**Unit 11**

2)

a) Equivalence Principle states that the gravitational mass of a body is the same as its inertial mass.

b) Einstein didn’t like the concept of an expanding Universe and is said to have found the idea “abominable”.

c) Slipher found that the nebulae seemed to move faster than the Milky Way escape velocity.

d) Hubble's law state that galaxy’s distance is proportional to its radial recession velocity.

e) The concept of a homogeneous and isotropic Universe is called the Cosmological Principle.

f) Arno Penzias and Robert Wilson discovered CMB radiation in 1964.

3)

a) Звезды на ночном небе, должно быть, всегда очаровывали людей.

b) Мы знаем о греческих философах, которые предложили гелиоцентрическую астрономическую модель с Солнцем посередине и планетами, вращающимися вокруг него, еще в 3 веке до нашей эры, но именно Николай Коперник тот, кто в 16 веке разработал первую современную версию модели.

c) В системе Коперника предполагалось, что звезды зафиксированы на далекой сфере, и ничто в наблюдениях не указывало на обратное.

d) Эйнштейну не понравилась концепция расширяющейся Вселенной, и говорят, что он считал идею «отвратительной».

e) Многие туманности, обнаруженные на небе, считались просто газовыми облаками в отдаленных частях Млечного пути.

f) Красное смещение объекта зависит от его скорости в радиальном направлении от нас, и Слайфер обнаружил, что туманности, кажется, движутся быстрее, чем вторая космическая скорость Млечного Пути.

g) В ответе Эддингтону, Лемэтр также указал на логическое следствие расширяющейся Вселенной: Вселенная должна существовать только в течение конечного времени и должна была возникнуть из первоначального единого кванта (по его словам).

**Unit 12**

1. Main interest is developing far more accurate clocks.
2. The method is to use electric fields to hold them in one place.
3. It's based on aluminium.
4. It will take a long time before we can implement such a computer, but it will eventually happen.

An important practical application of Wineland's discoveries was quantum clocks that surpass the widely used cesium time standards in accuracy. Both mechanical, and cesium, and quantum clocks work according to one principle - the swing of a pendulum or a balancer (in a mechanical clock), microwave oscillations (in cesium) or light (in quantum) serve as a unit of time. The Wineland quantum clock is based on a mercury ion locked in a “trap” and making transitions from one energy level to another under the influence of laser radiation. A quantum clock operates at a much higher frequency than a cesium clock. Therefore, their accuracy is such that if they started the countdown at the time of the emergence of the Universe (almost 14 billion years ago), today they would be mistaken for only a few seconds.

An even more interesting and promising area in which the discoveries of the laureates have found application is quantum computers. The idea of a computing system based on probabilistic logic and working with quantum bits - qubits, which can be in three states - two fixed and in a superposition state - appeared in the 90s of the last century. Quantum computers must have extremely high computing power, but the limitations of quantum mechanics didn’t allow the creation of working models of such computers.

The results of the research of Haroche and Wineland allowed physicists to overcome the “forbidden” quantum barrier. A theory of decoherence was developed that explains the process of breaking the state of superposition. Wineland created the first prototype of a quantum logic inverter out of two qubits - an element performing the operation “controlled NO”. Of course, to create a full-fledged computing system, only one logical element performing the negation is not enough, however, studies of Nobel laureates open the way to further discoveries and inventions in this area.