3 **(a)** Define gravitational field at a point.

.....

..... [1]

(b) Fig. 3.1 shows an isolated point mass of mass *M*.

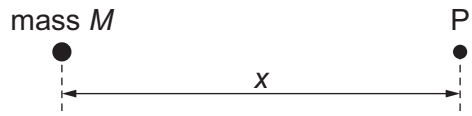

Fig. 3.1

Point P is at distance *x* from the point mass.

(i) By considering the force exerted by the point mass on a test mass of mass *m* placed at P, derive an equation for the gravitational field strength *g* at P, in terms of *M* and *x*. Identify any other symbols you use.

[2]

(ii) On Fig. 3.1, draw an arrow to indicate the direction of the gravitational field at P. [1]

(iii) Point Q is at distance $\frac{x}{2}$ from the point mass, on the opposite side of the mass from P, as shown in Fig. 3.2.

Fig. 3.2

Compare the gravitational field at Q with that at P.

.....

.....

..... [2]

(c) Two identical isolated uniform spheres X and Y each have radius R. The centres of the spheres are separated by distance L, as shown in Fig. 3.3.

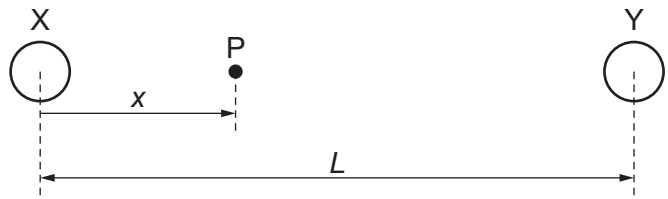

Fig. 3.3

Point P lies on the line joining the centres of X and Y, and is at a variable displacement x from the centre of sphere X.
The gravitational field strength at the surface of each sphere is g_0.

On Fig. 3.4, sketch the variation with x of the gravitational field g at point P between $x = R$ and $x = L - R$.

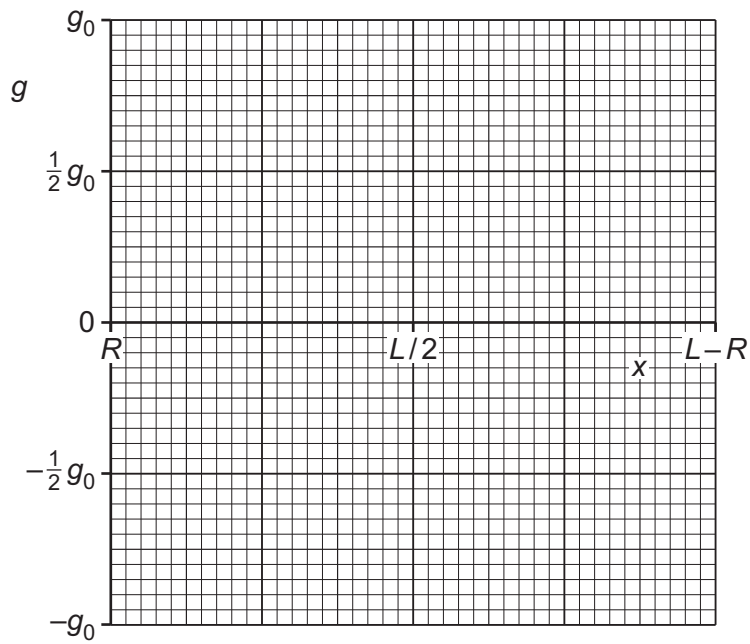

Fig. 3.4

[3]

[Total: 9]