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## Stage 1 – Vocabulary

## Photometry

 <b>associate</b> [ə'səʊʃiət] <i>v</i>	<b>lumen</b> [lu:mən] <i>n</i> ( <i>pl</i> lumina)	<b>radius</b> ['reɪdʒəs] <i>n</i>
<b>auditorium</b> [ˌɔ:drɪ'tɔ:riəm] <i>n</i>	<b>luminescent</b> [lu:mi'nesnt] <i>a</i>	( <i>pl</i> radii ['reɪdɪaɪ])
<b>calcium</b> ['kælsiəm] <i>n</i>	<b>lux</b> [lʌks] <i>n</i>	<b>roentgen</b> ['rɒntgən] <i>n</i>
<b>characteristic</b> [ˌkærɪktə'rɪstɪk] <i>a</i>	<b>metal</b> ['metl] <i>n</i>	<b>sphere</b> [sfɪə] <i>n</i>
<b>chemiluminescent</b>	<b>perpendicular</b> [ˌpə:pən'dɪkjələ] <i>n, a</i>	<b>steradian</b> [stə'reɪdɪən] <i>n</i>
[ˌkemɪlu:mi'nesnt] <i>a</i>	<b>phosphorescent</b> [ˌfɒsfə'resnt] <i>a</i>	<b>sulphate</b> ['sʌlfert] <i>n</i>
<b>candela</b> [kæn'di:lə] <i>n</i>	<b>phosphorus</b> ['fɒ:sf(ə)rəs] <i>n</i>	<b>sulphide</b> ['sʌlfəɪd] <i>n</i>
<b>energetic</b> [ˌenə'dʒetɪk] <i>a</i>	<b>photometry</b> [ˌfəʊ'tɒmɪtri] <i>n</i>	<b>ultraviolet</b> [ˌʌltrə'vaɪələɪt] <i>a</i>
<b>fluorescent</b> [flʊə'resnt] <i>a</i>	<b>plankton</b> ['plæŋktn] <i>n</i>	<b>watt</b> [wɒt] <i>n</i>
<b>group</b> [gru:p] <i>n</i>	<b>radiation</b> [ˌreɪdrɪ'eɪʃ(ə)n] <i>n</i>	<b>zinc</b> [zɪŋk] <i>n</i>

**appreciably** [ə'pri:ʃəblɪ] *adv* заметно, ощутимо  
**briefly** ['bri:flɪ] *adv* кратко, сжато  
**bulb** [bʌlb] *n* (электрическая) лампочка  
**candle** ['kændl] *n* свеча  
**casing** ['keɪsɪŋ] *n* оболочка, обшивка  
**cease** [si:s] *v* переставать, прекращаться; приостанавливать  
**common** ['kɒmən] *a* распространенный  
**compare** (with) [kəm'preə] *v* сравнивать(с)  
**comparison** [kəm'pærɪsn] *n* сравнение  
**disturb** [dɪs'tɜ:b] *v* беспокоить; нарушать  
**emission** [ɪ'mɪʃ(ə)n] *n* излучение; испускание  
**excite** [ɪk'saɪt] *v* возбуждать; вызывать  
**flame** [fleɪm] *n* пламя  
**filament** ['fɪləmənt] *n* нить накала  
**finally** ['faɪnəli] *adv* 1) в заключение; 2) в конечном счете, в конце концов  
**firefly** ['faɪəflaɪ] *n* светлячок  
**fusion** ['fju:ʒ(ə)n] *n* плавка, плавление  
**glow** [gləʊ] 1) *n* 1) сильный жар; накал; 2) свечение; 2) *v* 1) накаляться докрасна / добела; 2) светиться, сверкать  
**human** ['hju:mən] *a* человеческий, людской;  
**human being** – человек  
**illuminate** [ɪ'l(j)u:mineɪt] *v* освещать  
**incandescence** [ˌɪnkæn'desns] *n* накал, белое каление  
**infrared** ['ɪnfərə'red] *a* инфракрасный  
**irradiate** [ɪ'reɪdɪeɪt] *v* 1) освещать, облучать; 2) *физ.* испускать лучи  
**light** [laɪt] 1) *n* 1) свет; 2) лампа; 2) *v* (lit, lighted) зажигать; освещать  
**lighting** ['laɪtɪŋ] *n* освещение; осветительная аппаратура

**luminous** ['lu:mineəs] *a* светящийся, светлый;  
**luminous flux** – световой поток;  
**luminous intensity** – сила света  
**maintain** [meɪn'teɪn] *v* поддерживать  
**mean** [mi:n] *n pl* средство, способ  
**mostly** ['məʊstli] *adv* по большей части, главным образом, в основном  
**notably** ['nəʊtəblɪ] *adv* 1) исключительно, особенно; 2) весьма, заметно  
**otherwise** ['ʌðəwaɪz] *adv* в противном случае  
**oxidation** [ˌɒksɪ'deɪʃ(ə)n] *n хим.* окисление  
**peak** [pi:k] *n* пик; высшая точка; максимум  
**perceive** [pə'si:v] *v* воспринимать  
**place** [pleɪs] *v* помещать, размещать; ставить, класть  
**quinine** [kwɪ:'ni:n] *n хим.* хинин  
**quite** [kwɑɪt] *adv* совсем; довольно  
**random** ['rændəm] *a* случайный, беспорядочный; выбранный наугад  
**receive** [rɪ'si:v] *v* получать  
**restrict** [rɪ'strɪkt] *v* ограничивать  
**subtend** [səb'tend] *v геом.* стягивать (дугу), противолечь  
**sufficiently** [sə'fɪʃ(ə)ntli] *adv* достаточно  
**surface** ['sə:frɪs] *n* поверхность  
**thermal** ['θə:m(ə)] *a* термический, тепловой  
**touch** [tʌtʃ] 1) *n* прикосновение; 2) *v* касаться  
**vapour** ['veɪpə] *n* 1) пар, пары; 2) испарения  
**variety** [və'reɪəti] *n* 1) разнообразие; 2) (of) ряд, множество;  
**visible** ['vɪzɪbl] *a* видимый  
**vision** ['vɪʒ(ə)n] *n* зрение

