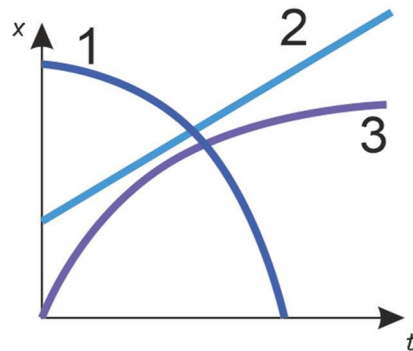


### Physics Exam

1. Please describe the types of motions (tasks 1, 2 and 3). The dependence of position  $x$  on time  $t$  is shown graphically. Please select the correct option. The graph 1 depicts ...

- accelerating motion in the positive direction.
- uniform motion in the positive direction.
- decelerating motion in the positive direction.
- accelerating motion in the negative direction.
- uniform motion in the negative direction.
- decelerating motion in the positive direction.



2. The graph 2 depicts ...

- accelerating motion in the positive direction.
- uniform motion in the positive direction.
- decelerating motion in the positive direction.
- accelerating motion in the negative direction.
- uniform motion in the negative direction.
- decelerating motion in the positive direction.

3. The graph 3 depicts ...

- accelerating motion in the positive direction.
- uniform motion in the positive direction.
- decelerating motion in the positive direction.
- accelerating motion in the negative direction.
- uniform motion in the negative direction.
- decelerating motion in the positive direction.

4. Please select the physical quantity that describes the amount of work done per unit of time. It is ...

- linear momentum.
- power.
- kinetic energy.
- potential energy.
- force.

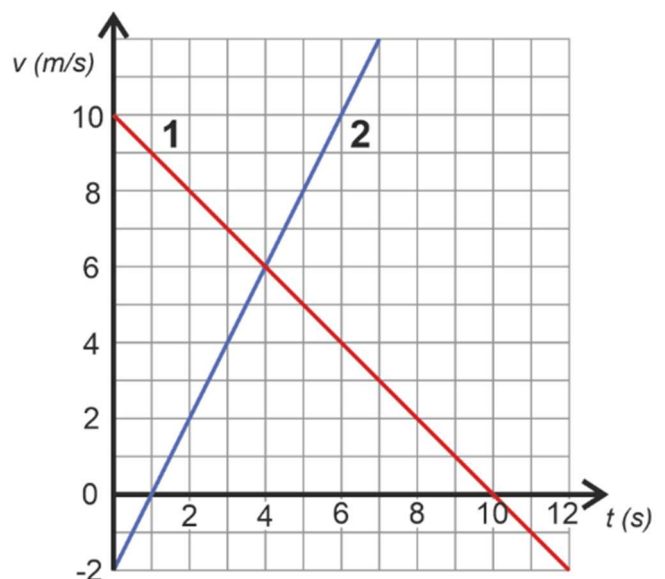
5. The dependences of velocities  $v$  on time  $t$  of two moving bodies 1 and 2 are depicted. Please select the correct options.

The acceleration of the body 1 is ...

- $1,0 \text{ m/s}^2$ .
- $-1,0 \text{ m/s}^2$ .
- $10 \text{ m/s}^2$ .
- $-10 \text{ m/s}^2$ .

The displacement of the body 2 during the first 6 seconds is ...

- 6 m.
- 12 m.
- 24 m.
- 36 m.



6. What force partially balances the gravitational force of a stone lying at the bottom of a pond? Please select the correct option.
- a. Force of pressure
  - b. Weight of the stone
  - c. Force of tension
  - d. Buoyant force
  - e. Force of friction

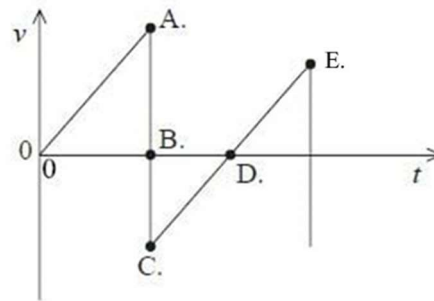
7. The stone was thrown vertically into the air. The drag force can be neglected. One of the following quantities describing the motion depends on the mass of the stone. Which one? Please select.
- a. Position
  - b. Instantaneous velocity
  - c. Linear momentum
  - d. Acceleration

8. A body is suspended stationary at the end of a spring. Two vertical forces acting on the body and being equal in magnitude according to Newton's first law, are: gravitational force and ... Please select the correct option.

