1.4

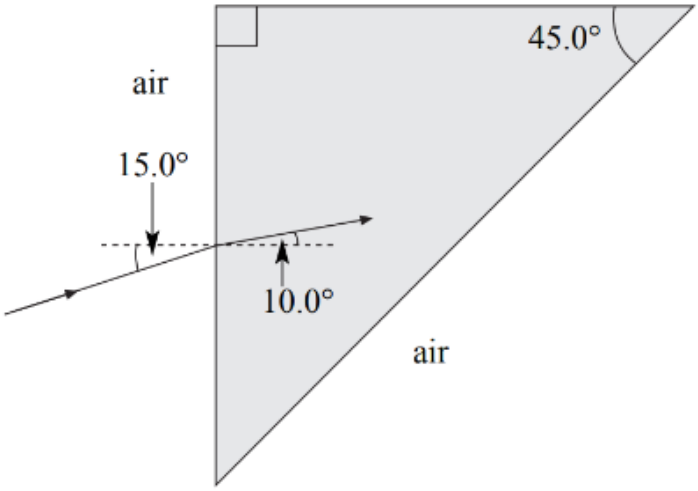
Q4. Two points on a progressive microwave have a phase difference of $\frac{\pi}{5}$ radians. The minimum distance between these two points is 2 cm. Calculate the frequency of the wave.

4.1

Q4. Calculate the angle to the second order bright spot if monochromatic light of frequency 5.08×10^{14} Hz is directed normally as a diffraction grating of 600 lines per mm.

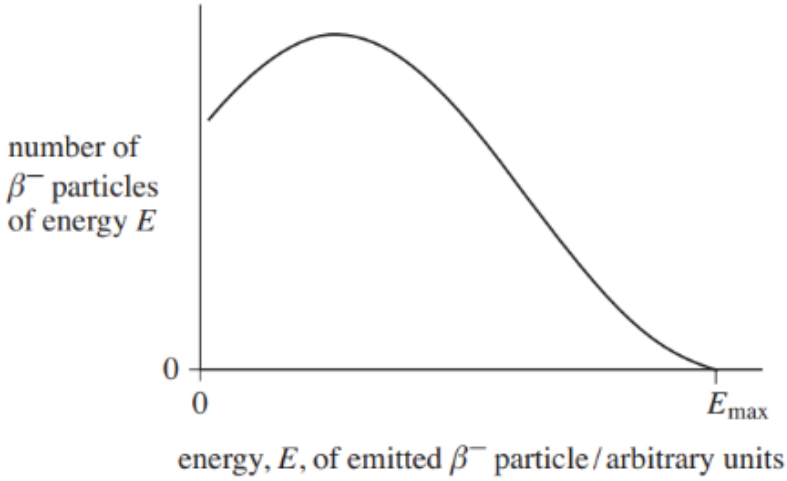
5.2

Q3. Explain if the ray of light will undergo total internal reflection or not at the glass-air boundary.



6.2

Q4. When a sample of potassium-40 decays, the emitted β^- particles have a range of energies from almost zero to a maximum value, E_{max}. The spectrum of energies observed is shown in diagram below.



Explain how this evidence led Pauli to predict the existence of a previously unidentified particle.

6.4

Q1. A common type of smoke detector contains a very small amount of americium-241,
The alpha radiation produced by americium-241 causes the ionisation of nitrogen and oxygen molecules in the smoke detector.
State what is meant by ionisation.

6.5

Q3. Describe how the strong nuclear force between nucleons varies with separation of the nucleons, quoting suitable values for separation.

10.2

Q4. The following equation represents electron capture.

$$p + e \rightarrow n + \nu_e$$

Energy and momentum are conserved in this process.
State **two** other quantities that need to be conserved and show that they are conserved in the process.

10.4

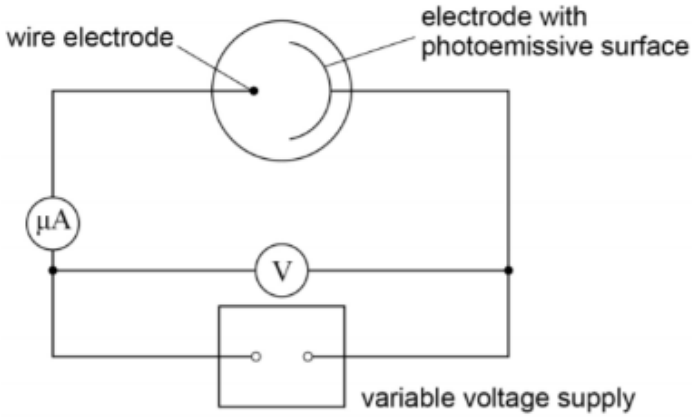
Q4. A positive pion and a neutron can interact through the strong interaction to produce a neutral kaon and particle X.

$$\pi^+ + n \rightarrow K^0 + X$$

Deduce the quark composition of particle X.

