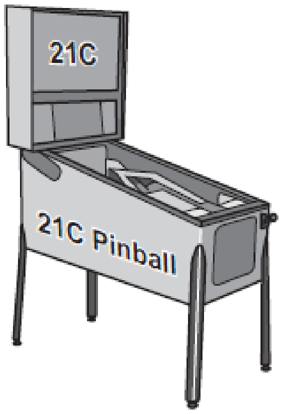
OCR
Oxford Cambridge and RSA

GCSE Physics B (Twenty First Century Science)

J259/03 Depth in physics (Higher Tier)

Question Set 39

1 Li is building a pinball machine.



In a pinball machine, a spring is used to push out a small metal ball at high speed.

Fig. 13.1 shows the mechanism that fires the ball.

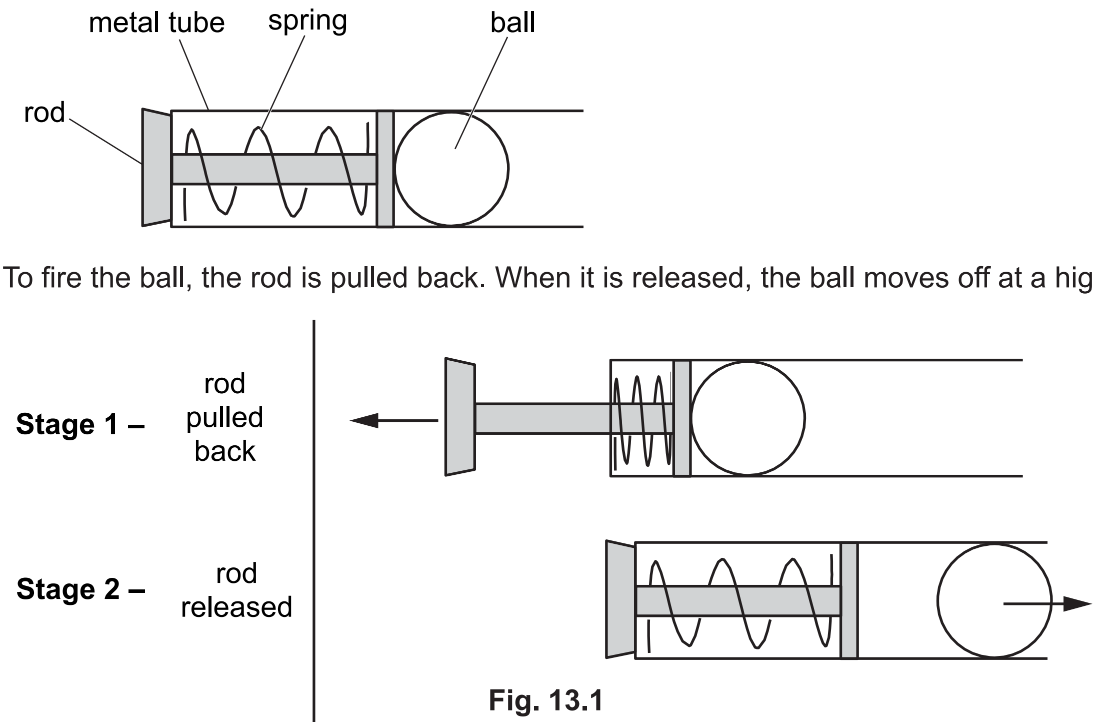
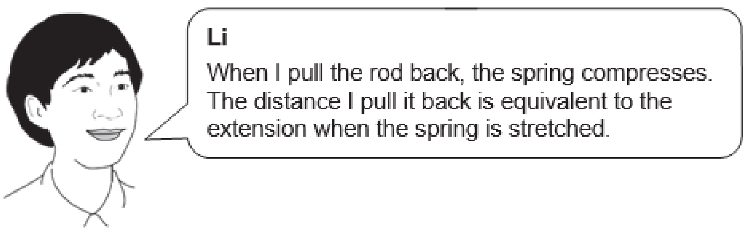


Fig. 13.1

(a) To test the mechanism, Li pulls the rod back by 5.0 cm.

The energy stored in the spring is 0.28 J



The energy stored in the spring is 0.28 J.

Calculate the spring constant of the spring.

Use the data sheet.