<b>by this means</b> – таким способом / образом <b>(not) to be compared (with / to)</b> – (не) может сравниться (с) <b>in comparison with</b> – по сравнению / в сравнении с	<b>to be familiar with</b> – знать что-л., быть в курсе чего-л. <b>other than</b> – кроме, за исключением <b>to the touch</b> – на ощупь <b>under these /such/ conditions</b> – при таких условиях / обстоятельствах
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**Task 1. Pay attention to ...****I. Pay attention to the pronunciation of the following words and then find them in exercise II.****appreciably** [ə'pri:ʃəblɪ] *adv***chemiluminescent** [ˌkemɪlu:mr'nesnt] *a***fluorescent** [fluə'resnt] *a***incandescent** [ˌɪnkæ'n'desnt] *a***luminescent** [lu:mr'nesnt] *a***phosphorescent** [ˌfɒsfə'resnt] *a***quantitative** ['kwɒntɪtətɪv] *a***sufficiently** [sə'fɪ(ə)ntɪ] *adv***uncomfortably** [ʌn'kʌmf(ə)təblɪ] *adv***II. Pay attention to the following derivatives. Read and translate.**

appreciate → appreciable → appreciably;

brief → briefly;

bright → brightness

chemiluminescent → chemiluminescence;

certain → certainly;

comfortable → uncomfortable → uncomfortably;

dark → darken → darkened (*Participle II*)

emit → emission;

energy → energetic;

excite → excitation;

final → finally;

fluorescent → fluorescence;

illuminance ← **illuminate** → illumination;

incandescent → incandescence;

intense → intensity;

light → lighting;

luminescent → luminescence;

measure → measurable;

phosphorescent → phosphorescence;

quantity → quantitative;

radiate → radiation;

relative → relatively;

suffice → sufficient → sufficiently

**Suffixes:****-able/-ible** *v* → *a***-ance/-ence** *a/v* → *n***-ation/- (t)ion/- (s)sion** *v* → *n***-ative** *n* → *a***-en** *a* → *v***-ent** *v* → *a***-ic** *n* → *a***-ing** *v* → *n***-ity** *a* → *n***-ly** *a* → *adv***-ness** *a* → *n***Prefixes:****un-** 'the opposite of' / 'not'

A fuller list of affixes is given on pp 9-13.

**III. Pay attention to the compounds. Read and translate them.***a*: glow + in the dark = glow-in-the-dark; red + hot = red-hot; white + hot = white-hot*n*: black + body = black body (*also* black-body); fire + fly = firefly**Pay attention to some other 'noun + noun' combination. Read and translate.**

a light bulb; a light source; a candle flame; a gas flame; room temperature; black body radiation; light emission; a point source; a street lamp

☞ IV. Pay attention to the plural of the following nouns.

leaf – leaves; lumen – lumina; radius [ˈreɪdʒəs] – radii [ˈreɪdɪi] / radiuses; spectrum – spectra

Choose the correct form of the noun.

1. When you see a (*leaf / leaves*) in the forest, it is because three different objects are doing their jobs: the (*leaf / leaves*), the eye, and the sun.
2. You see (*leaf / leaves*) in the forest because they are illuminated by the sun.
3. The (*lumen / lumina*) is a unit used to measure luminous flux.
4. The (*lumen / lumina*) are used to measure luminous flux.
5. Figure 5 demonstrates two circles. Their (*radius / radii*) are of three meters.
6. Steradian is the solid angle produced at the centre of a sphere by an area on the surface of the sphere equal to the square of its (*radius / radii*).
7. A heated subject emits a characteristic (*spectrum / spectra*) of black-body radiation.
8. (*Spectrum / Spectra*) of light are produced by prisms.

V. Pay attention to the following international words. They are often called 'false friends of a translator', as they can be translated in different ways.

**associate** [əˈsəʊʃieɪt] *v* 1) соединять, связывать; 2) связываться, ассоциироваться (with); 3) общаться (with); 4) присоединяться, вступать; становиться партнером (in)

**familiar** [fəˈmɪljə] *a* 1) близкий; хорошо знакомый, привычный; обычный; 2) фамильярный, бесцеремонный; 3) хорошо знающий, осведомленный; **to be familiar with** – знать что-л., быть в курсе чего-л.

**illumination** [ɪˌl(j)uːmɪˈneɪʃ(ə)n] *n* 1) освещение; 2) освещенность; 3) яркость; 4) (обыкн. *pl*) иллюминация; 5) вдохновение

**intensity** [ɪnˈtensɪtɪ] *n* 1) интенсивность, напряженность; сила, энергия; 3) сила света; 4) яркость, глубина

**material** [məˈtɪəriəl] 1) *n* 1) материал, вещество; 2) факты, данные, материал

**object** [ˈɒbdʒɪkt] *n* 1) предмет; вещь; 2) объект (*изучения и т.п.*); 3) цель; 4) тело; 5) *грам.* дополнение

**radiation** [ˌreɪdɪˈeɪʃ(ə)n] *n* 1) излучение, лучеиспускание, радиация; 2) облучение; 3) сияние

**substance** [ˈsʌbstəns] *n* 1) вещество; 2) материя, субстанция; 3) сущность, суть, содержание; 4) твердость; плотность; густота; 5) имущество, состояние

Translate the following sentences. Pay special attention to the words in bold.

