Phys 100 Practice Exam Questions

1. If you toss a ball upward with a certain velocity, it reaches a maximum height *h.* What maximum height does the ball reach if you throw it upward with double the initial velocity assuming that air drag can be neglected?

a. 0.5 h
b. 2h
c. 4h
d. 1.5h
e. √2 h

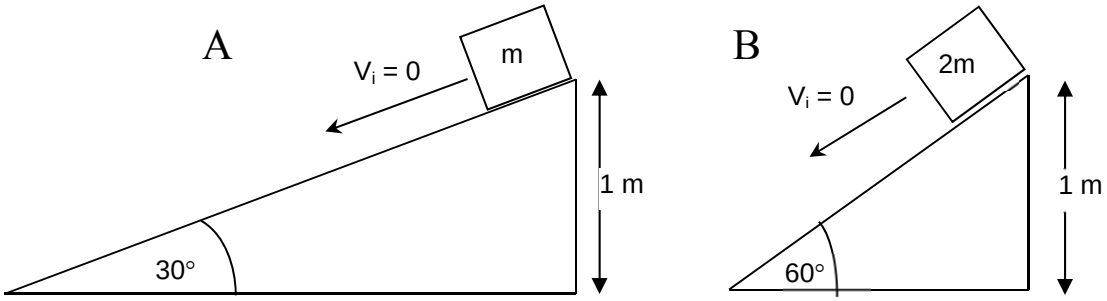
2. Incandescent light bulbs are notorious for being relatively inefficient in producing visible light. The tungsten wire inside such a bulb is at a temperature of approximately 3000 K and the emission spectrum is very similar to that of a blackbody. The efficiency is so low because

A. Most of the electrons are absorbed in the tungsten wire.
B. Most of the power is lost due to the resistance of the bulb.
C. The potential difference across the bulb is not large enough for efficient light production.
D. The electric power actually is efficiently transformed into radiation but at 3000 K, most of it is infrared.
E. A blackbody absorbs more light than it emits – that's why it appears black.

3. You just bought a brand new toaster from Future City Electronics and have gone back to your car in the parking lot. You put the toaster (still in its original box) on top of the car while you open the door, but forget to put it inside the car. You start up and drive away with the toaster box still on top of the car. While you are accelerating forward, which of the following friction forces will act on the box? (Assume that the box is not sliding on the roof and that air drag is negligible)

1. a static friction force in the direction of motion of the car;
2. a static friction force opposite to the direction of motion of the car;
3. no friction force because the box is not moving relative to the car;
4. a kinetic friction force in the direction of motion of the car
5. a kinetic friction force opposite to the direction of motion of the car.
6. none of the above

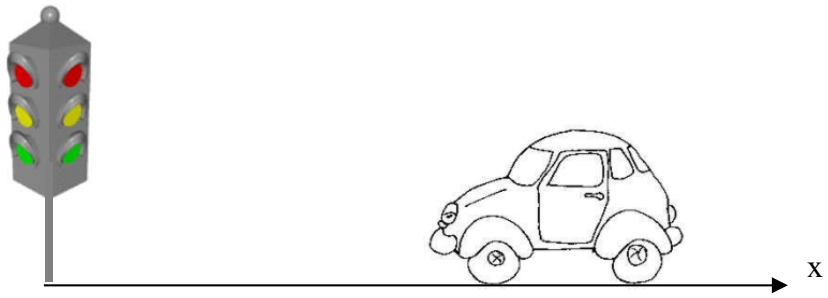
4. Block A and B start from rest and slide down two frictionless ramps. Block B has double the mass of block A. Which block is moving faster by the time it reaches the bottom of the ramp?



1. Block A
2. Block B
3. They are moving at the same speed
4. There is not enough information to answer the question

5. A stoplight to the west of you turns yellow when you are 20 m from the traffic light. Your car is traveling west at 12 m/s. You hit the brakes and your car's speed decreases at a rate of 6.0 m/s each second. The stoplight is considered to be the reference point (x = 0). A student made a picture of this situation.

Which of the following did he label INCORRECTLY?



$x_0 = +20$ m

$v_0 = -12$ m/s

$a = -6.0$ m/s^2

1. x_0
2. v_0
3. a
4. a & v_0
5. all of the values are correct

6. A person loads her moving truck so that it is twice as heavy loaded as it is when it's empty. She compares the fuel consumption (liters/100 km) of the full truck with the fuel consumption of the empty truck and finds out that on flat roads:

A. The fuel consumption does not depend on the load.
B. The fuel consumption of the loaded truck is increased by the same number of liters/100 km at low speeds and at high speeds.
C. The fuel consumption of the loaded truck is increased by more liters/100 km at high speeds than at low speeds.
D. The fuel consumption of the loaded truck is doubled at any speed
E. The fuel consumption of the loaded truck is increased by more liters/100 km at low speeds than at high speeds.

