SECTION B (60 MARKS)

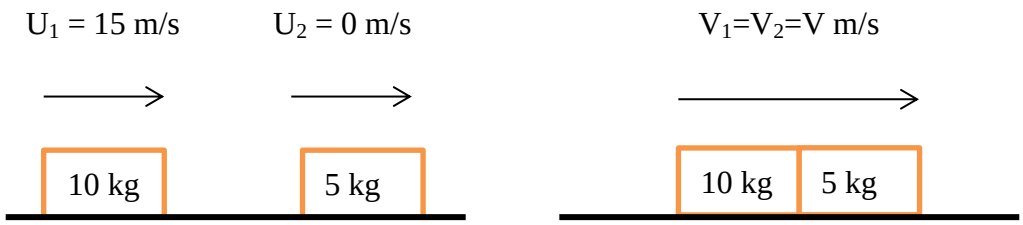
Answer **ALL** questions.

QUESTION 1

a. Define *force*.

(2Marks)

b. A vehicle of mass 1500 kg is travelling at 15 m/s. Calculate the kinetic energy of the vehicle. (4 Marks)



c.

Figure 4 : Inelastic collision

In an inelastic collision, a wooden trolley A of mass 10 kg is moving with initial velocity of 15 m/s (in **Figure 4**). It then collided with a stationary wooden trolley B of mass 5 kg and initial velocity = 0 m/s. Upon collision, trolley A and trolley B move together in the same direction. Calculate their final velocity.

(4 Marks)

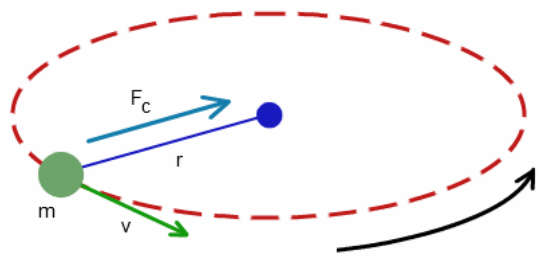
QUESTION 2

a. Define angular velocity.

(2 Marks)

b. An object of mass 2 kg is spinning around in a horizontal circle of radius 2 m at the end of a rope. Calculate the linear velocity of the object when the object rotates at 4 revolutions/second. (4 Marks)

c. What is the centripetal force required if a body of mass 0.25 kg is moving in a horizontal circular path of radius 5 m with an angular speed, ω = 4 rad/s?



(4 Marks)

Figure 5: Angular motion and centripetal force

QUESTION 3

a. Define specific heat capacity *c*.

(2 Marks)

b. How much heat will an iron casting of mass 10 kg have to release to drop in temperature from 200 °C to 20 °C?
The specific heat capacity of the iron is 480 J kg^{-1} K^{-1}.

(4 Marks)

c. Calculate the amount of heat required to change 1.2 kg of water at 20°C to steam at 100°C. Given the specific heat capacity of water, $\boldsymbol{c}$ = 4200 J kg^{-1} K^{-1} and the specific latent heat of vaporization, $\boldsymbol{L_V}$= 2257 kJ/kg.

(4 Marks)

QUESTION 4

a. Define *Work*.

(2 Marks)

b. A car of mass 950 kg stands on an incline of 5^0. If the hand brake is released, calculate the velocity of the car after travelling 100 m down the incline if the total resistances to motion is 70 N.

(8 Marks)

QUESTION 5

a. Define *simple machine*.

(2 Marks)

b.

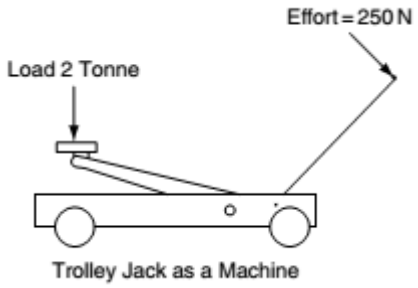


Figure 6: trolley jack

In the trolley jack example shown in Figure 6 an effort of 250 newtons is lifting a load of 2 tonnes. The load is lifted through a distance of 18 cm. The operator performs 50 pumping strokes of the handle. Each pumping stroke is equal to 50 cm long. Compute

i. the mechanical advantage,

ii. the velocity ratio, and

iii. the efficiency of the hand-operated car jack

(8 Marks)

QUESTION 6

a. Define tensile stress.

(2 Marks)

b. A steel tie rod used in a suspension system is *l* = 400 mm long with a diameter d = 15 mm. Determine the stress in the tie rod when a tensile force of 600 N is applied to it under braking.
(Take g=10 m/s^2, modulus of elasticity, E for the material =200 GN/m^2 ; 1 tonne = 1000 kg.)

(4 Marks)

c. Given the modulus of elasticity E for the rod = 2 x 10^{11} N/m^2 , calculate the extension of the rod caused by this force.

(4 Marks)