A-Level Physics: **w25 42**

1(a)(i)	radius = $6.37 \times 10^6 \times \cos 52.2° = 3.90 \times 10^6$ m
1(a)(ii)	period = 24 hours
	$v = 2\pi r / T$ **or** $v = r\omega$ **and** $\omega = 2\pi / T$
	$v = (2\pi \times 3.90 \times 10^6) / (24 \times 60 \times 60)$ $= 280$ m s^{-1}
1(b)(i)	$F = mv^2 / r$
	$= (58.6 \times 280^2) / (3.90 \times 10^6)$ $= 1.2$ N
1(b)(ii)	arrow pointing horizontally to the left
1(b)(iii)	arrow from student pointing along the dotted line, labelled 'weight'
	upwards arrow from student pointing in a direction to the left of normal and above the tangent to the Earth, labelled 'contact force'

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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 $(L - R)$

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1(a)	work done per unit mass
	work (done in) moving mass from infinity (to the point)
1(b)(i)	evidence of addition of 3.4×10^6 to 1.7×10^6 **or** 6.8×10^6
	$GM \times 122 / (5.1 \times 10^6)$ **or** $GM \times 122 / (10.2 \times 10^6)$
	$6.67 \times 10^{-11} \times M \times 122 \times [(5.1 \times 10^6)^{-1} - (10.2 \times 10^6)^{-1}] = 5.1 \times 10^8$ leading to $M = 6.4 \times 10^{23}$ kg
1(b)(ii)	$\phi = (-) (6.67 \times 10^{-11} \times 6.4 \times 10^{23}) / (3.4 \times 10^6)$
	$= -1.3 \times 10^7$ J kg^{-1}
1(c)(i)	Mars takes (just under) 25 hours to rotate once on its axis
1(c)(ii)	orbit is equatorial **or** orbit is in same direction as direction of rotation of Mars

A-Level Physics: **m25 42**

2(a)	sketch: line from $x = R$ to $x = 4R$ entirely in the negative ϕ region
	curve with continuously decreasing magnitude and with gradient of continuously decreasing magnitude, starting at $(R, \pm\phi)$
	line passing through $(2R, \pm\frac{1}{2}\phi)$ and $(4R, \pm\frac{1}{4}\phi)$
2(b)	horizontal straight line from $t = 0$ to $t = 24$ hours
	line starting at $(0, -\phi)$
2(c)	straight line with non-zero gradient from 0 to d
	line with negative gradient from $(0, V)$ to $(d, 0)$