Examples: Possible Exam questions 1033C

1. An object of height 10 cm is placed 40 cm from a concave mirror whose focal point is 15 cm in front of the mirror. Calculate the position of the image in the mirror and calculate its height. Draw a sketch showing the light paths connecting object and image. Is the image upright or inverted? Is the image real or virtual?

2. A pinhole camera (camera "obscura") is made using a box that is 6in on each side and 6 in in height. How far from an object (6 feet in height) must the box be placed so that the height of the image is 3 in at the back of the camera facing the pin hole? Draw a sketch showing the light paths connecting the object and the image.

3. A 10 liter volume of helium gas is contained in a flexible container. The initial pressure is 100 bar and the initial temperature is 27 celsius. The volume is expanded to 20 liters and the pressure raised to 150 bar. What is the final temperature?

4. A ray of light (initially in air) is incident on a slab of crown glass whose index of refraction is 1.60. If the angle of incidence is 30 degrees what is the angle of refraction that the ray in the glass makes with a perpendicular to the glass interface. Draw a ray diagram to show the path of the ray in air and in the glass.

5. Write down Planck's postulate for the energy of a photon in terms of the frequency. If a piece of red hot metal emits red light with a wavelength of 1 micron (10-6 m) calculate the frequency of the red radiation. What is the energy of a single photon? (Planck's constant $h=6.6 \times 10^{-34}$ J s). If the piece of metal contains 10^{24} atoms and each atom emits 1 photon per second, what is the power emitted by the red hot metal?

6. With respect to a stationary observer do moving clocks appear to tick faster or slower than the observer's clock? A ruler is moving at a speed v = (4/5)c with respect to an observer where c is the velocity of light. What is the apparent change in the length of the ruler as seen by the observer.

7. A straight wire carrying a current is placed between the poles of a permanent magnet such that the direction of the current is perpendicular to the magnetic field. Explain the right hand rule for the direction of the force on the wire. Draw a diagram to show the directions of the current, magnetic field and the force on the wire.

8. On the Earth where the acceleration due to gravity g=10 m/s_2, a small pebble dropped from a height (unknown) reaches the ground in 4 seconds. The same pebble is transported to planet Vulcan where g= 2.5 m/s_2. How long does it take the pebble to hit the ground on Vulcan?

9. Two rockets ships are on a collision course. Each ship has a mass of 1000 tons and is moving at 100 m/s. When they collide the two ships fuse at the point of collision. State the final speed of the fused ships, and write down the law that you used.

10. The force between two electrically charged cylinders is 2 newtons when they are 1 meter apart. What is the force when they are 50 centimeters apart?

11. Helium gas is stored in a strong steel cylinder. If the pressure at 300 K is 200 bar, what is the pressure if it is heated to 450K?

12. Jack throws a small stone up in the air vertically with a speed of 20 m/s. How high does the stone go if the acceleration due to gravity is 10 m/s? How fast is the stone moving when Jack catches it at the original position?

13. Jane who has a mass of 150 kg sits in a canoe that has a mass if 75 kg. Jane jumps out of the canoe with velocity of 2m/s. What is the recoil velocity of the canoe?

14. A rocket ship of mass 100,000 kg is traveling at 50m/s. It burns 2000 kg of fuel that is converted to hot gas and ejected at 1000 m/s. What is the velocity of the rocket after the burn?

15. A car driving at 10 m/s passes a stationary police vehicle. At the moment of passing the police vehicle, the car accelerates at 1m/s2. When does the police car catch up with the car?

Essay type questions

1. Write an overview of how a telescope works. What is the difference between a Galilean telescope and a Keplerian telescope?

2. Write an essay on the contributions of Michael Faraday to our knowledge of electricity and magnetism.

3. Review the important contributions that Max Planck made to quantum theory.

4. Discuss the three features of the photoelectric effect that support the photon model of light.

5. Write an essay of the contributions of Einstein to modern physics.

6. Explain the concept of Absolute Zero in temperature.

7. The importance of symmetries in Physics.

8. The contributions of Isaac Newton to Physics (or mathematics).

9. The importance of friction in everyday life.

10. Explain in words how Eratosthenes measured the diameter of the Earth. (one page maximum).

11. Is the concept of relativity important for an accurate GPS? Explain in some detail.

12. Discuss how a pendulum could measure the local acceleration due to gravity and why would that be useful?

13. Discuss the major contribution of Augustin de Coulomb to understanding electricity.

14. Describe how thunderclouds become electrically charged.

15. Describe the contributions of Newton to classical physics.

16. Discuss the importance of the scientific observationsof Robert Boyle.