AH ROTATIONAL MOTION AND ASTROPHYSICS QUICK REVISION QUESTIONS.

AH FORMULA

1. State the formula for
   a. angular velocity
   b. angular acceleration
   c. centripetal force
   d. gravitational force
   e. radial acceleration
   f. tangential acceleration
   g. torque
   h. angular momentum
   i. rotational kinetic energy
   j. gravitational potential
   k. gravitational potential energy
   l. schwartzchild radius

DEFINITIONS

1. State what is meant by angular velocity.
2. State the definition of escape velocity.
3. State the definition of gravitational potential.
4. State what is meant by gravitational field strength.
5. State what is meant by conservation of angular momentum.
6. State what is meant by a black hole.
7. State the meaning of the term Schwartzchild Radius.
8. State what is meant by the term gravitational lensing.
9. State the meaning of the term equivalence principle.
10. State what is meant by the term conservative field

1. Two students visit the tallest building on Earth. Student A takes a lift to the top of the building while student B waits at the bottom. General Relativity predicts that time will not pass at the same rate for both students. For which student does time pass at a slower rate? You must justify your answer.
2. Derive the equation for the escape velocity of an object.
3. With reference to General Relativity, explain why the Moon orbits the Earth.
4. The lyrics of the song Woodstock contain the lines "We are stardust; we are golden. We are billion year old carbon". Use your knowledge of Physics to comment on these lyrics.

FORMULAE

a	$\omega = \dfrac{d\theta}{dt}$
b	$\alpha = \dfrac{d\omega}{dt} = \dfrac{d^2\theta}{dt^2}$
c	$F = \dfrac{mv^2}{r} = mr\omega^2$
d	$F = G\dfrac{Mm}{r^2}$
e	$a_r = \dfrac{v^2}{r} = r\omega^2$
f	$a_t = r\alpha$
g	$T = Fr$ or $T = I\alpha$
h	$L = mvr = mr^2\omega \quad L = I\omega$
i	$E_K = \dfrac{1}{2}I\omega^2$
j	$V = -\dfrac{GM}{r}$
k	$E = Vm$ or $E_p = \dfrac{-GMm}{r}$
l	$r_{Schwarzschild} = \dfrac{2GM}{c^2}$

DEFINITION ANSWERS

1. Angular velocity, ω is the rate of change of angular displacement.
2. The (minimum) velocity/speed that a mass must have to escape the gravitational field (of a planet).
3. Work done moving unit mass from infinity to that point. or Infinity defined as zero potential.
4. Force exerted on 1 kg (of mass) placed in the field. Force per unit mass placed at that point. It is a vector quantity

5. Total angular momentum before (an event) = total angular momentum after (an event) in the absence of external torques
6. A region of spacetime with a strong gravitational field so that the escape velocity is greater than the speed of light—so that nothing can escape from inside it.
7. The distance from the centre of a black hole at which not even light can escape. or The distance from the centre of a black hole to the event horizon.
8. A distribution of matter, between a distant light source and an observer, causing a bending of the light from the source as the light travels towards the observer.
9. It is impossible to tell the difference between the effects of gravity and acceleration.
10.   A conservative field is one where the work done by the force on a particle that moves through any round trip is zero i.e. energy is conserved.

ADDITIONAL QUESTION ANSWERS

1. Time passes more slowly at lower altitudes (in a gravitational field). or lower gravitational field strength at higher altitude.
2.

(b)   (i) $E_P + E_K = 0$

$$-\frac{GMm}{r} + \tfrac{1}{2}mv^2 = 0$$

$$\tfrac{1}{2}\cancel{m}v^2 = \frac{GM\cancel{m}}{r}$$

$$v = \sqrt{\frac{2GM}{r}}$$

3. Massive objects curve spacetime. Other objects follow a curved path through this (distorted) spacetime
4. You could talk about the lifetime of stars, the age of the Universe (Higher really) but also that stars are made and remade, you can talk about the elements in stars and how we get elements like gold. There is the nuclear fission and the process of energy manufacture in stars etc. This is a good open ended question where you could show that you know a lot of your course work and then some additional points. Remember it ought to be at the AH level!