1. Given the equation of linear motion is

$$v^2 = u + 2as$$

where is v is final velocity, u is initial velocity, a is acceleration and s is displacement. Verify the homogeneity of the equation.

[2 *marks*]

2. (a) A bullet is shot from a gun at a speed of 345 m s^{-1} towards a piece of box with 5.5 cm thickness and emerges with speed of 260 m s^{-1}. Calculate the

(i) deceleration through the box.

(ii) time taken to get through the box.

[4 *marks*]

(b) A canon is positioned at a cliff of 60 m high from the ground. Then a cannon ball is shot from the canon at an angle of 53° from the horizontal with an initial speed of 25 m s^{-1} to the ground in 6.08 s. Calculate the

(i) maximum height it can reach from the ground.

(ii) speed when it reaches the ground.

[6 *marks*]

3. (a) A 50 g golf ball is struck by a club and flies off at 50 m s^{-1}. If the head of the club is in contact with the ball for 0.7 ms, what is the average force on the ball during the impact?

[2 *marks*]

(b)

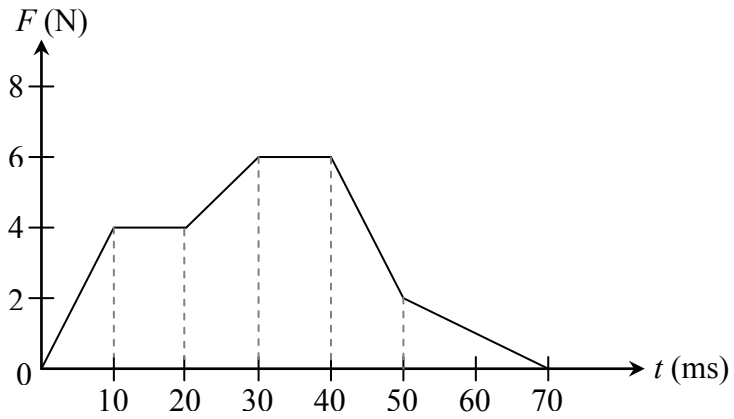

FIGURE 3.1

FIGURE 3.1 shows the force acting on a 0.05 kg classic pin ball over a period 70 ms.

(i) How long does the maximum force act on the ball during this period?

(ii) Calculate the impulse from t =15 ms to t = 40 ms.

[4 *marks*]

3. (c)

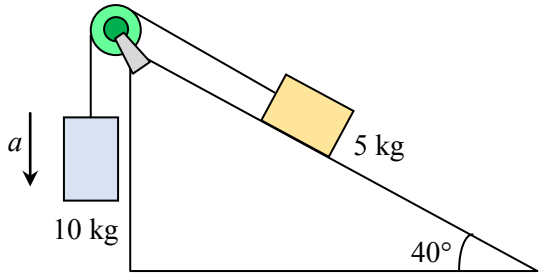

FIGURE 3.2

FIGURE 3.2 shows two packing crates of masses 10 kg and 5 kg are connected by a string that passes over a frictionless pulley. The 5 kg crate lies on a smooth inclined plane of angle 40°.

(i) Sketch free body diagram to show all the forces acting on the system.

(ii) Calculate the acceleration of the crates.

[7 *marks*]

4. (a) On an unknown airless planet, an astronaut drops a 4.0 kg ball from a 60 m ledge. The mass hits the bottom with a speed of 12 m s^{-1}. What is the acceleration of gravity *g* on this planet?

[2 *marks*]

(b)

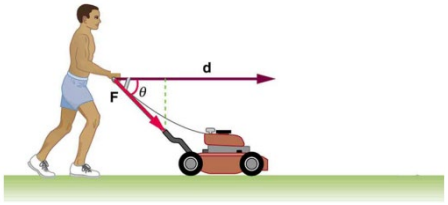

FIGURE 4

A 10 kg lawn-mower is initially at rest, pushed by a person cart for a distance of 12 m as shown in **FIGURE 4**. He pushes with force 50 N in a direction 40° below the horizontal. The frictional force between the mower and grass is negligible. Calculate the

(i) work done by the pushing force *F*.