1. Emission of light is often, but not always, **associated** with heat.
2. Today we are **familiar** with a wide variety of **objects** that glow without being heated.
3. Certain **substances** produce light when they are illuminated by more energetic **radiation**.
4. **This radiation** does not increase the temperature of fluorescent and phosphorescent **materials** appreciably above room temperature.
5. We know every source of light to have a measurable **luminous intensity**.
6. The lux is equal to the **illumination** produced by a flux of 1 lumen uniformly distributed over a surface having an area of 1 m<sup>2</sup>.
7. An X-ray apparatus produces harmful **radiation**.
8. I don't think you should **associate** with people like that.
9. He made himself much too **familiar** with the professor.
10. She is collecting **material** for a dissertation.
11. The **substance** of what he said was that he was against the idea.



VI. Pay attention to the following easily confused words.

a) **like** [laɪk] *adv* так, подобно

**likely** [laɪkli] *adv* вероятно

b) **most** [məʊst] 1) *a* (превосх. ст. от much и many); 2) *adv* 1) больше всего; очень  
**mostly** ['məʊstli] *adv* по большей части, главным образом, в основном

c) **once** [wʌns] *adv* однажды, один раз  
**at once** – сразу же, тотчас, немедленно

d) **quiet** [kwaɪət] *a* тихий, спокойный, бесшумный  
**quite** [kwɑɪt] *adj* полностью, весьма; довольно

e) *phrasal verbs*

**turn** [tɜ:n] *v* 1) вращать(ся), вертеть(ся); 2) поворачивать(ся)

**turn on / off** – включать / выключать (свет, газ и т.п.)

**turn out** – 1) выключать (свет, газ и т.п.); 2) оказываться

Choose the correct word to complete the meaning of the sentences.

1. The ancients had theories about light and vision, all of which were (*most / mostly*) wrong.
2. The (*most / mostly*) common light sources are known to be thermal or incandescent.
3. Luminous objects (*like / likely*) the sun or a flame can be seen by the eye without the presence of a third object.
4. A heated piece of metal (*like / likely*) platinum can emit light.
5. This substance is (*like / likely*) to emit light if it is illuminated by more energetic radiation.
6. A source of light whose dimensions are (*quiet / quite*) small in comparison with the area it illuminates is called a point source.
7. An ordinary light bulb (*turns / turns on / turns out*) to be uncomfortably hot to the touch almost (*once / at once*) after the light has been (*turned / turned on / turned off*).
8. It (*turns / turns on / turns out*) that, with respect to the stars, Venus (*turns / turns on / turns out*) (*once / at once*) every 243 Earth days.

### Fun with Words

### PLAY UPON WORDS ИГРА СЛОВ

*Play upon words with the same spelling, the same sound, different meaning (homographs)*  
Каламбуры со словами одинакового написания, одинакового звучания, но с разными значениями (омографы)

\*\*\*

**to brighten up** *v* 1) освещать; 2) наполнять(ся) радостью

- Children are said to brighten up a home.
- That's right – they never turn the lights off.

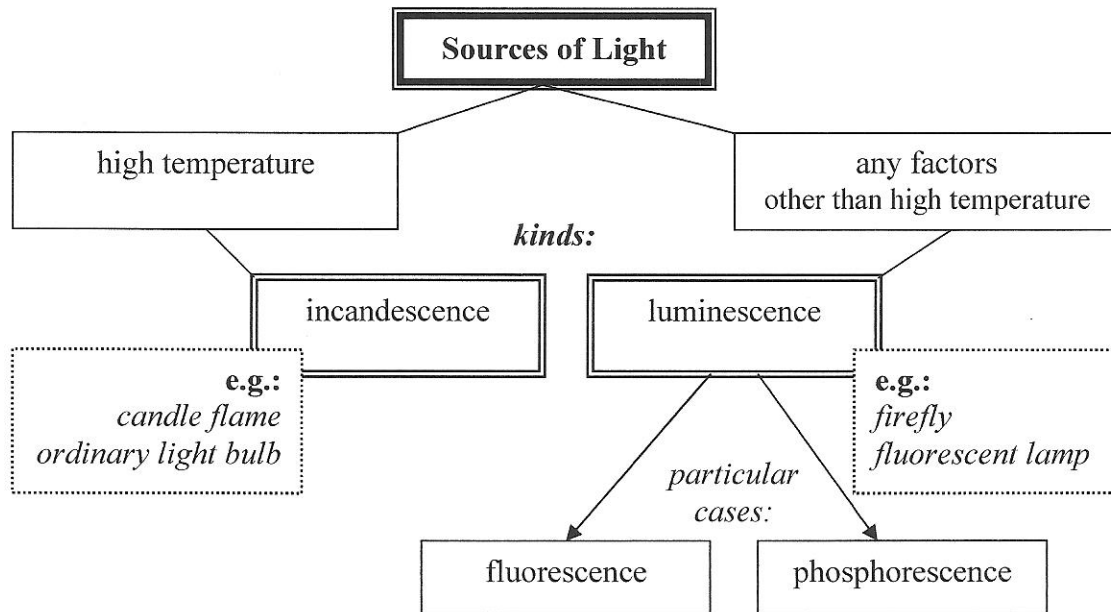
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**to go out** *v* 1) выходить, бывать в обществе; 2) гаснуть (об огне, свете, и т.п.)

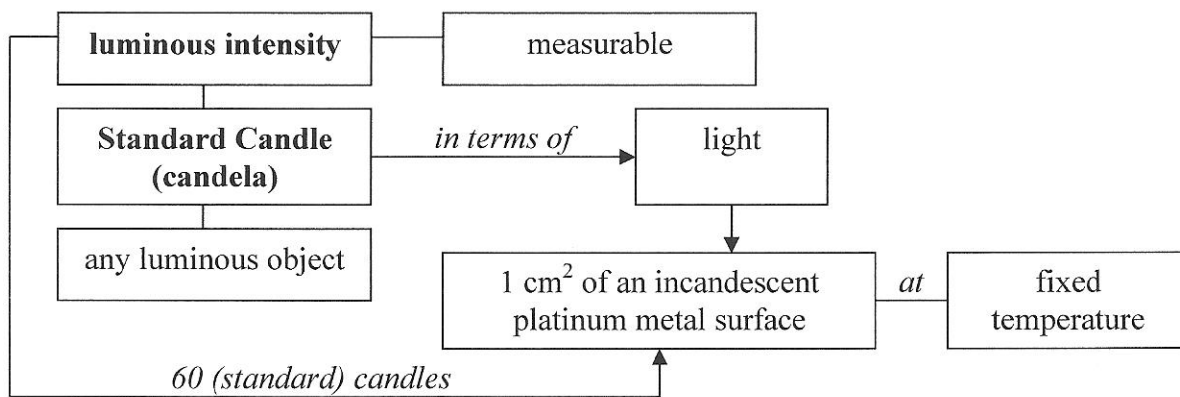
- Mother, where does the fire go when it goes out?
- I don't know, son. You might as well ask me where your father goes when he goes out.