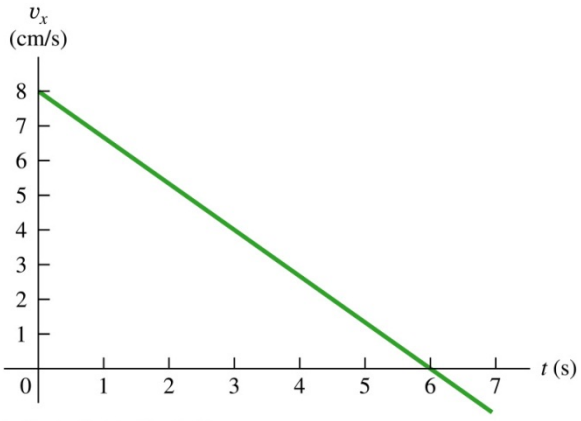
Explain your choice in one sentence:

7. Which of the following <u>direct</u> energy transformations occur in a coal power generation facility? (Choose **all** that apply)

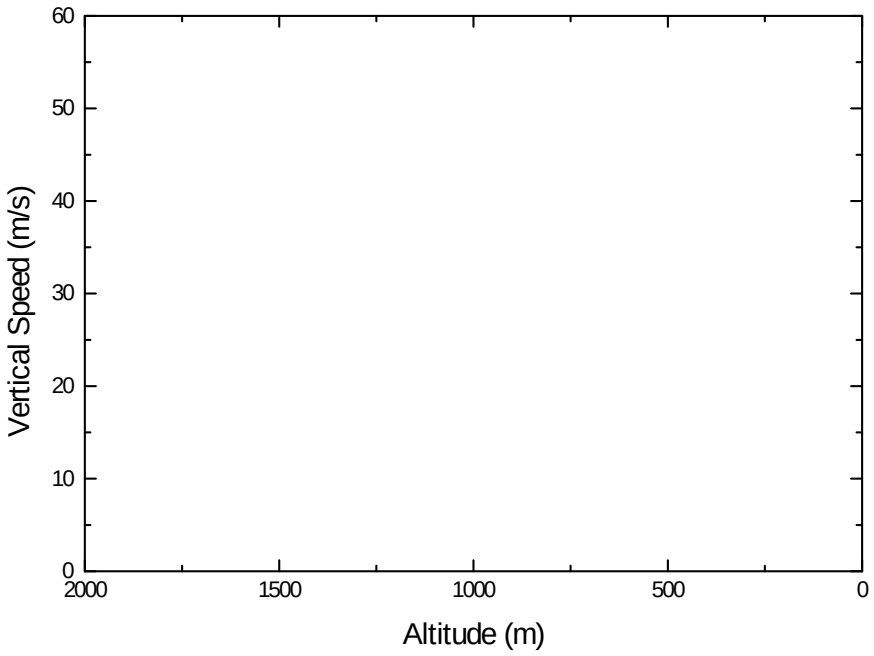
1. electrical to mechanical
2. chemical to thermal
3. mechanical to electrical
4. thermal to mechanical
5. thermal to electrical
6. chemical to electrical

8. A cat walks in a straight line. You make measurements of this cat's motion and obtain the graph shown below of the cat's velocity as a function of time. What can you say about the cat's motion? Select **<u>all</u>** that apply.

a) The cat stops moving at 6 s.
b) The cat turns around at 6 s
c) Velocity and acceleration are zero at t = 6 s.
d) The cat speeds up from 6 to 7 s.
e) The cat slows down from 6 to 7 s



9. A skydiver jumps out of a plane at an altitude of 2000 m and begins her descent. At 1500 m, the skydiver reaches her terminal speed of 55 m/s. When the skydiver descends to a height of 500 m from the ground, she deploys her parachute which rapidly slows her down to 5 m/s to ensure a safe landing. Qualitatively, sketch the (vertical) speed of the skydiver as a function of height above ground starting just after she jumps out of the plane and finishing just before she lands.



10. You have been playing around with a scale that will tell you your weight in newton. When you put the scale on the floor and step on it reads 600 N. You decide to try it out in an elevator, and see that at one particular moment the scale reads 570 N.

At that moment your acceleration is:

1. up
2. down
3. zero
4. there is not enough information given to determine this

The magnitude of the acceleration is roughly:

1. 0.5 m/s^2
2. 1.0 m/s^2
3. 1.5 m/s^2
4. More than 2.0 m/s^2
5. there is not enough information given to determine this

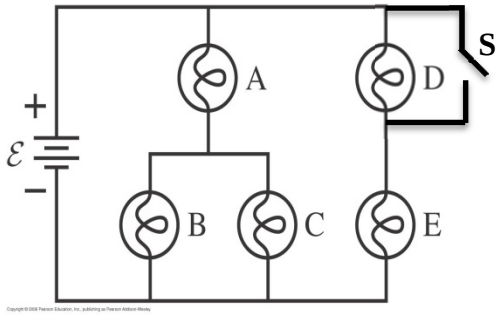
11. A psychiatrist observed a 1 μA current in patient's brain. Unlike current in metals which is carried by free electrons, the current in the brain is mainly carried by potassium ions. Each potassium ion has one unit charge e. How many potassium ions are flowing across the patient's brain per second?

