MOVEMENT Assignment & Newton's Laws

Name: _____ **Total: _____/ 84 marks**

1. Jenny is riding on the bus. She has been unable to get a seat so she is standing in the isle. Explain, using physics laws and principles, why is it important that she hold onto something while she is completing her journey on the bus. (3 marks)

1. When catching a ball, your cricket coach advises you to move your hands backwards. Explain the physics behind this "follow through" technique. (3 marks)

2. Explain why a large elephant standing at the lake to get a drink, has less momentum than a leaf falling from a nearby tree. (3 marks)

3. If you jump off a wall onto the ground below, according to Newton's Third Law, there should be equal and opposite forces. Undoubtedly you experience a force as you come to an abrupt halt, the Earth however appears unchanged. Does Newton's Third Law apply in this situation? Explain. (3 marks)

4. a. You are about to have an unpleasant experience. You are riding your bike along the road at 25.2 kmh^{-1} when a very large truck pulls out in front of you from the driveway on the left. You brake hard for 2.00 s but hit the truck at 7.20 kmh^{-1}. What was your deceleration? (2 marks)

b. In the moments before you hit the truck, as a student of physics you decide to calculate the impulsive force (impulse) you will feel. You and the bike have a combined mass of 120 kg and the truck brings you to a halt in 0.30 s. What is your impulse? (3 marks)

5. The gravity of the moon is about one sixth that of Earth. What would be the mass and weight of a 94.0 kg man who is standing on the moon? (2 marks)

Mass	Weight

6. Tommy is playing with his toy trains on a circular track. He sends a 0.300 kg train along a track at 1.40 ms^{-1} in one direction and the other 0.150 kg train in the opposite direction at 2.00 ms^{-1}. The two trains hit and the second is repelled with a velocity of 0.0800 ms^{-1}. What was the final velocity of the first train? (3 marks)

7. A student notices that when travelling on a lift he often feels heavier or lighter. If the student had a mass of 58.0 kg, determine his weight in the following situations when the lift is going up to his 10^{th} floor apartment.
   a. The lift is travelling between floors at a constant velocity of 2.00 ms^{-1}? (2 mark)

   b. The lift, still moving upwards, slows down rapidly with an acceleration of –1.50 ms^{-2} to stop at a floor? (2 mark)

   c. The lift now accelerates upwards with an acceleration of 2.00 ms^{-2}. (2 mark)

8. A fire fighter of mass 80.0 kg slides down a metal pole with an acceleration of 7.50 ms^{-2}. What is the value of the frictional force between his hands and the pole? (2 marks)

And now to review the previous work in the unit.

9. You walk 4.00×10^2 m west to the shops then 6.50×10^2 m south to your friend's homes. What is your displacement from your home? (2 marks)

10. Anthony ant has found an excellent source of food. He can travel at an average velocity of $0.594\ kmh^{-1}$. If the nest if 672 m away, how long will it take Anthony to tell the other ants in the nest where the food is? Give your answer in hours. (2 marks)

11. A hawk, travelling horizontally at $6.00\ ms^{-1}$, sees a pigeon 120.0 m in front of him. He accelerates at $4.60\ ms^{-2}$ to catch the pigeon. How long does it take him to get the pigeon? (3 marks)

12. Two boys are playing a game. Firstly, one makes a small paper boat then set it in the river to float under a bridge. The other boy stands on the bridge which is 14.0 m above the water and drops a small stone so as to land on the boat. If the boat is placed 12.0 m from the bridge and the river is moving at $2.50\ ms^{-1}$, how long after the boat is placed in the river must the stone be released so as to land on the boat. (3 marks)

13. A student (50kg) rides her bike(12kg) in a westerly direction at 8.0 m/s. There is a force due to friction and air resistance of 60N.

    a) What is the force she must provide?

    b) If she rides her bike for 1 km west, what work has she done?

(3 marks)

14. Whilst on excursion a physics student (62.0 kg) went to Scitech and rode a bike on an exhibit that stated he exerted 1200 Joules in one minute. He knows his bike (15.0 kg) at home provides a force due to friction and air resistance of 50.0N.

    a) How far over level ground can he go with one minute's worth of energy?

(2 marks)

    b) The student finds that he can not go as far when riding up a hill, why is this?

(2 marks)

15. Explain how having a roo bar fitted to a car can be considered very dangerous to pedestrians or to the car's occupants in a crash involving something heavier than a kangaroo.

(3 marks)

16. A person on a motorcycle (120 kg) with a 28.0kW motor is at rest.

a) If she accelerates for 5.00 sec from rest, what is her velocity?

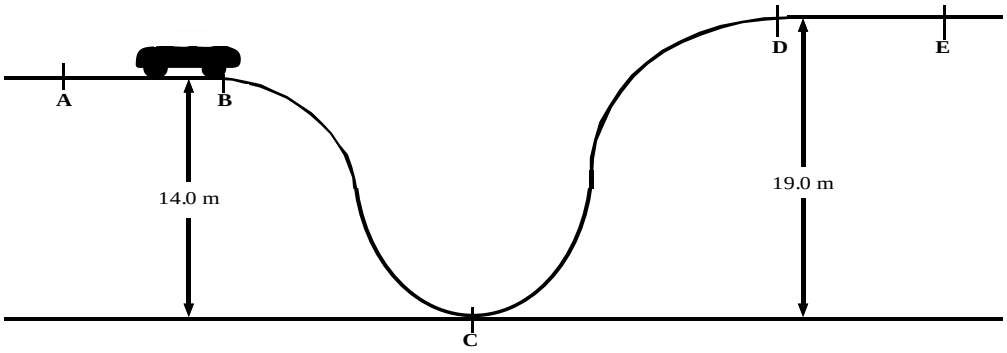
(4 marks)

b) How far has the motorcycle gone in this time?

(2 marks)

17. Consider an 80.0 kg carriage on a roller coaster ride as shown in the diagram below:

[15 Marks]



If the initial velocity of the carriage along AB is 12.0 ms^{-1}, calculate the following:

a) The carriage's kinetic energy along AB.

(2 marks)

b) The potential energy, relative to point C, of the carriage while it is moving along AB.

(2 marks)

c) The total energy the carriage has along AB.

(2 marks)

d) The velocity of the carriage at point C.

(3 marks)

e) The carriage's kinetic energy at D.

(3 marks)

f) The velocity of the carriage along DE.

(3 marks)

18. A 48.0 kg physics student, after watching the Olympics last year, has decided that he wants to join the Olympic Trampoline Team. He decides to try for the "Highest Jump" event. He manages to drag a 1.00 m tall trampoline to the base of a 9.00 m high cliff. He climbs to the top, closes his eyes and imagines the Gold Medal around his neck.

[13 Marks]

a) Using the trampoline as a reference point. What is the potential energy he possesses?

(3 marks)

b) He leaps off the cliff in perfect form, hitting the centre of the trampoline. What is his velocity at this point?

(3 marks)

c) The trampoline exerts a constant resistive force of 7400N. How far does the trampoline stretch downwards before he is catapulted up into the air?

(4 marks)

d) The trampoline absorbs some of the energy in accelerating him up, if the trampoline absorbs 25.0% of the energy in changing his direction, how high will he go?

(3 marks)