### Stage 2 – Schemes

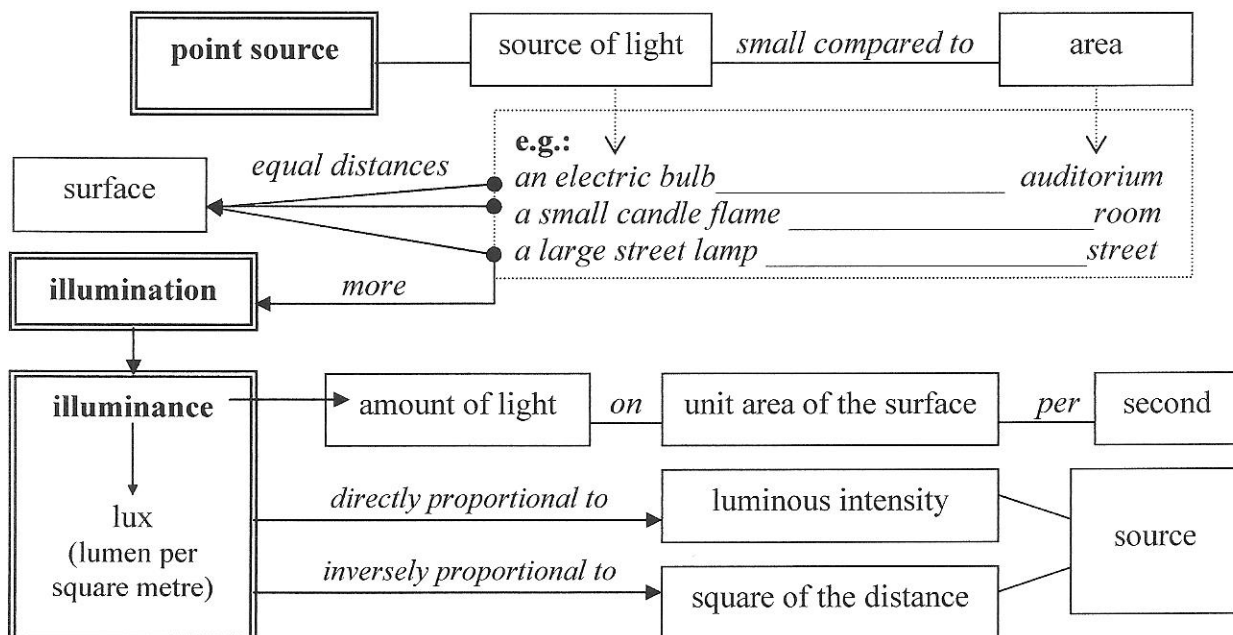
SCHEME 5.1



SCHEME 5.2



SCHEME 5.3



**Task II. Do the following exercises, using the schemes given on the left-hand page as a prompt.**

### SCHEME 5.1

**I. Complete the sentences:**

1. There are different ... of light sources. Some of them are caused by ... ..., others by some other factors.
2. ... is the emission of light caused by high temperature.
3. A candle flame and ordinary light bulb are the examples of ... .
4. ... is the emission of light caused by any factor other than high temperature.
5. A ... and ... ... are the examples of luminescence.
6. Fluorescence and phosphorescence are the ... ... of luminescence.

**II. Answer the following questions:**

- |  |   |
|--|---|
| 1. What kind of light sources do you know? | 4. What factors is luminescence caused by?        |
| 2. What is incandescence?                  | 5. What are the examples of luminescence?         |
| 3. What are the examples of incandescence? | 6. What are the particular cases of luminescence? |

**III. Discuss different kinds of light sources using the scheme.**

### SCHEME 5.2

**I. Choose the right variant:**

1. Every source of light has a luminous intensity. It (*is / is not*) measurable.
2. The unit of luminous intensity is the (*Standard Candle / lux*).
3. We define the Standard Candle in terms of the light emitted by 1 cm<sup>2</sup> of (*a luminescent / an incandescent*) platinum metal surface maintained at a (*random / fixed*) temperature.
4. One cm<sup>2</sup> of this surface has a luminous intensity of (*sixteen / sixty*) candles.
5. We use the Standard Candle to measure the luminous intensity of (*only some / any*) luminous objects.

**II. Answer the questions:**

1. Is luminous intensity measurable?
2. What unit do we use to measure luminous intensity?
3. How do we define the Standard Candle?
4. Is the candela used only for measuring the luminous intensity of incandescent light sources?

**III. Talk about luminous intensity of light sources using the scheme.**

### SCHEME 5.3

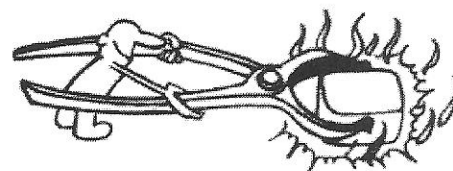
**I. Agree or disagree with the following sentences (statements expressing agreement and disagreement can be found on page 169):**

1. A point source is a source of light which is large compared to the area it illuminates.
2. An electric bulb illuminating a large auditorium, a small candle flame illuminating a room and a large street lamp illuminating a street are the examples of point sources.
3. A surface placed at equal distances from each of these sources receives more illumination from the electric bulb.
4. The illumination of a surface is called illuminance.
5. Illuminance is the amount of light falling on unit area of the surface per second.
6. The unit of illuminance is the Standard Candle in the SI units.
7. Illuminance depends on the luminous intensity of the light source and the distance of the illuminated area from the source of light.
8. Illuminance is inversely proportional to the luminous intensity of the source.
9. Illuminance is directly proportional to the square of the distance from the source.

