

3(a)	force per unit mass
3(b)(i)	$F = GMm / x^2$
	$g = F / m$
	$g = [GMm / x^2] / m = GM / x^2$ and G = gravitational constant
3(b)(ii)	arrow drawn at P pointing directly towards the point mass
3(b)(iii)	fields are in opposite directions
	field strength at Q is four times the field strength at P
3(c)	line starting at $(R, -g_0)$ and ending at $(L - R, +g_0)$
	line passing through $(L / 2, 0)$
	curve becoming shallower from R to $(L / 2)$ and then steeper from $(L / 2)$ to $(L - R)$

1(a)	force per unit mass
1(b)(i)	radial
	towards (centre of) planet
1(b)(ii)	(changes in) height (very) much smaller than radius
	$(\text{radius} + \text{height})^2 \approx \text{radius}^2$ or field lines are approximately parallel
1(c)(i)	$9.81 \times R^2 = 3.99 \times 10^{14}$
	$R = 6.38 \times 10^6 \text{ m}$
1(c)(ii)	gravitational potential $= - (GM / R)$
	$= - (3.99 \times 10^{14}) / (6.38 \times 10^6)$
	$= - 6.25 \times 10^7 \text{ J kg}^{-1}$
1(d)	potential (energy) zero at infinite separation
	(gravitational) force is attractive

1(a)(i)	direction of the force acting on a (test) mass placed at the point
1(a)(ii)	change in height negligible compared with radius (of Earth)
	(so) field lines are (effectively) parallel
1(b)(i)	$Y = GM / R^2$
	G is the gravitational constant
1(b)(ii)	gravitational force is (always) attractive or gravitational force (always) acts towards the centre of the sphere
	force is in opposite direction to displacement or at a point to the right of the centre, force acts to the left or at a point to the left of the centre, force acts to the right
	sketch: smooth curve with decreasing positive gradient, starting at $(R, -Y)$ and reaching $3R$ with g still negative or smooth curve with increasing positive gradient, ending at $(-R, Y)$ and reaching $-3R$ with g still positive
	both of the above curves, in correct quadrants
1(b)(iii)	curve passing through $(\pm 2R, \pm 0.25Y)$ and $(\pm 3R, \pm 0.11Y)$