

Topic 4 Momentum and 2nd Law

Past paper Questions

Q1. A bus of mass 80 tons, travelling at 4 m/sec, runs into back of a car of mass 1.8 tons travelling in the same direction at 2.5 m/sec. After impact, the velocity of the bus is 3.95 m/sec. The duration of impact was 1.05 sec. Determine

- a. Final velocity of car -5m
- b. The average force on the car during impact -5m

Q2.a) A ship of mass 250,000 tons travelling at 6 m/sec when engines are stopped. After 10 sec, the speed has dropped to 5.7 m/sec. Calculate

- i. The average deceleration -2m
- ii. The average resistive force on the ship -2m

b) With the ship's speed at 5.7 m/sec the engines are restarted, giving a propulsive force of 10MN. Assuming resistive force as same in Q2.a). Calculate

- i. the average acceleration -3m
- ii. the time taken to regain speed of 6 m/sec -3m

Q3. A car of mass 1000 kg travelling at 2 m/sec collides with a stationary bus of mass 7000 kg. After collision both vehicles are locked together. The vehicles come to rest 2 sec after impact. Calculate

- i. The common velocity after impact -4m
- ii. The friction force between vehicles and ground -6m

Q4. Winding gear is used to lift a load of 800 kg through a height of 2m in a time of 4.2 sec. the torque applied to the winding drum is 590 Nm and drum makes 5 revolutions. Calculate

- a. Work done by load -2m
- b. Work done by torque -2m
- c. Efficiency of winding gear -3m
- d. Power input to the winding gear -3m

Q5. A tractive force exerted on a railway locomotive of mass 400 tons is 100 kN and frictional resistance is 18kN. At this moment the locomotive is travelling at 3 m/sec. Calculate

- a. The net force on locomotive -2m
- b. The acceleration of locomotive -2m
- c. The velocity after 10 sec -3m
- d. Time taken to reach 10 m/sec -3m

Q6. Lift machinery with capacity of 2 tons is used to lift a load of 1800 kg. The load is lifted a total distance of 2.5m. The lift gear takes 6 turns to complete the lift with average torque of 1300 Nm necessary to complete the lift in 6 secs. Calculate

- i. Work output of winding engine -2m
- ii. Work input to the lifting gear -2m
- iii. The lift machinery efficiency -3m
- iv. The power input the lift machinery -3m

Q7. A shell of mass 6 kg is fired from a gun barrel of mass 1200 kg. The average force exerted on the shell is 200kN. The force acts for a time of 0.015 sec. Calculate

- i. The momentum of the shell as it leaves the gun -4m
- ii. The muzzle velocity of shell -4m
- iii. The initial recoil velocity of the gun -2m

Q8. A space vehicle of mass 100 kg is travelling at 1100 m/sec towards a space station of mass 9000 kg traveling in the same direction at 800 m/sec. The retro rockets of the space vehicles exert a retardation force of 1200 N. Calculate

- i. How long retro rockets should be fired to bring the vehicle to the same speed as the station -6m
- ii. The common velocity of the vehicle and the station after impact -4m

Q9. A railway truck of mass 6000 kg travelling at 1 m/s collides with a second truck of mass 4000 kg travelling at 0.8 m/sec in the same direction. During the collision the two trucks are coupled. The trucks come to rest 46 sec after impact. Determine

- i. The common velocity after coupling -5m
- ii. The total friction force acting after coupling -5m

Q10. A railway carriage of 40 tons traveling at 6 m/sec collides with a second carriage of 20 tons travelling at 3 m/sec in same direction. After impact the carriage are coupled together and come to rest in 40 sec. Calculate

- i. The velocity of carriage after impact -6m
- ii. The retardation force -4m

Q11. The engine of a single screw ship has an output power of 3 MW and the propeller shaft rotates at 100 rpm. The ship is travelling at 8 m/sec. The propeller thrust required to maintain this speed is 320kN. Calculate

- i. Torque in propeller shaft -4m
- ii. The output power of propeller -4m
- iii. The efficiency of propulsion gear -2m