- a. Force of pressure
- b. Force of friction
- c. Force of tension
- d. Weight of the body
- e. Buoyant force

9. At the time instant  $t = 0$ , a ball held above a horizontal table is released. The following graph illustrates the change in the velocity  $v$  of the ball with respect to time  $t$ . Which of the points depicted on the graph corresponds to the situation where the ball, upon rebounding from the table, loses contact with the table surface? Please select the correct option.

- a. A
- b. B
- c. C
- d. D
- e. E

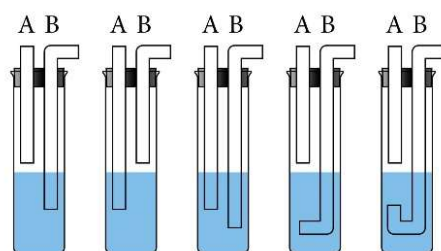


10. On a straight and level road, a car with a mass of 1500 kg experiences a traction force from the engine of 1800 N, as well as a drag force. The car's acceleration is  $0,8 \text{ m/s}^2$ . Please select the correct value of the drag force acting on the car.

- a. 600 N.
- b. 800 N.
- c. 1200 N.
- d. 400 N.

11. Which figure, counting from the left, depicts a scenario where the liquid does **not** flow out of tube B when air is blown forcefully into tube A?

- a. The first
- b. The second
- c. The third
- d. The fourth
- e. The fifth



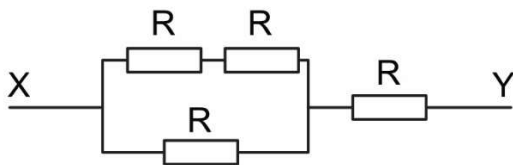
12. The centers of mass of two celestial bodies behaving as point masses are located at a distance  $R$  from each other, and the magnitude of the gravitational force acting between the bodies is  $F$ . What is the distance between the bodies when the magnitude of the force is  $F/4$ ? Please select.
- a.  $2R$
  - b.  $R/4$
  - c.  $R/2$
  - d.  $4R$
  - e.  $16R$
13. A small body rotates in a horizontal plane at the end of a rope of constant length. The tension force  $F$  in the rope is measured for different rotation periods  $T$  of the body. What quantities should be plotted on the axes of the graph representing the results of this experiment in order for the graph to be a straight line? Please select the correct answer.
- a.  $F$  and  $T$ .
  - b.  $F^2$  and  $T$ .
  - c.  $F^2$  and  $1/T$ .
  - d.  $F$  and  $1/T^2$ .
  - e.  $F^2$  and  $T^2$ .
14. A steel ball attached to the end of a four-meter-long inelastic wire is released at a certain distance from its equilibrium position. The ball begins to move in the chosen positive direction and returns to its initial position 4 seconds after the start of the motion. After what time interval from the start does the ball reach its maximum negative acceleration in magnitude? Please select the correct answer.
- a. 0,5 s.
  - b. 1,0 s.
  - c. 1,5 s.
  - d. 2,0 s.
  - e. 3,0 s.
15. The speed of sound in fresh water at a temperature of +10 degrees Celsius is 1.46 km/s. What wavelength does sound with a frequency of 2 kHz have in this water? Please select.
- a. 2,92 m.
  - b. 29,2 cm.
  - c. 29,2 mm.
  - d. 73 cm.
  - e. 73 mm.
16. What force acts on a body with a charge of  $20 \mu\text{C}$  in an electric field with a strength of  $300 \text{ kV/m}$ ? Please select the correct answer.
- a. 15 N.
  - b. 150 N.
  - c. 6 N.
  - d. 60 N.
  - e. 6 kN.
17. In a homogeneous electric field with a field strength of  $300 \text{ V/m}$ , the electric potential at a certain point is  $40 \text{ V}$ . What is the potential at a point located  $20 \text{ cm}$  away from this point in the direction of the field? Please select the correct answer.
- a.  $120 \text{ V}$ .
  - b.  $60 \text{ V}$ .
  - c.  $20 \text{ V}$ .
  - d.  $-20 \text{ V}$ .
  - e.  $-60 \text{ V}$ .
18. An electrical circuit with a total resistance of  $30 \text{ ohms}$  consists of a battery with an electromotive force of  $12 \text{ V}$ . How much work do non-electrical forces in the battery during a time interval of  $15 \text{ seconds}$ ? Please select the correct answer.
- a.  $360 \text{ J}$ .
  - b.  $180 \text{ J}$ .
  - c.  $72 \text{ J}$ .
  - d.  $6 \text{ J}$ .

