Understanding Assessment and Improving Delivery

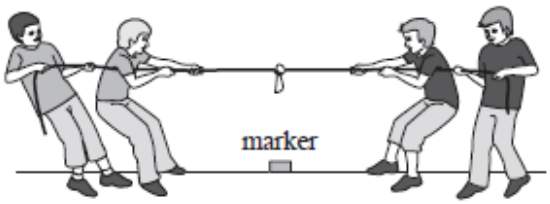
in IAL Physics

Linkage questions

UNIT 1

Question 1

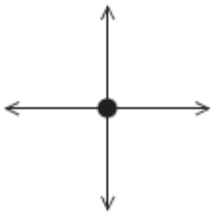
10 In a game of tug-of-war two teams of children pull on opposite ends of a rope. The team that pulls the other team over a marker wins the game.



(a) Initially Team A and Team B are stationary.

Add labels to the free-body force diagram for the child at the end of the rope for Team A at this instant.

(3)



*(b) Team B wins by pulling Team A over the marker.

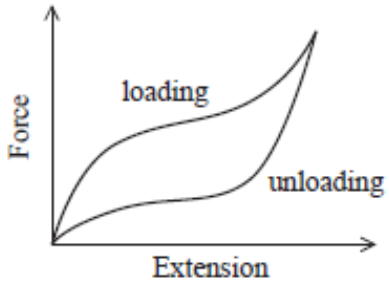
By considering the forces on the children and on the rope explain, in terms of Newton's laws, the process by which Team A loses the game.

(6)

Question 2

A resistance band is a length of an elastic material that can be used for exercise. The user repeatedly applies an increasing tensile force (loading) and then releases the force (unloading).

The force-extension graph for the resistance band is shown.



The user finds that the band gets warm during use.

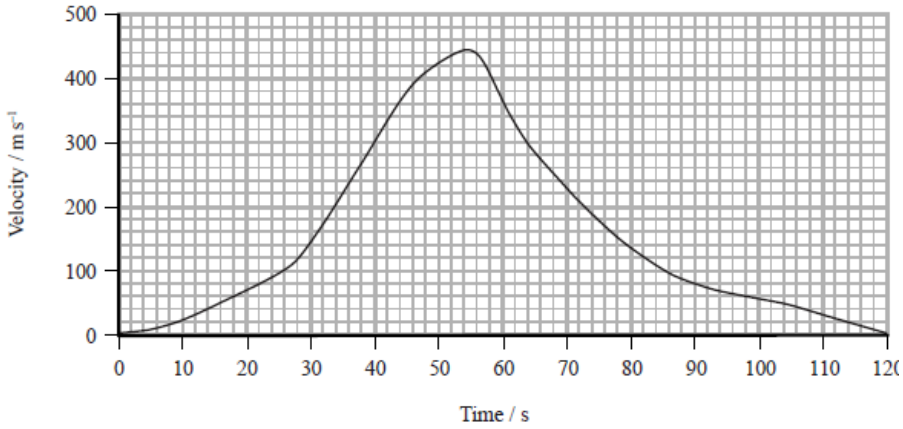
Describe, with reference to the graph, the behaviour of the resistance band when it is repeatedly loaded and unloaded.

(6)

Question 3

14 The world land speed record of 341 m s^{-1} was set in October 1997. In an attempt to break this record, a new supersonic car has been developed called the Bloodhound.

The developers of the Bloodhound have used computer modelling to produce a velocity-time graph for the predicted motion of the car, on a straight track, during the record attempt.



(a) A track of length 23 km is available for the record attempt.

Determine whether this track is long enough.

(3)

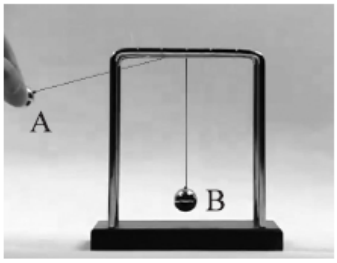
*(c) Discuss, with reference to the graph, the factors that would have been used to predict the motion of the car over the 120 s.

(6)

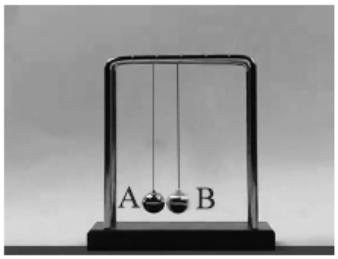
Question 4

Two small identical solid metal spheres, A and B, are suspended by light inextensible threads from a frame.

