2019 Year 11 Physics

Task 11: Test 6 – Forces and Motion

Name: \_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_/ 50 marks

1. Speedway programs often include an event called a "demolition derby". In this event, the cars, which are usually older models of conventional makes, race each other. The difference is that the drivers can deliberately collide. The idea is to damage an opponent’s car and force it from the race, hence "demolition derby".

The following scenario is unlikely - all cars travel in the same direction around the track - but not impossible.

‘Dangerous Davy’s car of mass 1.200 x 103 kg and travelling at 60.0 km h-1 collides head on with 'Mad McIntyre’s car of mass 2.000 x 103 kg, which is also travelling at a speed of 60 km h-1, but in the opposite direction.

1. What force does each car experience? Explain your reasoning. (No calculation needed).

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(1 Mark)

b) Would each car come to rest immediately after the collision? Explain your reasoning.

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(2 Marks)

c) Which of the two drivers is more likely to suffer whiplash injuries? Explain your reasoning.

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(2 Marks)

d) In such a potentially dangerous event, what safety features do drivers include in their cars to protect them in the inevitable collisions?

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(1 Mark)

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2. Starting from rest, Leon gets into his car and ends up in a lane where he travels over a long, straight but arched bridge. The bridge spans a distance of 100.0 m but has an arched length of 115.0 m . His car accelerates to a speed of 65.0 km h-1 which is the speed that he maintains for the remainder of the drive across the bridge. It takes 8.50 s to cross the bridge, calculate:

1. His average speed across the bridge.

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(2 Marks)

b) His average velocity across the bridge.

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(2 Marks)

3. Jordan, while running, can accelerate from rest to a velocity of 15.0 ms-1 in the same time that Ethan, driving a car can accelerate from 70 km h-1 to 85 km h-1. Which person has the greatest acceleration?

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(4 Marks)

4. Grant is horrendously injured at the base of the cliff and needs to be rescued by the State Emergency Service (SES). To retrieve him they use a pulley system set up at the top of the cliff. (Older buildings often had these machines for this reason) It consists of the pulley, a drive wheel and a cable and hook to lift the Josh to a point where he can be raised to the top of the cliff.

Pulley



Drivewheel

Grant

A cable running over a single pulley as shown in the diagram above supports the Grant, who has a mass of 75 kg.

a) What would be the tension in the cable if Grant is raised at a constant velocity of

2.0 m s-1.

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(2 Marks)

b) What would be the tension in the cable if Grant is raised at an acceleration of 2.0 m s-2

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(2 Marks)

5. Why is the force you need to apply to the pedals of a bicycle less if you begin your ride on a downwards slope?

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(1 Mark)

6. If you are involved in a traffic crash, is it safer for you (and the other driver) if your two cars stick together or bounce apart in the crash? Explain.

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(2 Marks)

MCBD07308_0000[1]7. Some physics students who were investigating the velocity of a moving car, which was initially at rest, tabulated their results for the first 6 seconds of the car's motion in the table below.

|  |  |  |
| --- | --- | --- |
| Time (s) | Velocity (m s-1) | Displacement (m) |
| 0 | 0 |  |
| 1 | 2 |  |
| 2 | 4 |  |
| 3 | 6 |  |
| 4 | 6 |  |
| 5 | 6 |  |
| 6 | 6 |  |

a) Plot a graph of velocity versus time on the paper provided.

(2 Marks)

b) From the graph, calculate the car’s acceleration after 2 s.

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(1 Mark)

c) From the graph, calculate the total displacement of the car after 6 s.

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(1 mark)

d) Complete the table by calculating displacements for each second of it’s travel.

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(2 marks)

e) Plot a graph of displacement versus time on the paper provided.

(2 Marks)

8. Mr Thomson is driving a 10.0 tonne truck travelling at 45.0 km h-1 when it collides with Ethan in a stationary car. The car has a mass of 1.50 x 103 kg.

1. Calculate the kinetic energies of both vehicles before the collision.

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(3 marks)

b) If, as a result of the collision, the truck is stopped but the car moves at 45.0 km h-1 in the initial direction of the truck, has the total kinetic energy of the system been conserved? You need to show how you arrived at your conclusion mathematically.

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(2 marks)

9. a) What factor change is there to the kinetic energy of your car if you double its speed?

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(2 marks)

b) What happens to the braking distance if the speed is doubled? You can ignore your own reaction time in this calculation and you can assume the stopping force provided by the braking system stays the same

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(2 marks)

10. When the force exerted on a car is not constant the work can be found from a force-displacement graph. How?

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(2 marks)

11. How much work is done when a force of 500 N is exerted on a car to make it move

2.5 m in the direction of the force?

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(2 marks)

12. For the following questions, assume the zero level of potential energy is at a convenient level. Velocities are assumed to be measured relative to the ground.

1. A tow truck hoists a 2300 kg wreck vertically by 3.0 m and horizontally by 4.0 m. By how much does the wreck's potential energy change?

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(2 marks)

1. A motor bike is travelling at 5.0 m s-1 and slows to 3.0 m s-1. Its mass is 100 kg. By how much does its kinetic energy change?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(2 marks)

c) A constant force of 400 N is applied to a 50 kg cart which is pushed up a hill for a distance of 8.0 m, reaching a maximum height of 3.0 m. 100 J of energy is lost due to friction. Sketch a diagram showing this situation. What total energy is gained by the cart?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(2 marks)

MCNA01464_0000[1]13. The power provided by a motor is plotted against time in the graph below. How much work was done by the motor in the first half minute?

Fix this – POWER (up to 4)

RTime up to 50 seconds

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(2 marks)

Relevant Formulae

V av = s/t vav = (v +u)/2

v = u + at s = ut + 1/2 at2

v2 = u2 + 2as F = ma

Ft = mv - mu p = mv

I = Ft W = Fs

Ep = mgh Ek = 1/2mv2

Acceleration due to gravity = 9.80 ms-2