Spring constant = ...N/m

[4]

(b) In a second test, Li pulls the rod back a different distance.

The energy stored in the compressed spring now is 0.32 J.

The mass of the ball is 0.040 kg.

Calculate the speed of the ball as it loses contact with the spring.

Assume that all energy stored in the compressed spring is transferred into kinetic energy of the moving ball.

Speed = ...m/s **[3]**

(c) (i) Write down the equation linking distance moved, force and work done.

[1]

(ii) In a third and final test, the kinetic energy of the ball when it leaves the spring is 0.25 J.

The same ball is used as the second test, with mass of 0.040 kg.

The ball moves 0.80 m up the slope of the pinball machine until it stops. It rises a total vertical height of 0.50 m

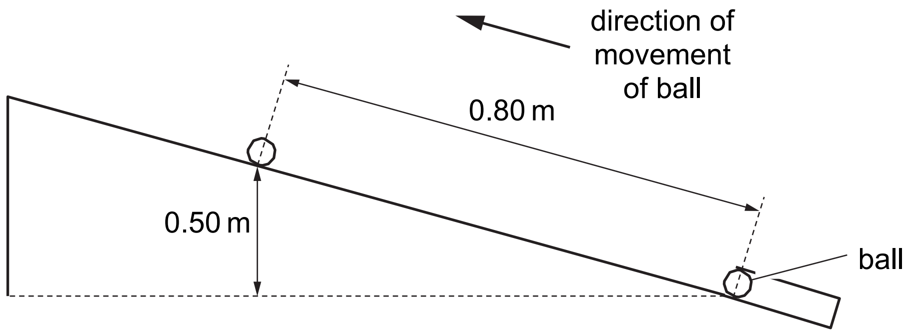
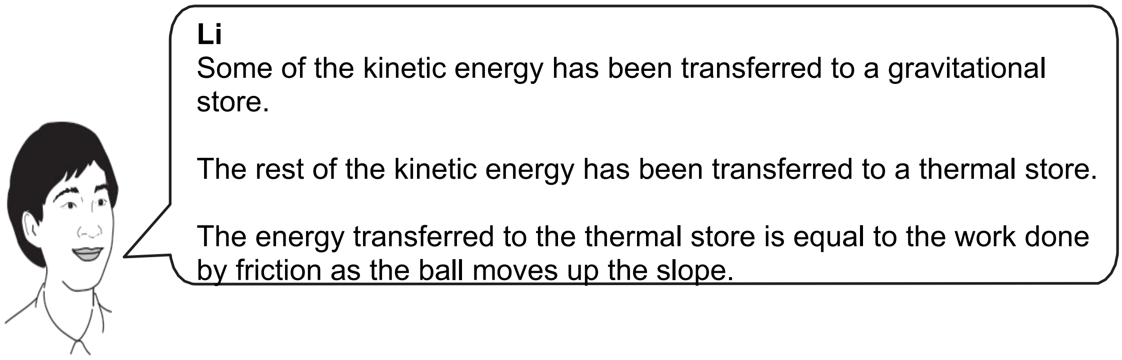


Fig. 13.2

Li explains the energy transfers as the ball moves up the slope in **Fig. 13.2**.



Calculate the average force of friction that acts on the ball as it moves up the slope.

Use Li's ideas about energy transfers.

Use your answer to **(c)(i)**.

Use the equation:
gravitational potential energy = mass × gravitational field strength × height.

Gravitational field strength = 10 N / kg.

Force of friction = ... N **[4]**

Total Marks for Question Set 39: 12

Resource Materials

Equations in Physics

change in internal energy = mass × specific heat capacity × change in

temperature energy to cause a change in state = mass × specific latent heat

for gases: pressure × volume = constant
(for a given mass of gas and at a constant temperature)

(final speed)^2 – (initial speed)^2 = 2 × acceleration × distance

energy stored in a stretched spring = ½ × spring constant × (extension)^2

potential difference across primary coil × current in primary coil =
potential difference across secondary coil × current in secondary coil

Higher tier only –

pressure due to a column of liquid = height of column × density of liquid ×

g force = magnetic flux density × current × length of conductor

potential difference across primary coil ÷ potential difference across secondary coil = number of turns in primary coil ÷ number of turns in secondary coil

change in momentum = resultant force × time for which it acts