D group physics task:

Edited at 10am 10 April 2017.

Forces types:

1. Give 4 known types of physical forces.

Limits of classical mechanics:

2. Give the limits of application of classical mechanics.

Mechanics:

Inertia:

3. Explain inertia.

4. What happens to the velocity of a body if there are no forces applied to it?

Torque:

5. Is the wheal with the smaller or larger radius easier to roll? Why?

Speed vs. velocity:

6. Does a car speedometer measure speed, velocity or both?

7. Explain the gravity law of Newton.

8. Find the orbital velocity and the escape velocity.

9. Explain the free-body diagram.

Friction:

10. What is static friction, sliding kinetic friction and rolling resistance?

https://en.wikipedia.org/wiki/Friction

https://en.wikipedia.org/wiki/Rolling\_resistance

11. Why does sling friction resist motion and why does rolling resistance help motion?

12. Explain the Laws of Kepler.

13. Define and explain conservative forces and conservation of energy.

14. Give examples of those forces, which are conservative and not conservative.

15. I start running from rest; the friction coefficient is 0.3, what is the maximum velocity and what is the distance after 1 second?

16. Show that $g=\frac{GM\_{E}}{R\_{E}^{2}}$, take g=10ms-2, G =6×10-11m3kg-1s-2, ME =6×1024kg, RE = 6×106m.

17. Give the expressions for work, energy and power. Explain.

18. Find the center of mass of these masses with these coordinates: 7kg(3m), 2kg(4m), 6kg(1m). Prove the center of gravity equation.

19. Explain weighted average. How would you use weighted average in decision support?

20. Find the similarities between the equations of collisions, mass center and thermal balance.

21. Can you pull yourself out of the mud, why? Can internal forces move the center of mass of a mechanical system and why?

22. Give the similarities and the differences between translation and rotation.

23. Solve the blocks stacking problem.

24. Draw the diagram displacement vs. pressure (with elasticity, plasticity, fracture, etc. sections)

Fluids:

Bernoulli Law:

25. Prove the equation for the pressure in the fluid at the depth *h*. Explain the Archimedes’ Law. Give the Bernoulli’s Law, explain the viscosity and the Magnus’ Effect.

26. Write essay about Bernoulli Principle and Magnus Effect.

27. What in the main rule of mechanics (related to the lever’s length)?

28. What is friction? Write expressions for friction forces.

29. Write the equations of Hook’s Law and oscillations.

30. Two eggs collide. Everything is the same for both eggs, except, one egg moves and the other is at rest. Which egg is more likely to be smashed?

31. Calculate change of weight of the same mass on the equator, compared to the pole.

32. Find the altitude and velocity at the geostationary orbit.

33. Is it better to launch satellites to the East or to the West? Why?

34. If a body is rotated and the thread fails, how would the body move?

35. Give and explain the main theorems of the classical solid mechanics of rigid bodies (theorem of linear momentum change, theorem of angular momentum change, theorem of kinetic energy change).

36. Why is perpetual motion impossible?

37. Explain the wave equation.

38. Define a vector.

39. Express the cross product through the determinant.

40. Explain triple product of vectors.

https://en.wikipedia.org/wiki/Triple\_product

41. Write the equations of the free massive thread and uniformly loaded massless thread.

42. Draw the typical curve of displacement versus force in elasticity, plasticity and fracture.

43. Give and explain the Archimedes Law.

44. Write the equation of the Bernoulli’s Law. Explain.

45. Define viscosity.

46. Explain the Magnus effect.

Waves:

47. Explain waves, diffraction, refraction, reflection, interference, longitudinal waves, transversal waves.

Compare mechanical waves, sound waves and electromagnetic waves.

https://en.wikipedia.org/wiki/Wave

Thermodynamics:

48. Which clothes are warmer, black or white? Why?

49. Define temperature, thermal capacity, pressure, thermodynamics, irreversibility, entropy, enthalpy, internal energy, ideal gas, real gas, Brownian motion and random walk.

50. Explain uniform and normal distributions.

51. Explain the thermodynamics of computing.

52. There are two bodies in a thermodynamically isolated system: C1 m1 T1 and C2 m2 T2. Find the resulting temperature T.

53. The thermal expansion rate α is 0.001. The temperature change is 10 degrees.

Find the extension of a 1 meter rod due to the temperature change.

Prove that ∆V ≈ ∆T3αV if ∆L ≈ ∆TαL and α << 1.

54. Write and explain the Ideal Gas Equation. Link temperature, pressure and internal energy with kinetic energy of particles.

55. Calculate E = 1.5KT, P from PV = nRT; N from PV = NKT for n = 2; T = 34; P = 99; V = 56.

56. Assess the efficiency of the heat engines, heat pumps, fridges and air conditioners.

57. Explain latent heat and laws of thermodynamics.

58. Solve the heat equation.

59. The density of copper is 9 × 103 kg/m3, and each copper atom has mass of 64u.

Estimate the average distance between the neighboring copper atoms. NA= 6.02214129(27)×1023 mol−1.

Benford Law:

60. Explain Benford Law.

https://en.wikipedia.org/wiki/Benford%27s\_law

Deadline: 15.4.2017 Saturday.