11.1

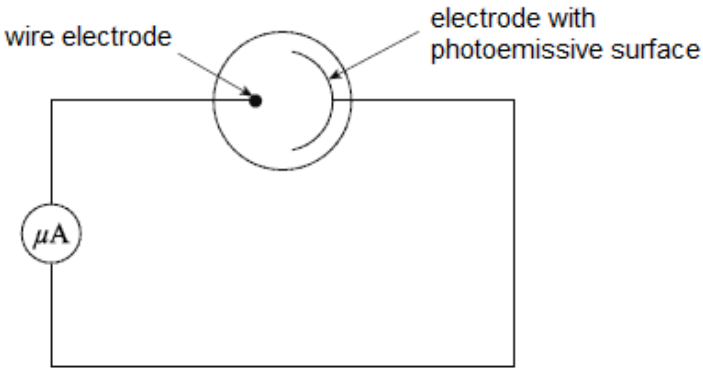
Q3. A current is measured on the microammeter when electromagnetic radiation is incident on the photoemissive surface.
The radiation is monochromatic and has a constant intensity.
The variable voltage supply is changed until the current is zero and the stopping potential is recorded.



The investigation is repeated with electromagnetic radiation of a different radiation.
Explain the effect that the frequency of the incident radiation has on the stopping potential.

11.4

Q2. Photons of wavelength 290 nm are incident on a metal photoemissive surface. The work function of the metal is 4.1 eV.



State what is meant by work function.

11.5

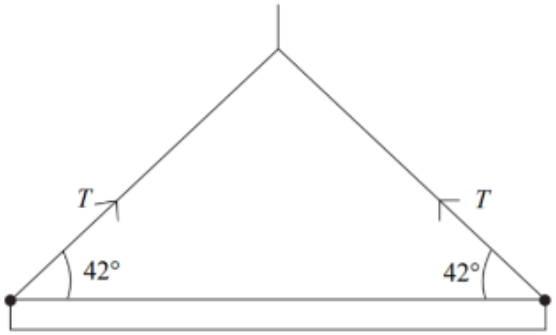
Q1. Photoelectrons of maximum kinetic energy 1.43×10^{-19} J are emitted from a metal surface when UV light was incident.
Calculate the stopping potential of the metal surface.

13.4

Q3. Electrons moving in a beam have the same de Broglie wavelength as protons in a separate beam moving at 2.8×10^4 m s^{-1}.
Calculate the speed of the electrons.

14.4

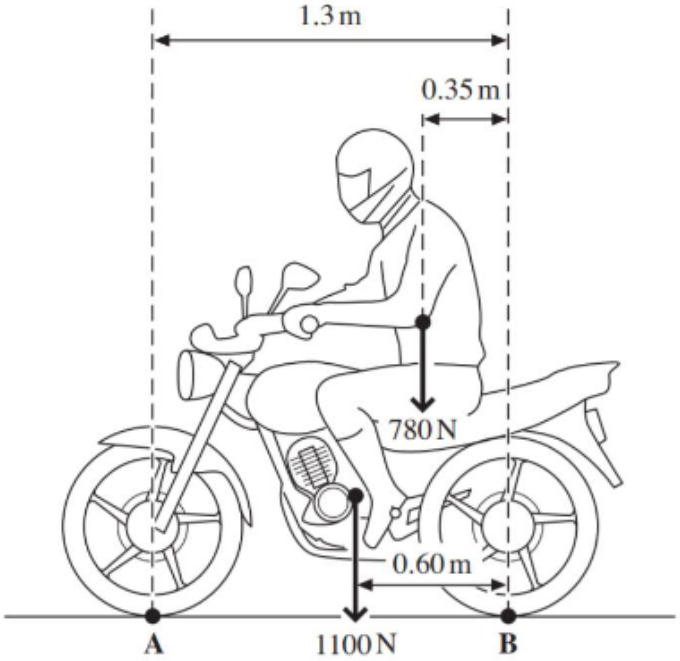
Q3. The diagram shows a uniform steel girder being held horizontally by a crane. Two cables are attached to the ends of the girder and the tension in each of these cables is T.



The tension, T, in each cable is 850 N.
Calculate the weight of the steel girder.

15.2

Q4. The figure below shows a motorcycle and rider. The motorcycle is in contact with the road at A and B. The motorcycle has a weight of 1100 N and the rider's weight is 780 N.



Calculate contact forces **A** and **B**.

15.4

Q2. Define the moment of a couple.