**ТЕХТ: ELECTRON EMISSION**

1. The electron tube depends for its action on a stream of electrons that act as current carriers. To produce this stream of electrons a special metal electrode (cathode) is present in every tube. But at ordinary room temperatures the free elec­trons in the cathode cannot leave its surface because of certain restraining forces that act as a barrier. These attractive surface forces tend to keep the electrons within the cathode substance, except for a small portion that happens to have sufficient kinetic energy (energy of motion) to break through the barrier. The majority of electrons move too slowly for this to happen.

2. To escape from the surface of the material the electrons must perform a certain amount of work to overcome the restraining surface forces. To do this work the electrons must have sufficient energy imparted to them from some external source of energy, since their own kinetic energy is inadequate. There are four principal methods of obtaining electron emission from the surface of the material: thermionic emission, photoelectric emission, field emission and secondary emission.

3. Thermionic emission. It is the most important and one most commonly used in electron tubes. .In this method the metal is heated, resulting in increased thermal or kinetic energy of the unbound electrons. Thus, a greater number of electrons will attain sufficient speed and energy to escape from the surface of the emitter. The number of electrons released per unit area of an emitting surface is related to the absolute temperature of the cathode and a quantity of the work an electron must perform when escaping from the emitting surface.

4. The thermionic emission is obtained by heating the cathode electrically. This may be produced in two ways: 1. by using the electrons emitted from the heating spiral for the conduction of current (direct heating) or 2. by arranging the heating spiral in a nickel cylinder coated with barium oxide which emits the electrons (indirect heating). Normally, the method of indirect heating is used.

5. Photoelectric emission. In this process the energy of the light radiation falling upon the metal surface is transferred to the free electrons within the metal and speeds them up sufficiently to enable them to leave the surface.

6. Field or cold-cathode emission. The application of a strong electric field (i.e. a high positive voltage outside the cathode surface) will literally pull the electrons out of the material surface, because of the attraction of the positive field. The stronger the field, the greater the field emission from the cold emitter surface.

7. Secondary emission. When high-speed electrons suddenly strike a metallic surface they give up their kinetic energy to the electrons and atoms which they strike. Some of the bombarding electrons collide directly with free electrons on the metal surface and may knock them out from the surface. The electrons freed in this way are known as secondary emission electrons, since the primary electrons from some other source must be available to bombard the secondary electron-emitting surface.

1. **Make up an abstract of the text basing on the answers to the review questions:**

***Review questions***:1. What does the action of the electron tube depend on? 2. What is present in every tube to produce the stream of electrons? 3. At what temperatures free electrons cannot leave their surface of the cathode? 4. What forces tend to keep the electrons within the cathode substance? 5. What must the electrons do to escape? 6. What must the electrons have to overcome the restraining surface forces? 7. How many methods are there for obtaining electron emission? 8. What are they? 9. What imparts the external energy to the electrons in thermionic emission? 10. What energy is used for producing free electrons in photoelectric emission? 11. What is field emission? 12. How is secondary emission obtained? 13. What emission is the most commonly used in electronics?

1. **Test 1.** **Find the correct answer out of the three given to each question**:
2. Which of the following devices depends for its action on a stream of electrons in vacuum:

a gas tube, an electron tube, a transistor

1. Which of the following forces keep the electrons within the emitter substance:

internal forces, external forces, attractive surface forces

1. Which of the following kinds of emission depends on in­creased thermal energy of electrons:

thermionic emission, secondary emission, field emission

1. Which of the following kinds of emission depends on a strong field:

thermionic emission, field emission, photoelectric emission

1. Which of the methods of emission is the most important and widely used:

field emission, thermionic emission, photoelectric emission

**Test 2. Find Russian equivalents for the English words and word combinations**:

1. a number of (а) буквально
2. except for (b) тот же самый
3. literally (с) так как; с тех пор как; с
4. suddenly (d) из-за
5. within (е) достаточно
6. in this way (f) внезапно
7. since (g) за исключением
8. the same (h) ряд
9. because of (i) таким образом
10. sufficiently (j) внутри; в; в пределах