19. Two points A and B are located in an electric field generated by the point charges  $-2q$  and  $+q$  according to the following figure. Please select the correct statements.



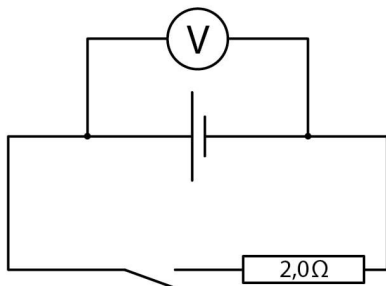
- In the point A the electric field is weaker than in the point B.
- In the point A the electric field is stronger than in the point B.
- In the point A the electric field is directed right and slightly up (geographical direction ENE).
- In the point A the electric field is directed left and slightly up (direction WNW).
- In the point A the electric field is directed right and slightly down (direction ESE).
- In the point A the electric field is directed left and slightly down (direction WSW).

20. What is the total resistance between points X and Y? Please select the correct answer.



- $3/2 R$
- $2/3 R$
- $7/3 R$
- $5/3 R$
- $3/5 R$

21. The following electrical circuit was constructed, in which the resistance of the resistor was 2 ohms.



The ideal voltmeter connected across the terminals of the voltage source showed 12 V when the switch was open and 3 V when the switch was closed. What was the internal resistance of the source?

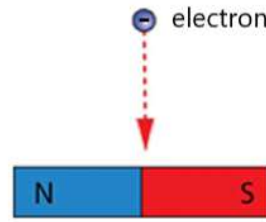
- $2,0 \Omega$ .
- $4,0 \Omega$ .
- $6,0 \Omega$ .
- $8,0 \Omega$ .

22. In the left wire, the electric current is directed away from us, into the page (the symbol  $\otimes$ ), while in the right wire, the current is directed out of the page (the symbol  $\odot$ ). The current strengths in the wires are equal. What is the direction of the total magnetic field at point P? Please select.

- Leftwards
- Upwards
- Downwards
- Into the page (from us)
- Out of the page (to us)



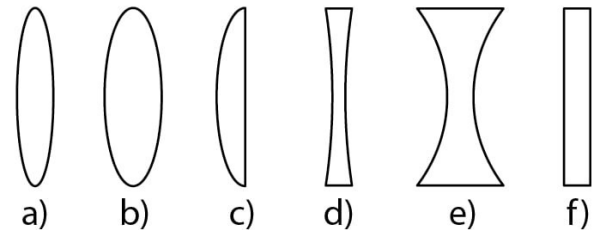
23. On the diagram, an electron moving from top to bottom towards the center of a permanent magnet is depicted. What is the direction of the magnetic force acting on the electron?
- Out of the page (to us)
  - Into the page (from us)
  - Rightwards
  - Leftwards
  - There is no force at all.



24. One of the following lists presents electromagnetic wave scales of radiations only in increasing order of wavelength. Which one? Please select the correct option.
- Microwaves, ultraviolet rays, infrared rays.
  - Radio waves, infrared rays, gamma rays.
  - X-rays, visible light, microwaves.
  - Visible light, gamma rays, radio waves.
  - Infrared rays, gamma rays, X-rays.

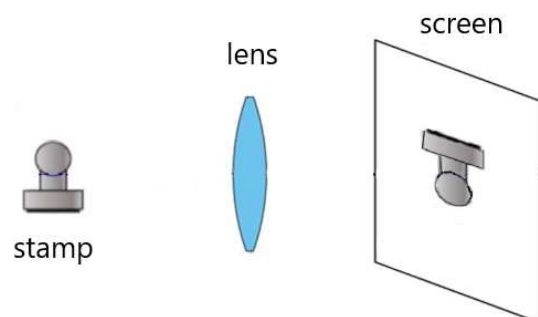
25. Which lens depicted below has the greatest positive optical power? Please select the correct option.

- a
- b
- c
- d
- e
- f



26. On the left side of the lens you can see a stamp, and an image of it is formed on the screen located to the right of the lens. An opaque cover is placed on the upper part of the lens. What happens to the image of the stamp?

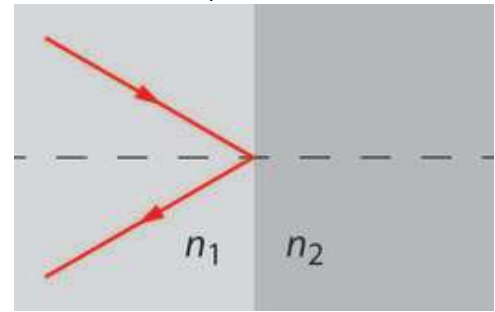
- The upper part of the image disappears.
- The lower part of the image disappears.
- The image is darker but complete.
- The image becomes smaller.
- The image does not change in any way.