(ii) final velocity of the cart.

(iii) power supplied by the force *F* for 15 minutes.

[6 *marks*]

5. A 50 kg rider is on a Ferris wheel of diameter 25 m. If the centripetal acceleration of the rider is 10 m s^{-2}, calculate its

(a) angular velocity.

(b) centripetal force acted on the rider.

[5 *marks*]

6. (a) A load with mass 200 g oscillate with simple harmonic motion is decsribed by the following expression

$$y = 5 \sin 2\pi t$$

where y and t displacement in centimeter and time in second, respectively.

Calculate the

(i) velocity **and** acceleration at $t = 4$ s.

(ii) maximum speed **and** acceleration of the oscillation.

(iii) total energy of the system.

[10 *marks*]

(b) A student reading his physics book on a lake dock notices that the distance between two incoming adjacent wave crests is 0.75 m and he then measures the time of arrival between the crests to be 1.6 s. Calculate the

(i) frequency.

(ii) speed of the wave.

[4 *marks*]

(c) A sinusoidal wave travelling in positive x-direction has amplitude of 15.0 cm, a wavelength of 40.0 cm and a frequency of 8.0 Hz. The vertical position of an element of the medium, $y = 0$ cm at $x = 0$ cm when $t = 0$ s.

(i) Calculate the angular frequency **and** wave number.

(ii) Write a general expression for the wave function.

[4 *marks*]

(d) The tension in a stretched string of length 50 cm, mass 1.0 g is 100 N. When the string vibrates, calculate the

(i) speed of the transverse waves travelling along the string**.**

(ii) fundamental frequency.

[5 *marks*]

7. (a) Young's modulus of a wire is 1.2×10^{11} N m^{-2}.

(i) Calculate the stress needed to increase the length of the wire by 0.1%.

(ii) What is the force required to produce this extension, if the cross-section area of the wire is 2.0 mm^2?

[4 *marks*]

(b) The diameter of a metallic disc is 4.000 cm when the temperature is 20 °C. The coefficient of linear expansion of the metal is 2.5×10^{-5} °C^{-1}. The size of the disc increases when it is heated. Calculate the

(i) temperature of the disc when its diameter becomes 4.004 cm.

(ii) coefficient of area expansion of the disc.

(iii) ratio between the coefficient of linear and area expansion.

[4 *marks*]

8. (a) A tank contains 2.0 mol of Helium gas at 20 °C. Assume that the Helium behaves like an ideal gas. Calculate the

(i) total kinetic energy of the gas molecules

(ii) average kinetic energy.

[4 *marks*]

(b) A monoatomic hot air balloon at 300 K holds 0.98 mol of air molecules. Calculate the internal internal energy of the air in the balloon.

[2 *marks*]

(c)

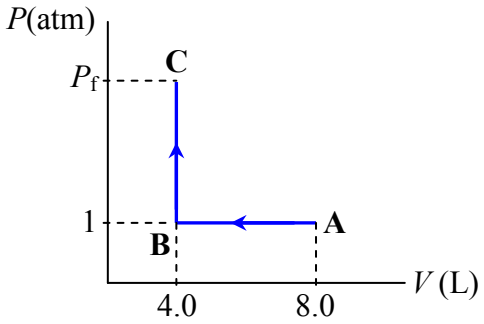

FIGURE 8

FIGURE 8 below shows an ideal gas which is compressed from a volume of 8.0 L to 4.0 L at constant pressure of 1.0 atm. Heat is then supplied to the system at constant volume while pressure and temperature is changed until the system finally reaches the initial temperature at **C**.
Calculate the

(i) total work done in the above process.

(ii) final value of pressure, P_f.

[5 *marks*]