Physics Competition

I Circle the correct answer

1. (2 points)

1) The unit for electric current was named after which scientist?

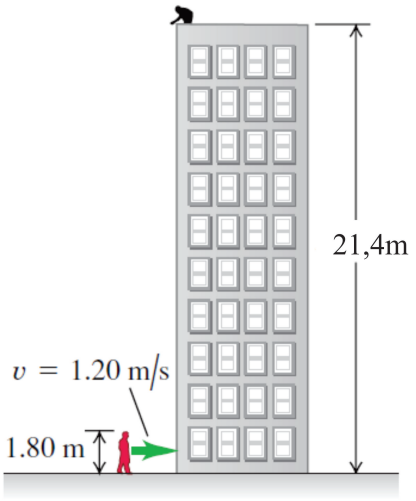
A) Isaac Newton B) James Watt C) Alessandro Volta D) André-Marie Ampère E) Georg Ohm

2) How can this unit be expressed in terms of some other SI units?

A) $1\frac{J}{C}$ B) $1\frac{C}{V}$ C) $1C \cdot s$ D) $1\frac{\Omega}{s}$ E) $1\frac{V}{\Omega}$

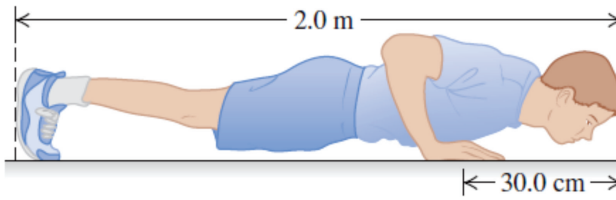
2. (2 points) Naughty student climbed the roof of his school, which is $21,4m$ high, and he wants to drop an egg on his physics professor's head. Professor, who is $1,8m$ tall, is walking towards the school entrance right below the student at a constant speed of $1,2m/s$. How far away from the entrance should the professor be at the moment when the student releases an egg? Assume that the egg is in free fall, neglect the air resistance and take the acceleration due to gravity to be $9,8m/s^2$.

A) $2,5m$ B) $4,8m$ C) $2,4m$ D) $5,4m$ E) $1,2m$



3. (2 points) In order to stregthen his arms and chest volleyball player, who is $2m$ tall and with a mass of $82kg$, does push-ups. His center of mass is $1,15m$ away from his feet, while the centers of his palms are $30cm$ away from the top of his head. What is the total force with which he has to push the floor with his hands in order to keep himself in this position? Assume that the volleyball player's body is horizontal. For the gravitational acceleration use $9,8m/s^2$.

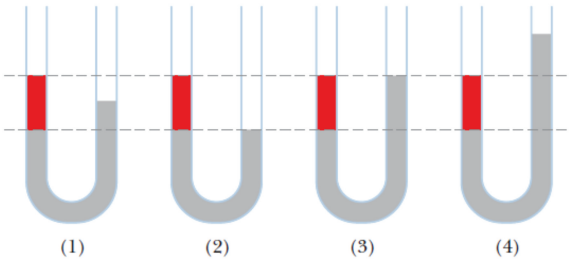
A) $543,6N$ B) $3080,5N$ C) $462,1N$ D) $1397,6N$ E) $209,6N$



4. (2 points) The picture shows four U-tubes. Same liquid was poured in the left part of each of the four U-tubes, while different liquids were poured in the right parts of the tubes.

1) Which of the drawings represents a situation where the liquids are not in equilibrium?

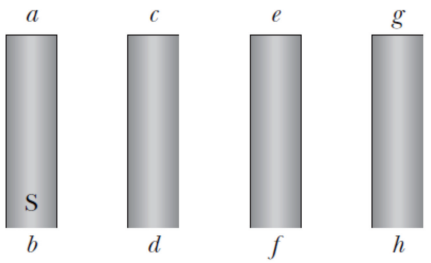
A) (1) B) (2) C) (3) D) (4)



2) If the rest of the U-tubes are in equilibrium and if we denote them, from left to right, with greek letters α, β i γ what is the correct expression that correctly compares densities of the three liquids poured in the right half of the U-tubes?

A) $\rho_\alpha < \rho_\beta < \rho_\gamma$ B) $\rho_\alpha > \rho_\beta > \rho_\gamma$ C) $\rho_\beta < \rho_\alpha < \rho_\gamma$ D) $\rho_\alpha = \rho_\beta > \rho_\gamma$ E) $\rho_\alpha < \rho_\beta = \rho_\gamma$

5. (1 point) Figure on the right shows four iron bars: three of them are permanent magnets while the fourth bar is made out of soft iron. Soft iron can easily be magnetized when found near other permanent magnets, but it also easily demagnetizes when there is no magnetic field around it. One of the magnetic poles is shown on the picture (S stands for the south magnetic pole). In the experiment the students found out that the ends a-d, c-e and d-h attract each other, while ends f and g repell each other. Which bar is not a permanent magnet i.e. which one is made out of soft iron? Initially the magnets are far from each other.

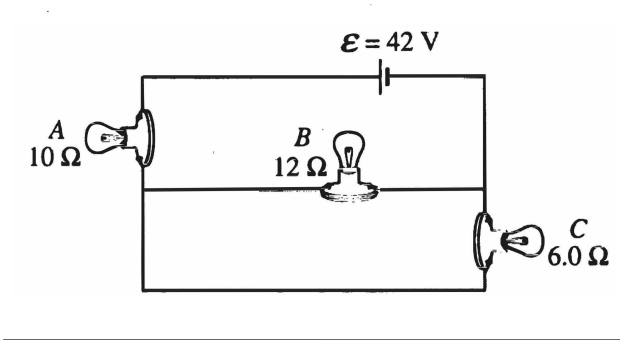


A) ab B) cd C) ef D) gh

6. The picture shows a scene from a movie "Jurassic Park" in which *T.rex* is chasing after a jeep where we can see the reduced image of the dinosaur in the side-view mirror. At the bottom of the mirror it is written: "Objects in mirror are closer than they appear". The reason for the warning is that the images we see in the mirror are reduced in size so they seem to be farther away than they really are.