27. Let us look again at the drawing located upwards. Please select the correct option.
- The stamp is located between the focus of the lens and the lens itself.
  - The stamp is located between the focus and the double focus of the lens.
  - The stamp is located at twice the focal distance from the lens.
  - The stamp is located beyond twice the focal distance of the lens.
  - None of the answer choices is correct.

28. Under what circumstances does the direction of light propagation change according to the given diagram? The quantity  $n$  is the refraction index. Please select the correct option.

- a. That occurs only when  $n_2 > n_1$ .
- b. That occurs only when  $n_2 = n_1$ .
- c. That occurs only when  $n_2 < n_1$ .
- d. Such a ray path is not possible.
- e. Such a ray path is always possible.



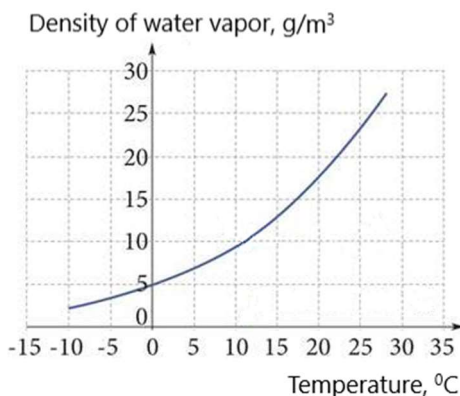
29. 500 grams of water at a temperature of 10 degrees Celsius were mixed with 0.3 liters of water at 90 degrees Celsius. There were no heat losses. What was the final temperature of the water mixture? Please select the correct option.

- a. 30 °C
- b. 40 °C
- c. 50 °C
- d. 60 °C
- e. 70 °C

30. In which process does a certain amount of ideal gas give a certain amount of heat to the surrounding environment? Please select the correct option.

- a. The isobaric expansion of the gas.
- b. The isothermal compression of the gas.
- c. The isothermal expansion of the gas.
- d. The adiabatic expansion of the gas.

31. At a temperature of 25 degrees Celsius, there were 13 grams of water vapor in one cubic meter of air. On the graph, the dependence of saturated water vapor density on temperature is depicted. The relative humidity of the observed air was ... As such air cools, the dew point occurs in the air at a temperature of ... Please select the correct options.



- a. 47 %.
- b. 57 %.
- c. 67 %.
- d. 77 %.
- e. 5 °C.
- f. 11 °C.
- g. 15 °C.
- h. 20 °C.

32. The mercury lamp used in the medical disinfection of rooms predominantly emits photons with an energy of 3.40 eV. The wavelength of this radiation is ... Please select the correct option.

- a. 656 nm.
- b. 486 nm.
- c. 414 nm.
- d. 365 nm.

33. A hydrogen atom emits light when ...
- the distance of the electron from the nucleus increases.
  - the energy of the electron decreases.
  - the speed of the electron decreases.
  - the negative energy is converted into positive.

Please select the correct option.

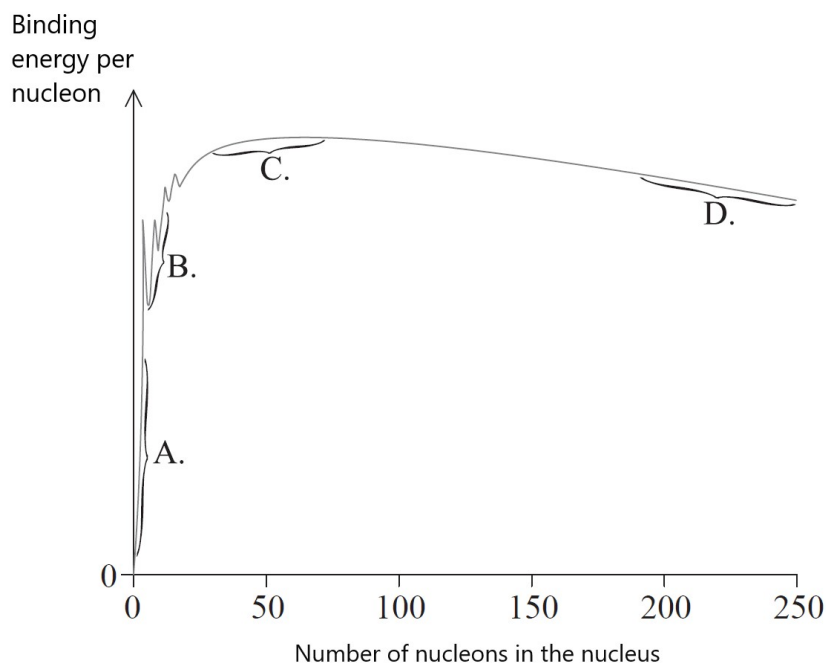
34. We have 56 grams of a beta-active iridium isotope with a mass number of 184 and a half-life of 3 hours, with 77 protons in its nucleus. Which amount of platinum isotope is formed from this iridium, during a 9-hour period? Please select the correct answer.
- 7 grams
  - 14 grams
  - 49 grams
  - 52 grams.

