

Q5 A stone is thrown from ground level and travels in a parabolic path above horizontal ground, experiencing only the downward force of gravity, until it lands on the ground again. The maximum height H reached by the stone is equal to its horizontal range R . At what angle to the horizontal was the stone launched? Select the option from the key that is closest to your answer, and pencil across *one* cell in row 5.

KEY for Q5

- A 45°
- B 51°
- C 57°
- D 60°
- E 67°
- F 76°
- G Impossible to answer without knowing the mass of the stone.
- H Impossible to answer without knowing the speed of launch.

Q6 In the ancient world, blocks of stone were hauled up sloping inclines using ropes and muscle-power. Suppose that a block weighing 2.1×10^3 kg is hauled up a 10° slope by a team of men pulling on ropes. No rollers are used so the block simply slides up the incline.

The coefficient of static friction between the block and the incline is 0.8. If each man is able to apply a force of magnitude 1 000 N, what is the minimum number of men needed to get the block sliding up the slope? Select one option from the key, and pencil across *one* cell in row 6.

KEY for Q6

- | | |
|---------------------------------------|-------|
| A 4 | E 27 |
| B 10 | F 37 |
| C 17 | G 210 |
| <input checked="" type="radio"/> D 20 | |

Q7 A distant planet, rather like the Solar System's Saturn, is surrounded by a series of rings. The rings are made up of particles of ice in uniform circular motion above the planet's equator. Consider one of these ice particles, 54 000 km from the centre of the planet. If the mass of the planet is 1.84×10^{27} kg, how long does it take the particle to complete one orbit around the planet? Pencil across *one* cell in row 7.

KEY for Q7

- | | |
|--|------------|
| <input checked="" type="radio"/> A 2 hours | E 24 hours |
| B 4 hours | F 36 hours |
| C 6 hours | G 72 hours |
| D 12 hours | H 96 hours |

PART B

The questions in this part of the assignment concern Unit 3 and deal with the following topics: conservation of momentum, kinetic energy, elastic collisions, potential energy, gravitational potential energy, strain potential energy, conservation of energy, the force-potential energy relationship, and the centre of mass.

Q8 A runaway railway carriage A of mass m is initially travelling with velocity $u_x(A) = 3.0 \text{ m s}^{-1}$ along an x -axis defined by a straight railway track. The carriage makes an elastic collision with a stationary goods wagon B of mass $2m$. Which one of the options in the key represents the velocities of the carriage and the goods wagon immediately after the collision? Pencil across *one* cell in row 8.

KEY for Q8

- | | |
|---|----------------------------------|
| A $v_x(A) = -3.0 \text{ m s}^{-1}$; | $v_x(B) = 3.0 \text{ m s}^{-1}$ |
| B $v_x(A) = 0.0 \text{ m s}^{-1}$; | $v_x(B) = 1.5 \text{ m s}^{-1}$ |
| C $v_x(A) = 0.0 \text{ m s}^{-1}$; | $v_x(B) = 2.1 \text{ m s}^{-1}$ |
| D $v_x(A) = 1.0 \text{ m s}^{-1}$; | $v_x(B) = 2.0 \text{ m s}^{-1}$ |
| <input checked="" type="radio"/> E $v_x(A) = -1.0 \text{ m s}^{-1}$; | $v_x(B) = 2.0 \text{ m s}^{-1}$ |
| F $v_x(A) = 1.0 \text{ m s}^{-1}$; | $v_x(B) = -2.0 \text{ m s}^{-1}$ |
| G $v_x(A) = -1.0 \text{ m s}^{-1}$; | $v_x(B) = -2.0 \text{ m s}^{-1}$ |

Q9 A spring with spring constant 300 N m^{-1} is used to propel a pinball of mass 0.1 kg up the 10° slope of a pinball table. The ball travels directly up the slope of the table before coming momentarily to rest 1.4 m away from the spring. Neglecting any energy losses due to friction, air resistance, etc., estimate the amount by which the spring was compressed. Select the option from the key that is closest to your answer, and pencil across *one* cell in row 9.

KEY for Q9

- | | |
|---|--------|
| A 1 cm | E 5 cm |
| B 2 cm | F 6 cm |
| C 3 cm | G 7 cm |
| <input checked="" type="radio"/> D 4 cm | |

Q10 A rigid object, initially at rest, is acted on by a single external force F . The body is in empty space and no other forces act on it. This question compares the two different cases shown in Figure 2. In case (a) the external force acts along a line that passes through the centre of mass; in case (b) the external force (of the same magnitude and direction as before) acts along a line that does not pass through the centre of mass. The key contains some statements about the body's response. Two of these statements are true and the others are false. Select the *two* correct statements from the key, and pencil across *two* cells in row 10.



FIGURE 2 A rigid body in empty space is acted on by a single force which (a) acts on a line through the centre of mass or (b) acts along a line that does not pass through the centre of mass.

KEY for Q10

- A—The body rotates in case (a) but not in case (b).
- B The body does not rotate in case (a) but rotates in case (b).
- C—The body rotates in both case (a) and case (b).