A. 600 000
B. 6 000 000
C. 600 000 000
D. $6 \cdot 10^{12}$
E. $6 \cdot 10^{18}$

12. Rank the brightness of the identical light bulbs (use >, <, =) in the circuit with the switch s open and closed

Switch open:

Switch closed:



13 a. Two resistors are in a series connection. $R_1 = 5.0\ \Omega$ and $R_2 = 10\ \Omega$. The voltage drop across R_1 is 5.0V. The total power dissipated by the two resistors should be

a) 5W;
b) 10W;
c) 7.5W;
d) 15W;
e) 12.5W;

13 b. Two resistors are connected in parallel to a battery. $R_1 = 5.0\ \Omega$ and $R_2 = 10\ \Omega$. The current through R_1 is 2.0A. The total current drawn from the battery should be

1. 1A;
2. 2A;
3. 3A;
4. 4A;
5. 6A.

Note: To get full marks, clearly state all assumptions and show all your work

14. An ambulance needs to be delivered to a remote town devastated by a major earthquake. All roads leading into the town are blocked due to the earthquake and the ambulance can only be rushed to the area by airlift. The ambulance will be pushed out of a military cargo jet at 3000 m altitude and rescue staff needs to find out what kind of parachute is needed for this mission.

How big should the parachute be so that the ambulance can land softly/safely?

15. A rescue helicopter equipped with an infrared camera (like the one demonstrated in class) is out late one summer night looking for a tourist lost in the BC wilderness. The infrared camera operates in the wavelength range 7 to 14 μm. The crew realizes that the most likely source of infrared radiation they are going to see is the person's head, which is not covered by clothes. You already figured out that 40% of radiation emitted by a human body is in the wavelength range 7 to 14 μm. The camera needs about 5 $\mu W/m^2$ of radiation to show a faint image of the person's head. Estimate the maximum distance that allows them to detect this person using this camera.

16.Your basement suite is really drafty, so you spend your birthday money on the biggest space heater you can afford. It is rated at a hefty 1200W, and you hope it can help to warm your apartment

After you get it home you start to wonder whether the wiring in your house can handle the load of this heater. You determine that each room in your house has a fuse rated at 15 A and the voltage in the wall plugs is 120 V. You also note that the temperature inside your home is 20 degrees Celsius and outside 8 degrees Celsius.

Will your fuse break when you turn on this heater? (Be sure to justify your answer with a calculation and/or explanation)

17. Your family has a small wooden cabin in Northern B.C. The cabin is shaped like a box and its dimensions are 3.5 m x 2.5 m x 2.0 m (length, width, height, respectively). The walls and the ceiling are 15 cm thick and one of the walls has a small single-pane window that is 60 cm x 40 cm in size. You and two friends want to stay in the cabin in late fall when the outside temperature is typically 5^0C. You have to decide whether a small 500 W space heater will be enough to keep you comfortable or whether you have to buy a bigger one. Be sure to explicitly show your model and assumptions.

18. Your little brother sitting on a sled is asking you to push him and go as fast as you can. You manage to reach a maximum speed of 12 km/h on level ground. The total mass of your brother and the sled is 27 kg and the coefficient of kinetic friction between the sled and the snow is $\mu = 0.08$. Assume that you push horizontally.

a) Draw a free body diagram of the sled with your brother, when it is accelerating.
b) What is the minimum pushing force, which you have to apply horizontally to maintain a constant speed of 12 km/h?
c) How far will your brother slide after you let go of him at 12 km/h?

19. After spending the holidays with your family you have put on a bit of weight. You decide to go running and do a 6.0 km long run on flat terrain. You are wondering whether you should run the distance at a fast or a moderate pace to burn more calories. You go online and read that a 59 kg person burns 590 kcal running at 9.7 km/h for an hour and 797 kcal running at 12.9 km/h for an hour. So should you at a run the 6.0 km at a fast (12.9 km/h) or a moderate pace (9.7 km/h) to burn more calories? Explain your reasoning and show all your work.

20. You know that a traditional incandescent light bulb only emits roughly 5% of its power as visible light; the rest is emitted as thermal radiation. How hot does the glass surface of a 60 W light bulb get in thermal equilibrium? (Neglect heat conduction and convection. Your answer will be an upper limit.)

21. People believe that using an air conditioning system in your car saves fuel compared to opening the windows. Is this generally true? The reason cited is that opening the windows increases air drag. Studies have shown that windows rolled down all the way increase the drag coefficient of a mid-size car by 20%. On the other hand, the power for the 400 W air conditioning system comes from the engine so using it increases fuel consumption. What is your recommendation?
To make a statement, calculate the power needed for city driving (45 km/h) and for highway driving (90 km/h), both with the windows rolled down or when using the air conditioning system. Data for Toyota Corolla: m = 1200 kg, drag coefficient (with windows closed) of $C_D = 0.33$, cross sectional area A = 1.92 m^2. The rolling friction of a car tire on asphalt or concrete is $\mu_r = 0.015$.

22. In the circuit below, the current through B is 1.50A and the current through C is 0.50A when A has a resistance of 9 Ω. If you replace A with a 27 Ω resistor, the current through B reduces to 0.75A and C to 0.25A.

a) What is the voltage of the battery?

b) What is the resistance of B and C?