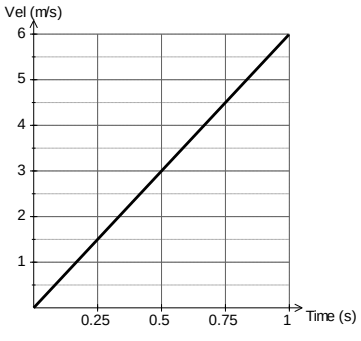
SPH3UI : Exam Review Practice Questions

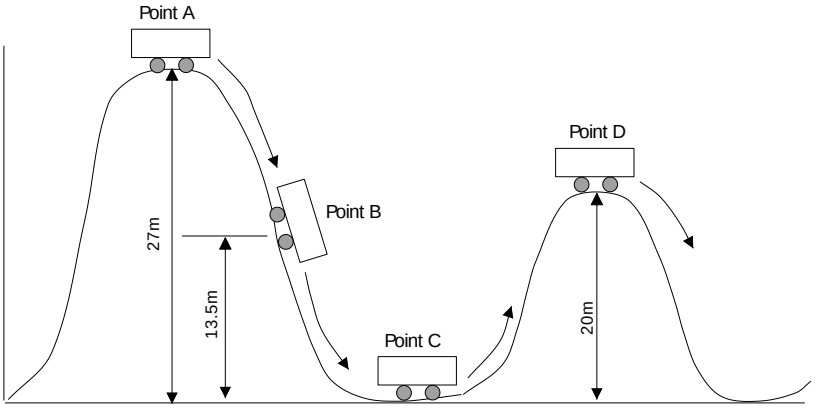
1. A sprinter in a 100 m dash has a velocity-time profile for the first second of the race as shown to the right:



   Determine the sprinters position-time graph (at t=0, .25, .5, .75 and 1.0 secs) and average acceleration

2. A Rocket is travelling at 100 m/s when it fires it's engines generating an average acceleration of 2.0 m/s^2 . While accelerating the rocket travels 20 km.
   a. How long does it take for the rocket to travel this 20km?
   b. How fast is the rocket going at the end of this acceleration period?
3. The tortoise and hare are having a 300m race. The hare gives the tortoise a 225m headstart and the tortoise travels at a constant velocity of 0.5 m/s.

   Assuming the hare accelerates uniformly from rest at 0.2m/s^2, does the hare pass the tortoise before the finish line and if so where?
4. You are attempting to push your car (that has run out of gas) on a flat stretch of road. The coefficient of static friction is 0.80 and coefficient of kinetic friction is 0.60. If the car has a mass of 1500 kg,
   a. what is the minimum force you must apply to start the car moving?
   b. what is the amount of force that you must push with to keep it moving?
5. Jupiter is the largest planet in the Solar System with a mass of 1.899×10^{27}kg and a radius of 7.149×10^{7}m. What would be the force of gravity on a 1 kg object on the surface of Jupiter? Compare this to the force on the same object on the surface of the earth.
6. The average mass of the coaster car is 1,000kg (including passengers). Assuming zero kinetic energy at the top of the ride (i.e. not moving) calculate the following:
   a. If it took 20 seconds to pull the coaster to the top what Power was needed by the motor to lift the coaster?
   b. What would the speed of the coaster be at point D?

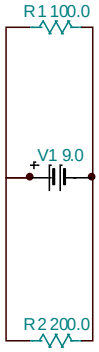


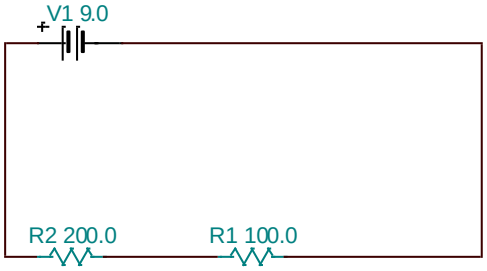
7. Draw a heating diagram and calculate the energy required to melt 2.0kg of ice initially at -30°C and warm it up to 85°C.

   The following specifications may help in solving this problem.