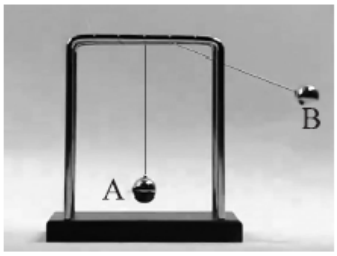
*(a) Sphere A is pulled to one side as shown and released. Sphere A collides with sphere B and stops and sphere B swings upwards. The time intervals between the photographs below are the same.



Photograph 1



Photograph 2



Photograph 3

Using Newton's laws of motion, explain the motion of the spheres during the collision in terms of the forces acting on them.

(6)

UNIT 2

Question 5

13 An electron beam is directed onto crystalline graphite. A fluorescent screen on the other side of the crystal shows the pattern in Figure 1. The brighter areas correspond to higher electron intensity.

The speed of the electrons is increased and the resulting pattern is shown in Figure 2.

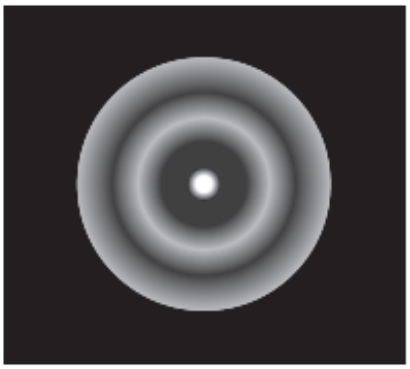


Figure 1

Figure 2

*(a) Discuss the conclusions that can be drawn from this information about the behaviour of electrons and the structure of graphite.

(6)

Question 6

15 The behaviour of electromagnetic radiation can be described in terms of a photon model or a wave model.

In the photoelectric effect, electromagnetic radiation is incident on a metal plate and under certain conditions electrons are emitted.

It is observed that, for a given metal,

- no electrons are emitted if the frequency of the incident radiation is below a certain threshold frequency.
- electrons are emitted instantaneously if the frequency of the incident radiation is above a certain threshold frequency.
- the kinetic energy of the emitted electrons depends only on the frequency of the incident radiation.

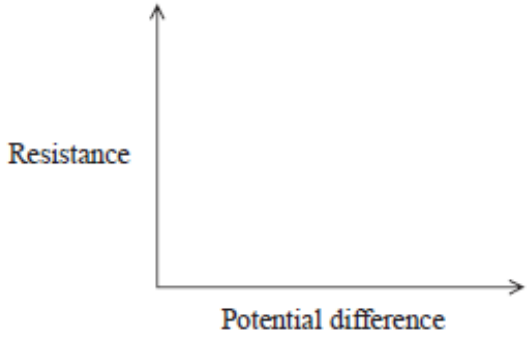
Discuss how the photon model of electromagnetic radiation can explain these observations and why the wave model of electromagnetic radiation cannot.

(6)

Question 7

(b) Sketch a graph of resistance against potential difference for the filament bulb over the range 0 V to 7 V.

(3)



*(c) Explain the variation of resistance with potential difference for the filament bulb in terms of particle behaviour.

(6)

Question 8

11 The photograph shows a guitar. The strings of the guitar are at the same tension.

When a string is plucked, a standing wave is set up on the string.

*(a) Explain how a standing wave is set up on a string.

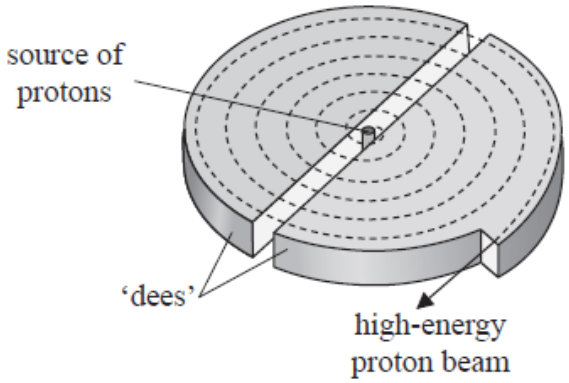
(6)

UNIT 4

Question 9

9 Proton beam therapy is being introduced in the UK as a new cancer treatment.

A beam of protons is accelerated by a cyclotron to an energy of 23 MeV and is then focused onto a tumour.



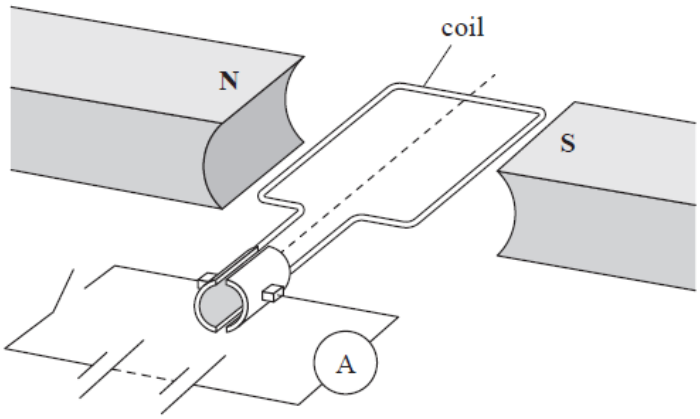
*(a) Explain how the cyclotron produces the high-energy proton beam.

