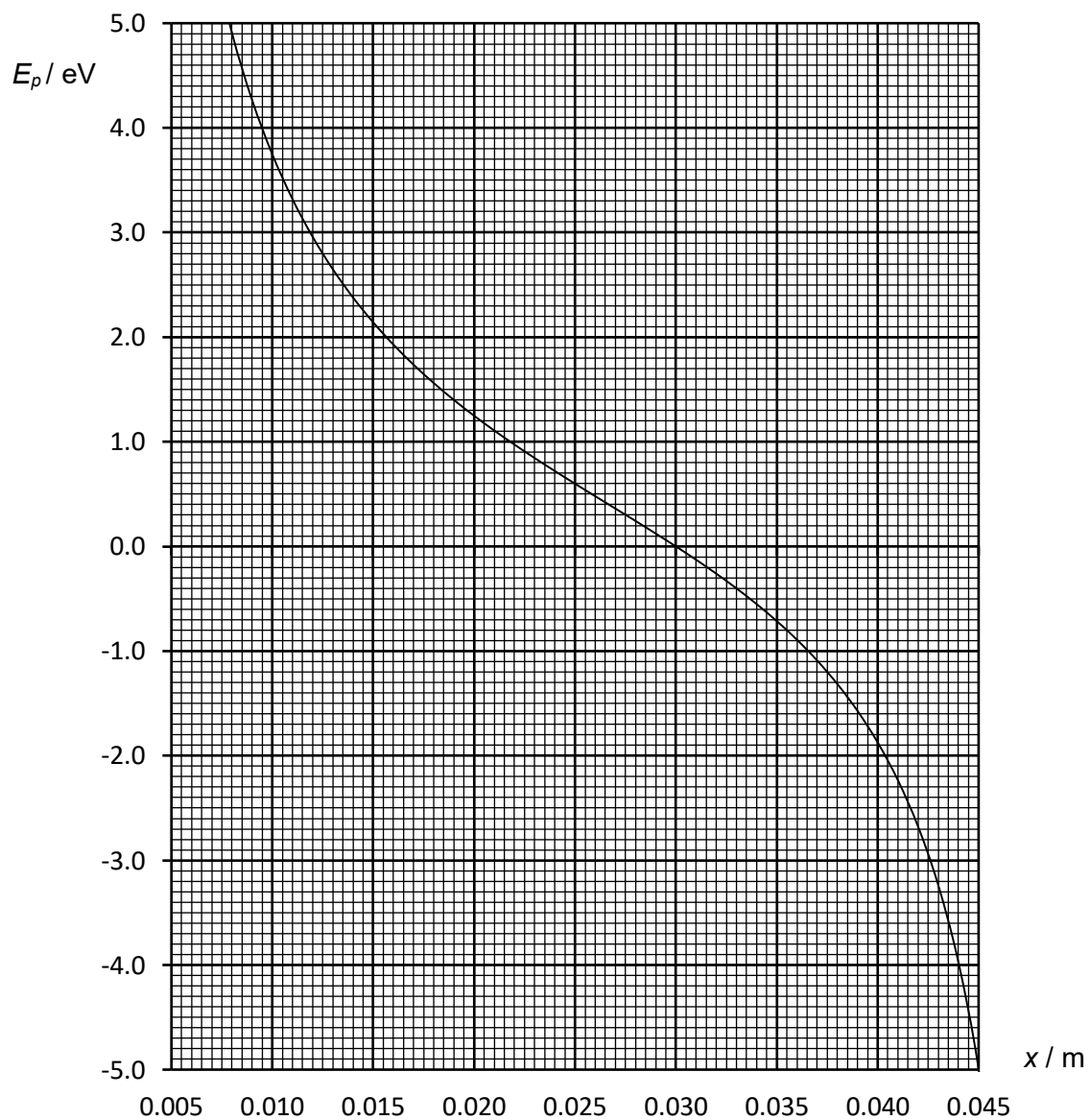

Fig. 2.4

(i) State and explain which charge P or Q is negatively charged.

…………………………………………………….…………………………..

…………………………………………………….…………………………..

…………………………………………………….…………………………..

…………………………………………………….………………………… [2]

(ii) Use Fig. 2.4 to estimate the magnitude of the force acting on the electron when it is at the point $x = 3.0$ cm.

force = ………..……………… N   [3]

(iii) On Fig. 2.4, sketch a new graph if the magnitude of charge Q is increased.

[1]