

Name of the Student: _____

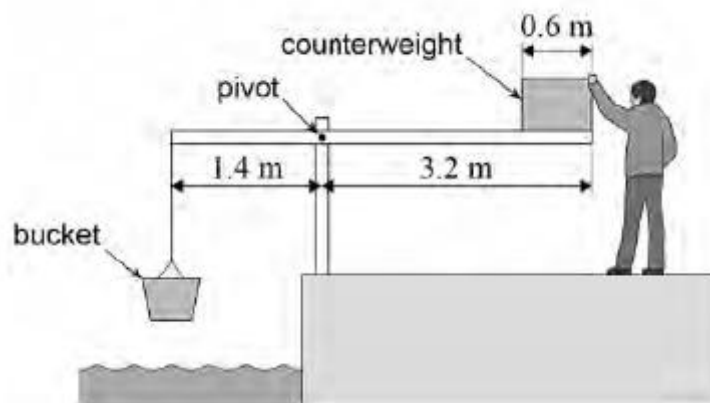
Max. Marks : 23 Marks

Time : 23 Minutes

Q1.

A shaduf is a device used to lift water from a well. It consists of an upright support to which a uniform beam is pivoted. It can be assumed that the weight of the beam is negligible. On one end of the beam is a counterweight, and on the other a bucket which can hold the water.

Figure 1 shows a diagram of a typical shaduf.

Figure 1

The counterweight is of uniform material and has a weight of 50 N. It is 0.60 m long.

- (a) Calculate the moment of the counterweight about the pivot when the beam is horizontal.

moment = _____ N m

(2)

- (b) The bucket has a weight of 120 N and has a capacity of 0.16 m^3 . When the bucket is half full, a force is required at the end of the beam to lift the bucket and water.

Calculate the value of this force when the beam is horizontal.

density of water = 1000 kg m^{-3}

additional force = _____ N

(5)

- (c) Explain how the force in part **(b)** would be different if the weight of the beam is **not** considered to be negligible.

(3)

(Total 10 marks)

Q2.

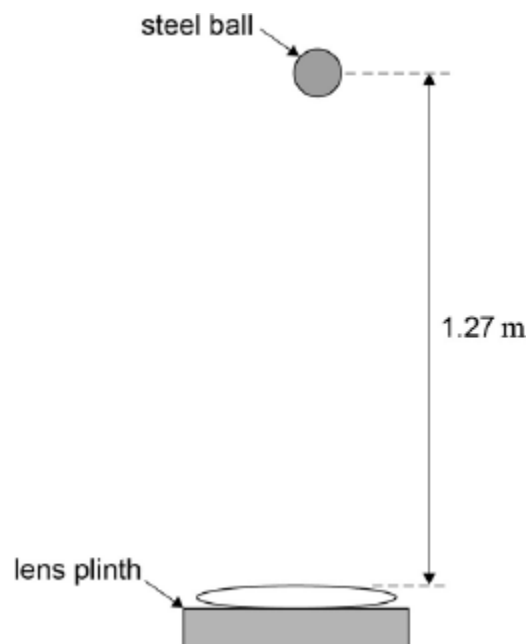
Spectacle lenses can be tested by dropping a small steel ball onto the lens, as shown in the figure below, and then checking the lens for damage.

A test requires the following specifications:

diameter of ball = 16 mm

mass of ball = 16 g

height of drop = 1.27 m



- (a) Calculate the density of the steel used for the ball.

density = _____ kg m⁻³ (3)

- (b) In a test the ball bounced back to a height of 0.85 m.

Calculate the speed of the ball just before impact.

speed = _____ m s⁻¹ (2)

- (c) Calculate the speed of the ball just after impact.

speed = m _____ m s⁻¹ (2)

- (d) Calculate the change in momentum of the ball due to the impact.

momentum = m _____ kg m s⁻¹ (2)

- (e) The time of contact was 40 ms. Calculate the average force of the ball on the lens during the impact.

average force = _____ N (2)

- (f) Explain, with reference to momentum, why the test should also specify the material of the plinth the lens sits on.