(6)

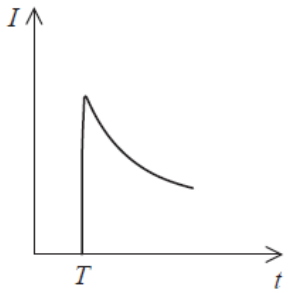
Question 10

A simple electric motor consists of a coil that is free to rotate in a magnetic field.

A student connects the motor to an ammeter and a battery.



The graph shows how the current I in the coil varies with time t. The switch is closed at time T.



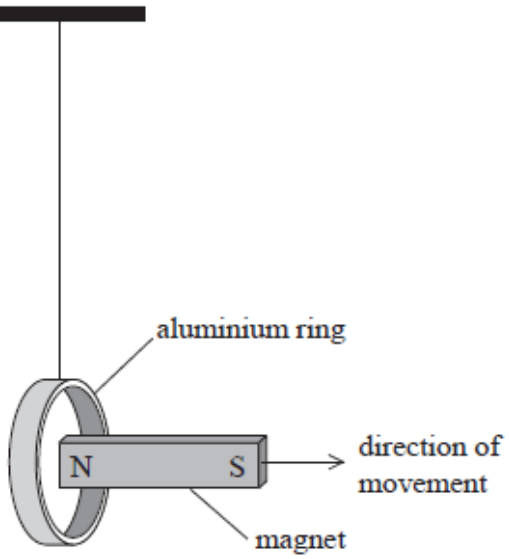
Explain why the current rises to a maximum then decreases.
Your answer should include a reference to Faraday and Lenz's laws.

(6)

Question 11

*(c) A linear induction motor provides the force to accelerate the train forwards. A current flows in sequence through coils of wire mounted in the track. The train is dragged along as the magnetic field progresses along the coils of wire in the track. This is similar to moving a permanent magnetic field away from a conductor.

A teacher demonstrates this effect by quickly removing one end of a bar magnet from a suspended aluminum ring.



When the magnet is removed from the ring, the ring moves in the same direction as the magnet.

Explain, using the laws of electromagnetic induction, why the ring moves in the direction of the magnet.

(6)

UNIT 5

Question 12

Our understanding of the atom has developed over time, from early models in which atoms were considered to be hard incompressible spheres, through to the nuclear model of the atom and the ladder model in which electrons exist in a discrete number of allowed energy states.

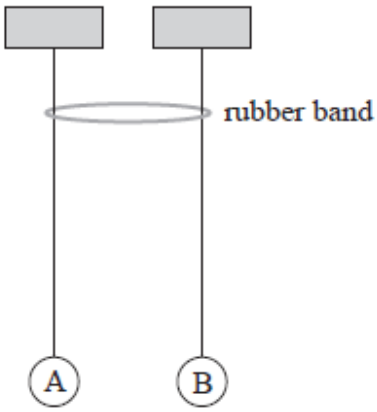
*(a) The model of atoms as hard incompressible spheres, moving rapidly and randomly, can be used to explain why gases exert a pressure.

Explain, using ideas of momentum, why the pressure exerted by a gas increases as the temperature of the gas increases.

(6)

Question 13

The diagram shows two identical pendulums, A and B, side by side with a rubber band placed over both strings.



Pendulum A is displaced and starts to oscillate. As pendulum A oscillates, pendulum B starts to oscillate with the same time period, its amplitude increasing as the amplitude of pendulum A decreases. At one stage pendulum A is no longer oscillating and pendulum B has its maximum amplitude. Then pendulum A starts to oscillate again with increasing amplitude, as the amplitude of pendulum B decreases.

The apparatus is adjusted so that the pendulums do not have the same length as each other. When the first pendulum is set into oscillation, the second pendulum starts to oscillate, but with very small amplitude; the first pendulum does not stop oscillating.

*(a) Explain this behaviour.

(6)

Question 14

The photograph shows a 'singing bowl'.

When the handles are rubbed with both hands the bowl 'sings', producing a loud note with a frequency of 720 Hz.

A vibration generator is attached to the bowl and connected to a signal generator. The signal generator is adjusted to produce frequencies from 600 Hz to 800 Hz.

At all frequencies in this range the bowl produces a sound at the applied frequency. The sound is quiet for all frequencies except 720 Hz, when it is much louder.

Explain these observations.

(6)