**Test 3. Find an antonym (a), (b), (c) or (d) to the word in bold type:**

1. The **primary**question — (a) principal; (b) difficult; (c) secondary; (d) new
2. A **slow** motion of electrons — (a) similar; (b) rapid; steady; (d) continuous
3. The **internal**forces — (a) attractive; (b) strong; (c) restraining; (d) external
4. A **small** portion — (a) great; (b) similar; (c) external; (d) common
5. A **high** speed — (a) decreased; (b) low; (c) adequate; (d) sufficient
6. The **strong** attractive forces — (a) slight; (b) equal; (с) unequal; (d) weak
7. **Outside** the tube — (a) near; (b) in front of; (c) inside; (d) around
8. **Cold**water — (a) clean; (b) hot; (c) boiled; (d) mineral
9. To **heat** the liquid — (a) boil; (b) change; (c) evaporate; (d) cool
10. The **majority** of the electrons — (a) a great number of; (b) weight; (c) minority; (d) amount
11. **Common** measuring devices — (a) various; (b) necessary; (c) special; (d) new
12. The flow is **rapidly**determined — (a) often; (b) commonly; (c) frequently; (d) slowly
13. **Many** particles — (a) light; (b) few; (c) free; (d) heavy
14. To **be present** in this tube — (a) be included; (b) be inclosed; (c) be changed; (d) be absent
15. **Free particles** — (a) small; (b) bound; (c) loose; (d) tiny
16. **Absolute** temperature — (a) high; (b) low; (c) relative; (d) the same
17. **More** interested in — (a) usually; (b) always; (c) never; (d) less
18. **Negative** charges — (a) the same; (b) unlike; (c) different; (d) positive
19. **Large** particles — (a) a lot of; (b) various; (c) tiny; (d) great
20. In a **downward** direction — (a) upward; (b) outward; (c) straight; (d) right

**Test 4. Finish each sentence choosing one of the three variants (a), (b) or (c)**:

1. The electron tube depends for its action on...

(a) restraining forces; (b) a stream of electrons; (с) a magnetic field.

1. A special metal electrode is present in every tube to produce...

(a) a magnetic field; (b) a stream of positive charges; (с) a stream of electrons.

1. At ordinary room temperatures the "free" electrons in the metallic cathode cannot leave its surface because of...

(a) attractive forces acting as a barrier; (b) forces of the external magnetic field; (c) thermal energy of the atoms.

1. A small portion of electrons has sufficient kinetic energy to break through...

(a) the surface of the tube; (b) the plate substance; (c) the surface barrier.

1. To escape from the surface of the cathode the electrons must have...

(a) attractive internal force; (b) sufficient energy from some external energy source; (c) low speed.

1. The energy for electron emission comes from...
	1. internal sources; (b) external sources; (c) external and internal sources.
2. There are...
	1. two principal methods of obtaining electron emission; (b) three principal methods of obtaining electron emission; (c) four principal methods of obtaining electron emission.
3. The cathode metal is heated in...
	1. photoelectric emission; (b) cold-cathode emission; (c) thermionic emission.
4. In thermionic emission the cathode is made of...
5. metal; (b) semiconductor; (c) an insulator.
6. In thermionic emission the number of released electrons depends on...
7. resistance; (b) cooling; (c) temperature.
8. In photoelectric emission the energy of the light falls...

(a) upon the surface of the non-conducting material; (b) into the glass envelope filled with the gas; (c) upon the surface of the metal.

1. In photoelectric emission the energy of the light radiation is transferred to...
2. free electrons; (b) bound particles; (c) positive charges.
3. In photoelectric emission electrons to which the energy of the light radiation is transferred are...
4. on the surface of the metal; (b) in the space about the cathode; (c) within the metal.
5. Field emission is...

(a) hot-cathode emission; (b) photoelectric emission; (c) cold-cathode emission.

1. Electrons escape from the cathode surface because of...
2. the attraction of the positive field; (b) the attraction of the negative field; (c) the cooling of the cathode's metal.
3. When high-speed electrons suddenly strike a metallic surface they give up their kinetic energy to...
4. electrons; (b) positive particles; (c) positive charges.
5. Some of the bombarding electrons collide directly with...
6. positively charged particles; (b) uncharged particles; (c) free electrons.
7. From the surface the bombarding electrons may knock out...
8. uncharged particles; (b) free electrons; (c) positive charges.
9. The electrons freed by bombarding are known as...
10. secondary emission electrons; (b) thermionic emission electrons; (c) photoelectric emission electrons.
11. The most important and the most commonly used method of emission is...
12. secondary emission; (b) field emission; (c) thermionic emission.