1) (1 point) Is the side-view mirror:
A) plane; B) concave; C) convex?

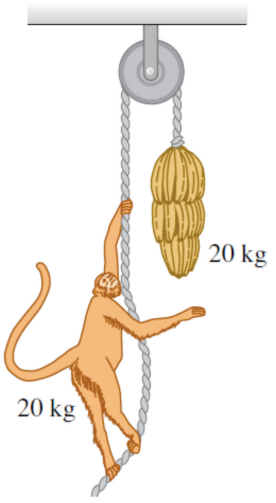
2) (2 points) If the radius of curvature of that mirror is $1,2m$ and *T.rex* is $3m$ away from it, what is the distance of its image from the mirror?
A) $0,75m$ B) $0,5m$ C) $6/7m$ D) $2m$ E) $4,25m$



7. (3 points) The picture shows a scheme of an electric circuit with a DC battery and three light bulbs. Using the numerical values shown in the picture rank the power of emitted light by the bulbs.

A) $P_A < P_C < P_B$ B) $P_A < P_B < P_C$
C) $P_C < P_A < P_B$ D) $P_A > P_B = P_C$
E) $P_A > P_C > P_B$

II Fill in the blanks with: INCREASES, DECREASES or STAYS CONSTANT



8. A monkey, with a mass of $20kg$, is holding tightly to a light rope that goes over a frictionless pulley. On the other end of the rope there's $20kg$ of bananas attached to it. Monkey sees the bananas on the other end of the rope and starts pulling it downwards so that he could get to the bananas.

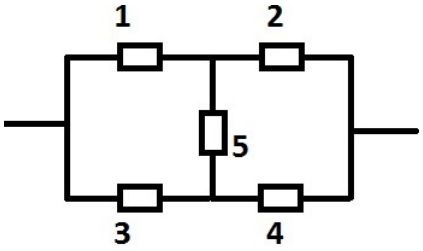
a) (2 points) How is the distance between the monkey and the bananas changing over time?_____

b) (1 point) At some point monkey releases the rope and starts free falling. How is the distance between him and the bananas changing now?_____

9. (2 points) A man is standing on a bathroom scale and then he quickly squats down curious to see what would the scale show.

a) How did the man's movement affect what the scale was showing while he was accelerating downwards compared to what it was showing in the beginning?_____

b) Compare the initial mass with what the scale was showing just before the man comes to a stand still at the bottom of his squat?_____

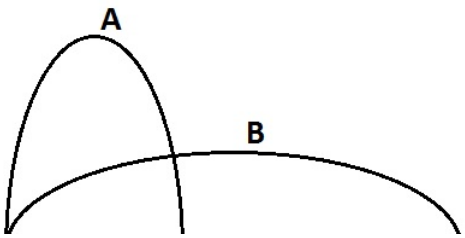


10. (3 points) The picture shows a network of five identical resistors connected to a battery. How does the current flowing into the resistor network change if:

A) resistor 1 "blows up"?_____ B) resistor 5 "blows up"?_____

C) resistors 1 and 5 "blow up"? _____

III Give an answer in the following form $A < B$, $A > B$ or $A = B$



11. (3 points)The picture on the left shows trajectories of two objects thrown from the ground. Compare the times it took them to fall down assuming the air resistance to be negligible.

12. (3 points) Simple pendulum is made out of a thin and long metal wire of negligible mass and a small and heavy ball attached to the wire's bottom end. Compare the periods of oscillations of the same pendulum during a hot summer day (A) and during a cold winter night (B).

IV Solve the problems

13. (4 points) Electric motor in a small crane is powered by an ideal DC battery with EMF of $6V$ and the current running trough the motor is $1,5A$. We're using the crane to lift a weight of mass $1200g$ with constant velocity against the pull of earth's gravity. What is the velocity of the weight assuming there are no energetic losses? Gravitational acceleration is $9,8m/s^2$.

14. (5 ponts) What should be the minimum height (vertical length) of a plane mirror hung on the wall so that a $170cm$ girl could see her whole image in it while standing?

V Answer the question and give an explanation

15. The picture shows a man wearing two kinds of glasses. One pair of glasses is for nearsightedness (myopia)and the other pair is for farsightedness (hyperopia). Nearsighted people can see objects that are close clearly, while those further away are blurry to them. That is a consequence of the oblate shape of their eye due to which the retina is farther away from the eye's lens compared to a normal eye. Their eye lens focuses rays of light coming from distant object in front of the retina (instead of on it as is the case with people having no problems with their vision) which is the reason that distant objects are blurry to them. In the case of farsighted people the situation is reversed. The shape of their eye is such that the retina is slightly closer to the eye's lens compared to the normal eye which is the reason they see objects further away much more clearly than the ones closer by because the light rays coming from the closer objects are focused behind the retina. Glasses help both near and farsighted people to focus images of objects right at the retina.

1)

2)

a) (3 points) What kind of lens should a nearsighted (farsighted) person use for their glasses? Converging or diverging?
b) (4 points) Looking at the pictures shown on the right can you make a conclusion as to which glasses (1) or 2)) are for nearsighted and which ones are for the farsighted people?

16. (4 points) Is it easier to drink water from a glass trough a straw if there is more water in the glass or less? Is it easier to drink water from a glass trough a straw in Belgrade or on Mount Everest assuming, that the temperatures are equal?