BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF ENVIRONMENTAL SCIENCE

BACHELOR OF SCIENCE HONOURS DEGREE IN SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT

ESM115

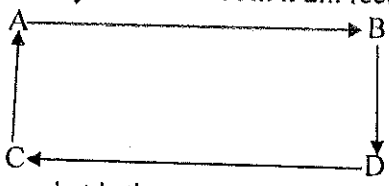
BSc PART I EXAMINATION
Basic Physics

2 HOURS
INSTRUCTIONS
Answer **all questions** from SECTION A, and **two** questions from SECTION B

JUN 2024

SECTION A

1(a). The motion of a body describes a 5m x 2m rectangle ABDC.



After the motion what is the:

(i) distance travelled? [2]
(ii) displacement? [2]
(iii) Convert: 120km/h into m/s [2]
(iv) Convert 15m/s into km/h [2]

(b). Define momentum and show that force may be defined as the rate of change of momentum. [4]

(c). What do you understand by the conservation of momentum? [2]

(d). Complete the table below on quantities and SI Units [6]

Property	SI unit
Volume	
Force	
Energy	
Pressure	
Acceleration	
Speed	

(e). Decide whether work is being done in the following situations:

(i) Picking up a bowling ball off the floor. [2]
(ii) Two people pulling with the same amount of force on each end of a rope. [2]
(iii) Hitting a tennis ball with a tennis racket. [2]

(iv) Pushing hard against a wall for an hour. [2]

(v) Standing very still with a book balanced on your head. [2]

SECTION B

2. A train P is travelling along a horizontal track between two stations which are 1.5Km apart. The train leaves the first station from rest with a uniform acceleration for 300m until it reaches a speed of $30ms^{-1}$. The train then maintains this speed for T seconds before decelerating uniformly at 1.25 ms^{-2} coming to rest at the next station. The motion is represented by Figure1:

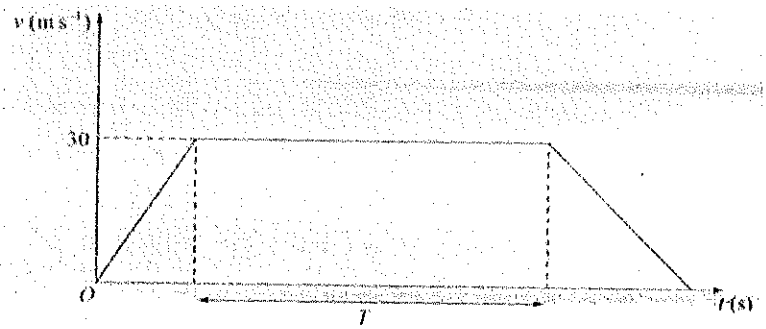


Figure1 Motion of train between two stations

(a) Find the acceleration of the train during the first 300m of its journey. [4]

(b) Find the value of T. [4]

(c) In a store, two workers are lifting 5kg bags of flour onto the shelves. There are five shelves, 0.4m apart. The lowest shelf is 0.4m from the floor. Figure 2 below shows the two workers.

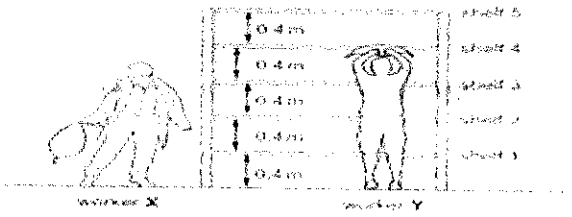


Figure 2

Worker X lifts three bags from the floor to shelf 2. Worker Y lifts one bag from the floor to shelf 5.

(i) Which worker has done more work than the other? [2]

(ii) Use calculations of the work done to explain your answer. [5]

(d). Each worker lifts one bag from the floor to shelf 2. Worker X does this more quickly than worker Y. Which worker exerted the higher power during their lift? Explain your answer. [5]

3(a) A lift rises vertically from rest with constant acceleration. After 4 seconds it is moving upwards with a velocity of 2m/s. It then moves with a constant velocity for 5 seconds. The lift then slows down uniformly, coming to rest after it has been moving for a total of 12 seconds.

(i). Sketch a velocity-time graph for the motion of the lift. [4]

(ii). Calculate the total distance travelled by the lift. [3]

(b). An airplane accelerates down a runway at 3.20 m/s^2 for 32.8 s until it finally lifts off the ground. Determine the distance travelled before take-off. [3]

(c) (i) Describe an experiment to determine the weight of an object using the principle of moments. [8]

(iii) What is the scientific definition of work? [2]

4 (a). A car engine does 50,000 J of work to accelerate at 10 m/s^2 for 5 meters. What is the mass of the car? [5]

(b). A person uses a 75-newton force to push a 51-kilogram car up a ramp. The ramp is 10 meters long and rises one meter. Calculate the efficiency. [5]

(c). Why are work and energy both measured in joules? [4]

(d). Why is work done with a machine the same as work done without a machine? [2]

(e). What is the mechanical advantage of a lever that allows Mike to lift a 24-newton box with a force of 4 Newtons? [4]

5. A car travels along a straight horizontal road. It takes 120s to travel between two sets of traffic lights which are 2145m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30s until its speed is $22ms^{-1}$. The car maintains this speed for t seconds. It then moves with constant deceleration coming to rest and the second set of traffic lights.

(a) Sketch a speed-time graph for the motion of the car between the two sets of traffic lights. [5]

(b) Find the value of t. [5]

A motorcycle leaves the first set of traffic lights 10s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration, ams^{-2} and passes the car at point A which is 990m from the first set of traffic lights. When the motorcycle passes the car, the car is moving at speed of $22ms^{-1}$.

(c) Determine the time it takes for the motorcycle to move from the first set of traffic lights to point A. [5]

(d) Calculate the value of a.

[5]

End of paper