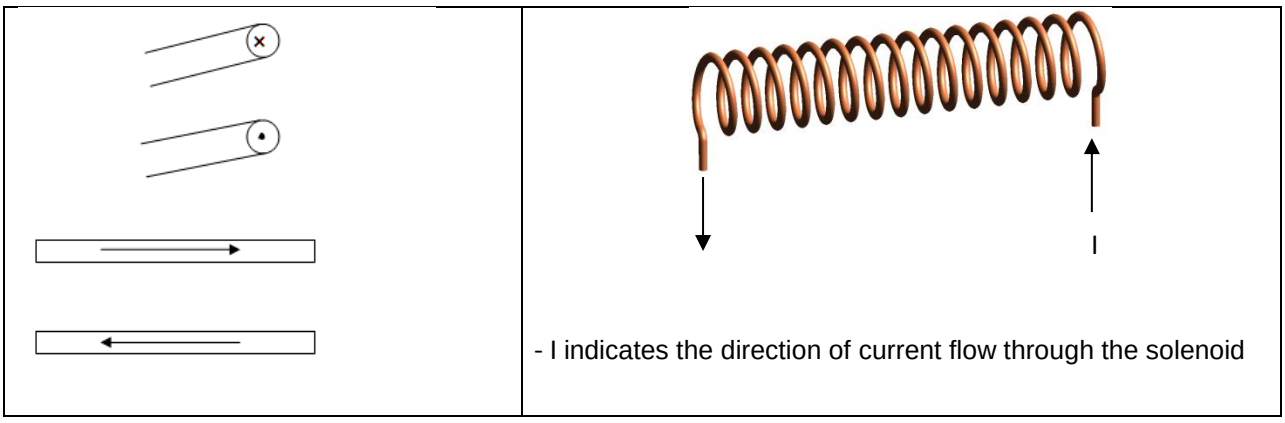
c - specific heat content (J/kg °C) (ice)	2,100
L_f - Latent heat of fusion (J/kg)	3.34×10^5
c - specific heat content (J/kg °C) (water)	4,180
Lv – Latent heat of vaporization (J/kg)	2.26×10^6
c - specific heat content (J/kg °C) (steam)	2,100

8. A monarch butterfly beats her wings at a frequency of 9Hz. If the amplitude of the wings motion is 1.5cm, calculate how far the wings move in one minute.
9. A closed ended air column is 120 cm long.
   a. What are the wavelengths of the first 3 resonant waves?
   b. If the air temperature is 20°C, what is the frequency of these three waves?
10. Characterize the following circuits (find all the missing voltages, currents and overall power used and show the direction of the current(s))





11. Electromagnetism:
   a. State the three main components of an electric motor.
   b. What is the key difference between an electric generator and an electric motor?
   c. Show the direction of the magnetic field for the following current carrying conductors.



Answers:

1. t=0s, Δd=0.0m
   t=0.25s, Δd=0.1875m
   t=0.5s, Δd=0.75m
   t=0.75s, Δd=1.6875m
   t=1.0s, Δd=3.0m
   a=6.0m/s^2

2a. t=100s, b. v_2=300m/s

3. the hare wins the race, passes the tortoise at the 250m mark

4a. $F_{fs}=1.2x10^4$N b. $F_{fk}=0.88x10^4$N

5. F_g=25N, 2.5x's bigger than on earth

6a. P=13.2 kW (13,200 Watts), b. v=11.7m/s

7. Q_{tot}=1.5MJ

8. 32.4m

9. λ_1=4.8m, λ_2=1.6m, λ_3=0.96m, f_1=71.6Hz, f_2=215Hz, f_3=358Hz,

10. parallel, I_1=0.09A, I_2=0.045A, I_{tot}=0.135A, $V_1=V_2$=9.0V, P=1.215W
    series, $I_1=I_2=I_{tot}$=0.03A, V_1=3.0V, V_2=6.0V, V_{tot}=9.0V, P=0.27W

11a. permanent magnet, battery (source of charge), coil of wire

11b. motor – uses electricity and magnetism to create motion
     generator – uses motion and magnetism to create electricity

11c.