Question	Answer	Marks
1(a)	at least 4 straight radial lines to P 	B1
	all arrows pointing along the lines towards P	B1
1(b)	**Any 2 from:** gravitational force provides the centripetal force (centripetal or gravitational) force has constant magnitude (centripetal or gravitational) force is perpendicular to velocity (of moon) / direction of motion (of moon)	B2
1(c)(i)	$\frac{GMm}{r^2} = mr\omega^2$	M1
	$M = \frac{r^3\omega^2}{G}$ and gradient = $r^3\omega^2$ hence $M = \frac{\text{gradient}}{G}$ or $r^3 = GM \times 1/\omega^2$ so gradient = GM hence $M = \frac{\text{gradient}}{G}$	A1
1(c)(ii)	$M = 4.1 \times 10^{23} / (6.0 \times 10^7 \times 6.67 \times 10^{-11}) = \mathbf{1.0 \times 10^{26}}$ kg	B1

Question	Answer	Marks
1(c)(iii)	$\frac{GMm}{r^2} = \frac{mv^2}{r}$ $\frac{GM}{r} = v^2$	C1
	$v^2 = \frac{6.67 \times 10^{-11} \times 1.0 \times 10^{26}}{1.2 \times 10^8}$ $v^2 = 5.6 \times 10^7\ \text{m s}^{-1}$	C1
	$v = 7500\ \text{m s}^{-1}$	A1

Question	Answer	Marks
1(a)	force per unit mass	**B1**
1(b)(i)	lines drawn are radial from the surface	**B1**
	arrows show pointing towards planet	**B1**
1(b)(ii)	field lines show force (on satellite) is towards centre of planet **or** velocity of satellite is perpendicular to field lines	**B1**
	(gravitational) force perpendicular to velocity causes centripetal <u>acceleration</u>	**B1**
1(c)(i)	T = 24 hours	**C1**
	$a = r\omega^2$ **and** $\omega = 2\pi / T$ **or** $a = v^2 / r$ **and** $v = 2\pi r / T$ **or** $a = 4\pi^2 r / T^2$	**C1**
	$a = (4\pi^2 \times 6.4 \times 10^6) / (24 \times 60 \times 60)^2$ $= 0.034\ \text{m s}^{-2}$	**A1**
1(c)(ii)	identification of the two forces acting on the object as gravitational force and (normal) contact force	**M1**
	gravitational force and normal contact force are in opposite directions, and their resultant causes the (centripetal) acceleration	**A1**