**II. Answer the following questions:**

- |  |  |
|--|--|
| 1. What is a point source?                 | 4. What unit is used to measure illuminance? |
| 2. What are the examples of point sources? | 5. What does illuminance depend on?          |
| 3. What is illuminance?                    |  |

**III. Discuss a point source and illuminance using the scheme.**

**Stage 3 – Text****Photometry**

Photometry is the science of measurement of visible light in terms of its perceived brightness to the human eye. It involves quantitative measuring luminous fluxes and quantities related to them, *e.g.* luminous intensity of light sources, illuminance provided by different light sources, *etc.*

**LIGHT SOURCES**

The study of light, known as optics, is an important research area in modern physics. The ancient Greeks, Arabs and Chinese had theories of light and vision, all of which were mostly wrong, and all of which were accepted for thousands of years. One thing the ancients did get right is that there is a distinction between objects that emit light and objects that don't. When you see a leaf in the forest, it is because three different objects are doing their jobs: the leaf, the eye, and the sun. But luminous objects like the sun, a flame, or the filament of a light bulb can be seen by the eye without the presence of a third object. Emission of light is often, but not always, associated with heat. Today we are familiar with a great variety of objects that glow without being heated, including fluorescent lights and glow-in-the-dark toys.

There are different kinds of light sources, some of them are caused by high temperatures, others by some other factors. The most common light sources are known to be thermal or incandescent. Examples include sunlight, ordinary light bulbs, and glowing solid particles in flames (a candle flame, a gas flame, *etc.*). If we maintain a substance at a sufficiently high temperature relative to room one (about 68°F), it emits a characteristic spectrum of black body radiation, *i.e.*, under these conditions it emits visible light. The peak of the black-body spectrum is in the infrared for relatively cool objects like human beings. As the temperature increases, the peak shifts to shorter wavelengths, producing first a red glow, then a white one, and finally a blue colour as the peak moves out of the visible part of the spectrum and into the ultraviolet. These colours can be seen when metal is heated to 'red-hot' or 'white-hot'. The blue colour is most common seen in a gas flame. For instance, if we heat a piece of metal like platinum until it 'glows', *i.e.* until it becomes white or bright-red hot, we can see it even in a darkened room by the light it emits. So it is a thermal or incandescent source of light. The process of the light emission caused by high temperature is called incandescence.

Certain substances produce visible radiation without being heated, *i.e.* they emit light for any cause other than high temperature. Such substances are considered to be luminescent. Accordingly the emission of light caused by any factor other than high temperature is called luminescence. For example, fireflies produce light by this means, and boats moving through water can disturb plankton which produces a glowing wave. Let's compare two kinds of lamps: an ordinary light bulb and a fluorescent lamp. As far as the former is concerned it is sure to be uncomfortably hot to the touch almost immediately after it has been lit. We consider it to be an incandescent light source. The latter is unlikely to be too hot to the touch. Hence, it is a luminescent light source.

Fluorescence and phosphorescence are considered to be particular cases of luminescence. Certain substances produce light when they are illuminated by more energetic radiation, *e.g.* ultraviolet light shining on zinc sulphide causes it to emit a green light. A process is known to be fluorescence. Some substances emit light slowly after excitation by more energetic radiation. This is known as phosphorescence. Radiation does not increase the temperature of fluorescent and phosphorescent materials appreciably above room temperature.



## PHOTOMETRIC UNITS AND QUANTITIES

It is known that every source of light has a measurable luminous intensity. The higher (is) the temperature of the source, the greater is the luminous intensity of the light it emits. The sun is certain to have a greater luminous intensity than an ordinary electric bulb. In general, the luminous intensity depends on the direction. Otherwise the light source is called isotropic. Luminous intensity is measured in the Standard Candles (or more briefly, the candelas). The candela is one of the basic SI units. It is defined as 1/60 of the luminous intensity of the light produced by 1 cm<sup>2</sup> of an incandescent platinum metal surface maintained at a fixed temperature 1763°C. The luminous intensity emitted by one cm<sup>2</sup> of such a surface is 60 Standard Candles. The candela is used to measure the luminous intensity of any luminous object: both incandescent and luminescent.

A source of light whose dimensions are quite small in comparison with the distance from the place of observation to the source is called a point source. Examples include an electric bulb and small candle flame illuminating a large auditorium or room and a street lamp illuminating a street. A surface placed at equal distances from each of these point sources is certain to receive more illumination from the street lamp. The illumination of a surface is known as illuminance and it is the amount of light falling on unit area of the surface per second. The derived unit of illumination is the lux (lumen per square metre). Illuminance depends on both the luminous intensity of the source and the distance of the illuminated area from the source of light. Illuminance is directly proportional to the luminous intensity of the source and inversely proportional to the square of the distance from the source. The lumen is a unit used to measure luminous flux. It equals the luminous flux emitted by a source with a luminous intensity of one candela within a solid angle of one steradian.

## NOTES ON THE TEXT

1. **Arab** ['æɹəb] – араб(ка)
2. **Chinese** ['tʃaɪniːz] – китаец, китайка
3. **68°F** – 68 degrees Fahrenheit ['færənhaɪt] – 68 градусов по шкале Фаренгейта
4. **1763°C** – 1763 degrees Celsius ['selsjəs] – 1763 градуса по шкале термометра Цельсия  
**Centigrade scale** is the name formerly used for **Celsius scale**. The name is not now used in the SI Units but is often used by meteorologists.