How many neutrons does the platinum atom's nucleus contain? Please select the correct answer.

- 105 neutrons.
- 106 neutrons
- 107 neutrons.
- 108 neutrons.

35. The following graph depicts the relationship between the specific binding energy of atomic nuclei and the number of nucleons (mass number). From which region to which region the transition occurs in thermonuclear reactions, which are hopefully to take place in future nuclear power plants? Please select the correct option.

- C → D
- A → B
- B → C
- C → B
- D → C



## Physics Formula Sheet

$$v = \frac{\Delta x}{\Delta t} = \frac{s}{t}$$

$$a = \frac{v - v_0}{\Delta t}$$

$$x = x_0 \pm vt$$

$$x = x_0 \pm v_0 t \pm \frac{at^2}{2}$$

$$v = v_0 \pm at$$

$$s = v_0 t \pm \frac{at^2}{2}$$

$$s = \frac{v^2 - v_0^2}{2a}$$

$$\Delta(m_1 \vec{v}_1 + m_2 \vec{v}_2) = 0$$

$$a = \frac{F}{m}$$

$$F_G = G \frac{m_1 m_2}{r^2}$$

$$P = m(g \pm a)$$

$$a_k = \omega^2 r = \frac{v^2}{r}$$

$$F_h = \mu N$$

$$F_r = m g$$

$$F_e = -k \Delta l$$

$$A = F s \cos \alpha$$

$$N = \frac{A}{t}$$

$$p = \frac{F}{S}$$

$$p = \rho g h$$

$$F_{\ddot{u}} = \rho V g$$

$$E_k = \frac{mv^2}{2}$$

$$E_p = m g h$$

$$E = E_k + E_p$$

$$\varphi = \omega t$$

$$v = \omega r$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$T = \frac{1}{f}$$

$$v = \lambda f$$

$$I = \frac{q}{t}$$

$$E = \frac{F}{q}$$

$$F = k \frac{q_1 q_2}{r^2}$$

$$U = \frac{A}{q}$$

$$\varphi = \frac{E_p}{q}$$

$$E = \frac{U}{d}$$

$$U = \varphi_1 - \varphi_2$$

$$B = \frac{F}{I l}$$

$$F = K \frac{I_1 I_2}{r} l$$

$$F = B I l \sin \alpha$$

$$F_L = q v B \sin \alpha$$

$$\frac{\sin \alpha}{\sin \gamma} = n$$

$$n = \frac{c}{v}$$

$$D = \frac{1}{f}$$

$$c = \lambda f$$

$$E = h f$$

$$I = \frac{U}{R}$$

$$I = \frac{\mathcal{E}}{R + r}$$

$$A = I U \Delta t$$

$$N = I U$$

$$T = t(^{\circ}\text{C}) + 273 \text{ K}$$

$$E_k = \frac{3}{2} k_B T$$

$$p = n k_B T$$

$$p V = \frac{m}{M} R T$$

$$Q = c m \Delta t$$

$$Q = \lambda m$$

$$Q = L m$$

$$Q = r m$$

$$Q = \Delta U + A$$

$$A = p \Delta V$$

$$E = m c^2$$

$$g = 9,81 \text{ m/s}^2 \text{ (N/kg)}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6,626 \times 10^{-34} \text{ J s}$$

$$e = 1,602 \times 10^{-19} \text{ C}$$

$$1 \text{ eV} = 1,602 \times 10^{-19} \text{ J}$$

$$G = 6,674 \times 10^{-11} \text{ N m}^2/\text{kg}^2$$

$$k = 9 \times 10^9 \text{ N m}^2/\text{C}^2$$

$$K = 2 \times 10^{-7} \text{ N/A}^2$$

$$k_B = 1,38 \times 10^{-23} \text{ J/K}$$

$$R = 8,31 \text{ J/(K} \cdot \text{mol)}$$