Revision Sheet

A-Level Physics · Unit 13 Gravitational fields

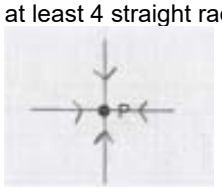
6 vocabulary items · 39 marks of exam questions (4 questions)

Part 1 · Vocabulary review answer key. Section A wants the exact English spelling.

Question	Answer	Marks
1	gravitational field strength	1
2	gravitational potential	1
3	test mass	1
4	field line	1
5	point mass	1
6	geostationary	1

Question	7(a)	1(b)	1(c)	Question	2(a)	2(b)(i)	2(b)(ii)	2(c)(i)

8(a)(i)	work (done) per unit mass
	work (done on mass) in moving mass from infinity (to the point)
8(a)(ii)	$E_P = \phi m$ $E_P = (-GM/r) \times m = -GMm/r$ **or** $\phi = -GM/r$ **and** $E_P = \phi m = -GMm/r$
8(b)(i)	$\Delta E_P = 6.67 \times 10^{-11} \times 1.99 \times 10^{30} \times 2.20 \times 10^{14} \times [1/(6.38 \times 10^{10}) - 1/(8.44 \times 10^{11})]$
	$= 4.23 \times 10^{23}$ J
8(b)(ii)	(gravitational) force is attractive so decrease **or** (gravitational) force does work so decrease
8(b)(iii)	$\Delta E_P = \frac{1}{2}m(v_2^2 - v_1^2)$
	$4.23 \times 10^{23} = \frac{1}{2} \times 2.20 \times 10^{14} \times (v^2 - 34\,100^2)$
	v (= 70 800 m s^{-1}) = 70.8 km s^{-1}
8(c)	both PE and KE equations include m, so path is unchanged

9(a)	at least 4 straight radial lines to P 
	all arrows pointing along the lines towards P
9(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)
9(c)(i)	$\frac{GMm}{r^2} = mr\omega^2$
	$M = \frac{r^3\omega^2}{G}$ and gradient = $r^3\omega^2$ hence $M = \frac{\text{gradient}}{G}$ or $r^3 = GM \times 1/\omega^2$ so gradient = GM hence $M = \frac{\text{gradient}}{G}$
9(c)(ii)	$M = 4.1 \times 10^{23} / (6.0 \times 10^7 \times 6.67 \times 10^{-11})$ = **1.0×10^{26}** kg

9(c)(iii)	$\frac{GMm}{r^2}=\frac{mv^2}{r}$ $\frac{GM}{r}=v^2$
	$v^2=\frac{6.67\times10^{-11}\times1.0\times10^{26}}{1.2\times10^{8}}$ $v^2=5.6\times10^{7}\ \text{m s}^{-1}$
	$v=7500\ \text{m s}^{-1}$

10(a)	(gravitational) field strength equals (gravitational) potential gradient
	reference to minus sign
10(b)(i)	potential is zero at infinity
	(gravitational) force is attractive
	(test) mass getting closer (from infinity) loses potential energy
10(b)(ii)	• potential at (surface of) planet is smaller than at (surface of) moon • potential gradient at (surface of) planet is smaller than at (surface of) moon • magnitude of potential varies inversely with distance from centre near the spheres • (point of) maximum potential is nearer to moon than planet *Any two points, 1 mark each*
10(b)(iii)	sketch: one curve, starting with gradient of decreasing magnitude at 2*R* and finishing with gradient of increasing magnitude at *D* – *R*
	field strength shown as zero (only) near the point of maximum potential
	negative field strength near one sphere and positive field strength near the other