**Task III. Read the text and then do the following exercises.**

☞ I. In the text, find the English equivalents for the words and phrases below:

- |  |  |
|--|--|
| ○ были, в основном, ошибочными                                     | ○ когда металл нагревается до красна или до бела           |
| ○ одно, что древние действительно правильно понимали               | ○ пока он не раскалится до бела или до красна              |
| ○ сегодня мы знакомы с целым рядом /огромным множеством/ предметов | ○ тепловой источник света                                  |
| ○ игрушки, светящиеся в темноте                                    | ○ по любой причине, кроме                                  |
| ○ обыкновенные электрические лампочки                              | ○ лампа дневного света                                     |
| ○ при достаточно высокой температуре относительно комнатной        | ○ что касается первой                                      |
| ○ абсолютно черное тело  | ○ неприятно горяча на ощупь                                |
| ○ подобно людям  | ○ частные случаи   |
| ○ когда температура увеличивается                                  | ○ сила света, которую можно измерить                       |
|  | ○ по сравнению с расстоянием                               |
|  | ○ зависит как от силы света источника, так и от расстояния |
|  | ○ телесный угол равный 1 стерадиану                        |

II. Use suitable forms of the words from the box instead of the underlined ones.

1. The sun is an incandescent light source.
2. Certain substances emit light without becoming incandescent.
3. A firefly emits visible light by this means.
4. Fluorescent lights glow without being heated.
5. Radiation does not increase the temperature of fluorescent and phosphorescent substances.
6. A source of light whose dimensions are quite small in comparison with the area it illuminates is called a point source.
7. An electric bulb illuminating a large room is a point source.
8. The sun is certain to have a greater luminous intensity than an ordinary electric bulb.

- a) lamp
- b) material
- c) sure
- d) thermal
- e) fairly
- f) to light
- g) to produce
- h) in this way

III. Rewrite sentences using 'both ... and ...' and the words from the box. Then translate them.

A candle flame is an example of incandescence. – **Both** a candle flame **and** an ordinary light bulb are examples of incandescence. **Как** пламя свечи, **так и** обыкновенная электрическая лампочка – **примеры** накаливания.

1. A firefly is an example of luminescence.
2. Fluorescence is a particular case of luminescence.
3. The candela is used to measure luminous intensity of incandescent light sources.
4. Illuminance depends on the distance of the illuminated area from the source of light.
5. Photometry is the branch of optics.

- a) a fluorescent lamp
- b) geometrical optics
- c) the luminous intensity
- d) ~~an ordinary light bulb~~
- e) phosphorescence
- f) luminescent

IV. Read the following information and answer the questions.

1. Do atoms emit or absorb light? Is emission spontaneous or stimulated?
2. Is a firefly a luminescent or bioluminescent light source?
3. Is phosphorescence caused by more energetic radiation or by bombarding subatomic particles?

1. Atoms emit and absorb light at characteristic energies. This produces 'emission lines' in the spectrum of each atom. Emission can be spontaneous, as in light-emitting diodes, gas discharge lamps, and flames. Emission can also be stimulated, as in laser or a microwave maser.
2. Luminescence is caused by a great variety of factors: electronic beam, X-rays, optical radiation, chemical processes, etc. The process of emitting light during certain chemical processes is known to be chemiluminescence. In living things, this process is called bioluminescence. For example, fireflies emit light in this way.
3. Phosphorescent materials can be excited by bombarding them with subatomic particles. Cathodoluminescence is one example of this. This mechanism is used in cathode ray tube television.

V. Rewrite sentences, using 'as far as ... is / are concerned'. Translate them into Russian.

A firefly is a source of light. – **As far as** a firefly **is concerned**, it is a source of light. **Что касается** светлячка, **то он является** источником света.

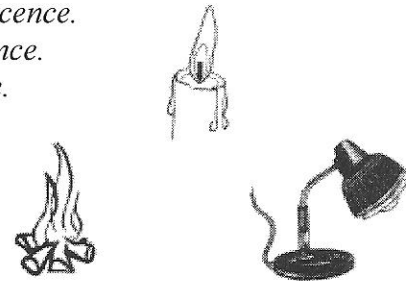
1. All sources of light have a luminous intensity.
2. A piece of platinum reflects light and is not seen in a darkened room.
3. A heated piece of platinum emits light and is seen even in a darkened room.
4. Incandescence is the emission of light caused by high temperature.
5. Certain substances emit light without becoming incandescent.
6. Fluorescence and phosphorescence are particular cases of luminescence.

✎ VI. Translate into English.

1. Что касается источников света, то их можно разделить на две группы.
2. Что касается включенной электрической лампочки, то она неприятно горяча на ощупь.
3. Что касается ламп дневного света, то они являются люминесцентными источниками света.
4. Что касается канделя, то она используется для измерения силы света.
5. Что касается маленького пламени свечи, освещающим комнату, то оно является точечным источником.

IN OTHER WORDS

- ❖ (The process of) the light emission caused by high temperature is called incandescence.  
*Incandescence is the emission of light, caused by high temperature.*
- ❖ Sunlight, ordinary light bulbs, and a candle flame are examples of incandescence.  
*The examples of incandescence include sunlight, ordinary light bulbs, and a candle flame.*
- ❖ We know that fluorescence is a particular case of luminescence.  
*It is known that fluorescence is a particular case of luminescence.*  
*Fluorescence is known to be a particular case of luminescence.*  
*Fluorescence is known as a particular case of luminescence.*
- ❖ We use the candela to measure luminous intensity.  
*The candela is used for measuring luminous intensity.*  
*The candela is a unit of luminous intensity.*  
*Luminous intensity is measured in candelas.*



✎ VII. Rewrite each sentence so that your sentence has a similar meaning to the given one. Write as many variants as you can.

1. Luminescence is the emission of light, caused by any factor other than high temperature.
2. Fireflies and fluorescent lamps are examples of luminescence.
3. We expect that this substance emits light without being heated.
4. The examples of bioluminescence are fireflies emitting light and plankton producing glowing wave.
5. It is considered that a candle flame illuminating a room is a point source.
6. The lux is a unit of illuminance.
7. The lumen is a unit used to measure luminous flux.

IV. Answer the questions based on the text.

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. What problem does the text deal with?</li> <li>2. What do we call a luminous object / an illuminated object?</li> <li>3. What is a source of light?</li> <li>4. Is the Moon a source of light?</li> <li>5. What kinds of light sources do you know?</li> <li>6. What is incandescence caused by?</li> <li>7. How can we produce light by incandescence?</li> </ol> | <ol style="list-style-type: none"> <li>8. What materials do we call fluorescent substances?</li> <li>9. What kind of light source is a firefly?</li> <li>10. What units do we use to measure luminous intensity?</li> <li>11. How was the Standard Candle defined?</li> <li>12. Is a candela used only for measuring luminous intensity of incandescent light sources?</li> <li>13. What is a point source?</li> <li>14. What is illuminance?</li> </ol> |
|--|--|

V. Add details from the text "Photometry" to schemes 5.1, 5.2 and 5.3 and then describe the schemes using your own words. While describing, make use of the expressions given on pages 167 – 168.

**Stage 4 – Definitions****From “Longman Dictionary of Scientific Usage”**

**source** A place from which something comes or is emitted. A source is not restricted to a point in time; it can be past, present or future, e.g. **a)** a metal at high temperature is a source of light and a source of electrons (the light and electrons are emitted); **b)** at one time, wood was the main source of heat; at present, coal and oil are the main sources of heat and energy; in the future, atomic fusion may be the main source of energy.

**glow** To emit light without a flame, usually accompanied by the emission of heat.

**incandescence** **1.** When a material *glows* ( $\uparrow$ ) and emits light in the visible spectrum after it has been heated, the process is called incandescence. The emission of light caused by high temperatures. **2.** The light emitted in this way. – *incandescent* (a.)

**luminescence** **1.** Any process which involves the emission of light by a substance. **2.** The light emitted in this way. – *luminescent* (a.)

**fluorescence** **1.** The radiation of emitted light by a substance while it is irradiated by light or other radiation. *The wavelength* ( $\rightarrow$ )<sup>1</sup> of emitted light is different and usually longer than the wavelength of the exciting radiation. When ultraviolet light falls upon fluorescent materials, visible light is emitted, e.g. quinine sulphate solution under ultraviolet light fluoresces blue. In fluorescent lighting, the ultraviolet light inside the tube causes the outer casing to fluoresce. **2.** The light emitted in this way. – *fluorescent* (a.)

**phosphorescence** **1.** When a substance is irradiated and continues to emit light after the exciting radiation has ceased, the process is

called phosphorescence. The length of time of the phosphorescence varies. **2.** The light emitted in this way. Calcium sulphide is the example of phosphorescent material. – *phosphorescent* (a.)

**chemiluminescence** **1.** The process of emitting light during certain chemical processes, notably by slow oxidation of phosphorus. **2.** The light emitted in this way. The glow of phosphorus vapour in air is chemiluminescence produced by oxidation. – *chemiluminescent* (a.)

**intensity** *The quantity* ( $\rightarrow$ )<sup>2</sup> of *energy* ( $\rightarrow$ )<sup>3</sup>, carried by *a wave motion* ( $\rightarrow$ )<sup>1</sup>, passing per unit solid angle in unit time. It is measured in watts per steradian ( $\downarrow$ ) ( $W sr^{-1}$ ). The symbol for intensity is *I*.

**steradian** *The unit* ( $\rightarrow$ )<sup>2</sup> of measurement of a solid angle. It is the solid angle produced at the centre of a sphere by an area on the surface of the sphere equal to the square of the radius. The symbol for the solid angle is  $\Omega$  or  $\omega$  (the Greek letters capital and small omega). The solid angle subtended by a surface of area *A* at the centre of a sphere of radius *r* is  $A/r^2$ . If *A* is the whole surface of the sphere ( $A = \pi r^2$ ) the total solid angle at the centre of the sphere is  $A = \pi r^2/r^2$ , or 4 steradians. The symbol is *sr*.

**candela** The luminous intensity, in the perpendicular direction, of a surface of 1/6 000 000 square metres of a black body at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre. The symbol is *cd*.

<sup>1</sup> – see “THEORIES OF LIGHT” (Set B)

<sup>2</sup> – see “UNITS OF MEASUREMENT”

<sup>3</sup> – see “PHYSICS”



**Task IV. Read the definitions of the terms from “Longman Dictionary of Scientific Usage” and do the following exercises.**

❧ I. Write definition of the terms given in Boxes A and B rendering the articles below into English.

A

cathodoluminescence	roentgenoluminescence	photoluminescence
fluorescence		phosphorescence

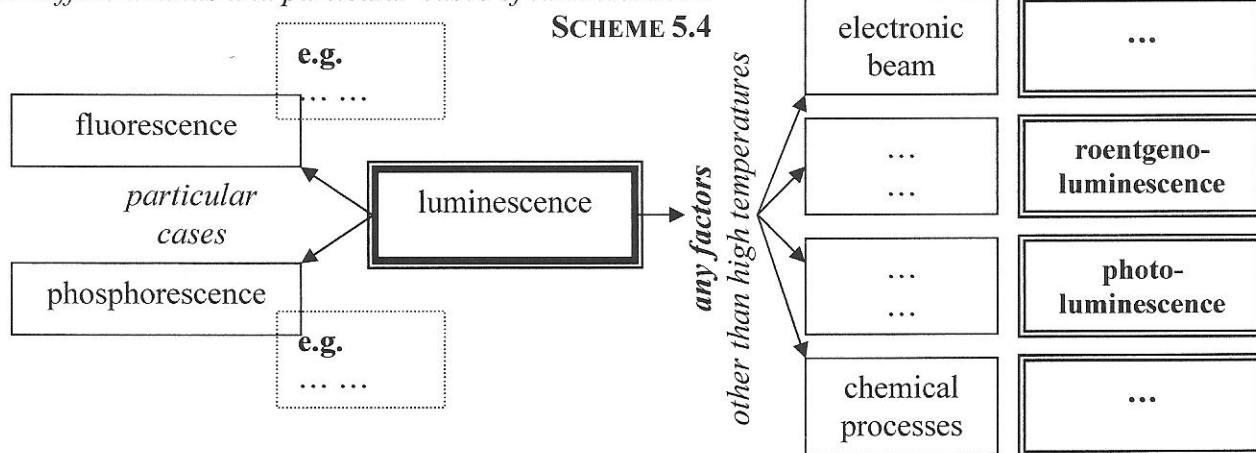
Причиной люминесцентного излучения являются внешние причины: бомбардировка вещества электронным пучком /beam/ (катодолюминесценция), рентгеновскими лучами /roentgen rays or X-rays/ (рентгенолюминесценция), оптическим излучением (фотолюминесценция), химические реакции (хемилюминесценция). Если люминесцентное излучение после прекращения действия его возбудителя заканчивается быстро ( $10^{-8}$  с), то такой вид люминесценции называется **флуоресценцией**; при медленном спаде излучения после отключения источника излучения наблюдается **фосфоресценция**.

B

luminous intensity	candela	illumination
luminous flux	steradian	point source

**Световой поток** – мощность видимого излучения или энергии световых волн, переносимая в единицу времени через телесный угол. Единица измерения – люмен (лм). **Сила света  $I$**  – отношение светового потока к телесному углу. Единица измерения – **кандела** – одна из основных единиц СИ: кандела (кд) равна силе света в заданном направлении от источника, испускающего монохроматическое излучение частотой  $540 \times 10^{12}$  Гц, энергетическая сила /radiant intensity/ которого в этом направлении составляет  $1/683$  Вт/ср (ср – **стерадиан** – единица измерения телесного угла. 1 ср равен телесному углу с вершиной /vertex/ в центре сферы, вырезающему на поверхности сферы площадь, равную площади квадрата со стороной, равной радиусу сферы). **Освещенность  $E$**  – отношение светового потока к площади облучаемой поверхности. Единица измерения – люкс (лк),  $1 \text{ лк} = \text{лм}/\text{м}^2$ . **Точечный источник света** – источник, линейные размеры которого значительно меньше, чем расстояние от него до точки наблюдения.

❧ II. Complete the scheme (you can't do it without the help of the previous exercise) and talk about the different kinds and particular cases of luminescence.



**Task V. Let's play the game ‘Research Conference’. The instructions are given on pages 170 – 172. Discuss the following topics:**

- ❑ Different Kinds of Light Sources
- ❑ Luminous Intensity
- ❑ Point Source. Illuminance

## Stage 5 – In Addition

### Think and Guess

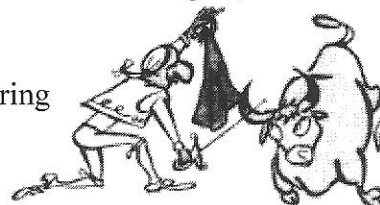
### Fire Idioms

As far as fire (or flame) is concerned it is an incandescent source of light. “Active Study Dictionary of English” defines ‘fire’ as ‘burning with flames’ or ‘a mass of burning material, lit for the purpose of cooking, heat, light, etc. or lit by accident’. But there are some idioms and sayings in English that are connected with ‘fire’ and ‘flame’ and have nothing in common with light or heat. Match the expressions with their correct meanings and then try to give the Russian equivalents to these idiomatic expressions.

1. He often finds himself between two fires.
2. She plays with fire.
3. They went through fire and water.
4. He pulls chestnuts out of the fire.
5. There is no smoke without fire.
6. They get on like a house on fire.
7. Out of the frying pan into the fire.
8. He has been fired.
9. She pours oil on the flame. (She adds fuel to the fire.)
10. She is one of his old flames.



- a) to be extremely friendly; to always be together;
- b) to do the hardest and most painstaking<sup>1</sup> part of some job for someone else's benefit<sup>2</sup>;
- c) to act or speak in such a way as to increase passion<sup>3</sup> or excitement; to make something bad worse;
- d) to be or find oneself between two equally serious evils or dangers, between two equally unpleasant alternatives;
- e) to be dismissed from a job;
- f) to trifle<sup>4</sup> with something dangerous without considering the consequences;
- g) an ex-girlfriend (or an ex-boyfriend);
- h) most rumours<sup>5</sup> are based on the truth;
- i) to go from one unpleasant or dangerous situation to another;
- j) to go through a great deal in life; to endure dangers of all kinds



<sup>1</sup> **painstaking** [pɛɪnz'teɪkɪŋ] very careful

<sup>2</sup> **benefit** ['benɪfɪt] advantage; profit; good effect

<sup>3</sup> **passion** ['pæʃən] a strong, deep, often uncontrolled feeling, esp. of love, hatred, or anger

<sup>4</sup> **trifle** ['traɪfl] to treat without seriousness or respect

<sup>5</sup> **rumour** ['ru:mə] unofficial news; common talk, perhaps untrue

(from “Active Dictionary of English”)

### PAY ATTENTION!

Use **'light a fire'** or **'light a candle'** (= make it burn)

e.g. The hunters **lit a fire** to keep warm at night.

If you **light** something that is not intended to burn, you **'set fire to it'** or **'set it on fire'**

e.g. Someone **set fire to** the school bus.

When a thing begins to burn, it **'catches fire'**.

e.g. The pile of papers **caught fire**. Someone must have **set fire to it** / **set it on fire**.