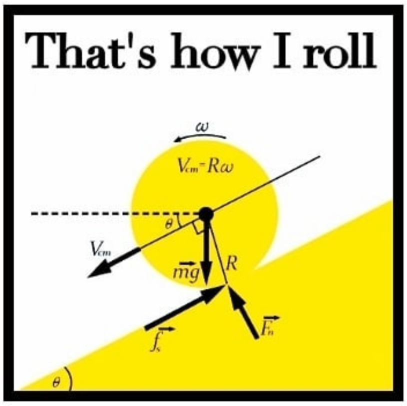
SWINBURNE
SENIOR SECONDARY COLLEGE

Physics
HOLIDAY HOMEWORK
Year 12, 2019



Teacher(s)/Subject Coordinator:	paul.harris@sssc.vic.edu.au
Work required in preparation for start of 2019:	Watch the following clip on scientific notation https://www.youtube.com/watch?v=WwmJ5nMmigQ and write down your personal 5 key points Complete the motion questions attached to this sheet Attempt diagnostic test on fields supplied in class
Textbooks and other resources:	Checkpoints Physics 3&4 Scientific Calculator
Key Links:	https://www.vcaa.vic.edu.au/Pages/vce/studies/physics/exams.aspx https://www.vcaa.vic.edu.au/Documents/vce/physics/PhysicsSD-2016.pdf
Due date:	Friday 1st of February 2019

Question 1

Jenni pushes her 100 kg fridge across the kitchen floor. The fridge is initially at rest and reaches a speed of 3.0 m s^{-1} after being pushed for 5.0 s. A constant frictional force of 140 N opposes the fridge's motion.

a. Calculate the average acceleration of the fridge in m s^{-2}. 2 marks

b. How far does the fridge travel in the 5.0 s period? 2 marks

c. Calculate the net force acting on the fridge. 2 marks

d. What force is Jenni applying on the fridge to produce this motion? 2 marks

e. Calculate how much work was done on the fridge by Jenni pushing it across the kitchen floor. 2 marks

f. Calculate Jenni's rate of work (power) on the fridge in pushing it across the kitchen floor. 2 marks

Question 2

New cars are tested for their various safety features. One test involves crashing the car head-on into a solid steel and concrete barrier at a speed of 56 km h^{-1} (Figure 13).

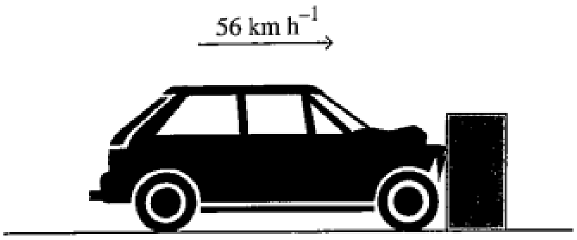


Figure 13

A simplified force versus crumple distance graph obtained from this crash is shown in Figure 14.

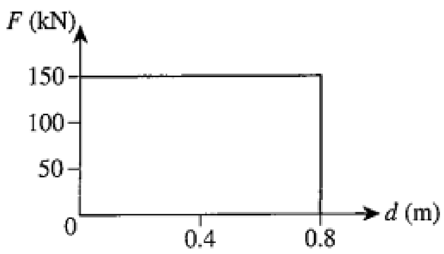


Figure 14

a. Calculate the work done (in kJ) by the crumple zone in stopping the car. 3 marks

b. Calculate the mass of the car. 3 marks

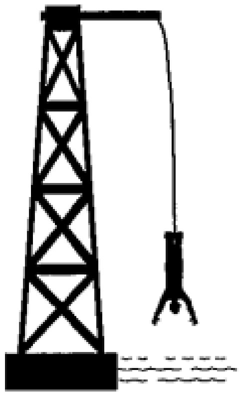
c. Calculate the acceleration of the car during the crash. 2 marks

d. Calculate (in ms) how long the crash lasted. 2 marks

e. Calculate how far the car would crumple if the same average force was applied to the car as shown in Figure 14, but the car was travelling at 80 km h^{-1} instead of 56 km h^{-1}. 2 marks

Question 3

Bungee jumping involves various energy changes. Figure 15 shows a bungee jumper at the bottom of their jump, momentarily still, just a few metres above the water. Bungee jumping can be modelled by assuming that when the jumper is at the bottom of their jump, the total stored potential energy in the elastic bungee rope is equal to the gravitational potential energy at the top of their jump.



not to scale

Figure 15

Dave, of mass 90 kg, begins the jump 70 m above the point where he will eventually come to a momentary stop. His elastic bungee rope is in free fall with him for a distance of 40 m and then tightens for the last 30 m, bringing him to a momentary stop.

For the questions below assume that air resistance and the mass of the elastic bungee rope are both negligible.

a. Calculate Dave's gravitational potential energy relative to his 'momentary stop' position 70 m below. 2 marks

b. Calculate how fast Dave would be going if he fell the whole 70 m and he was not attached to the bungee rope. 2 marks

c. Calculate the work done by the elastic bungee rope in bringing Dave to a momentary stop. 2 marks

Question 4

Figure 16 shows the force (F) versus extension (Δx) graph for a spring.

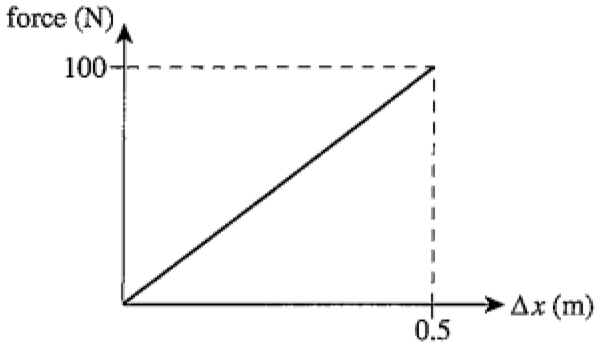


Figure 16

a. Calculate the spring constant for this spring. 2 marks

b. Calculate the amount of energy stored in this spring when the spring is extended by 0.25 m. 2 marks

The spring is now extended by 0.5 m.

c. The amount of energy stored in the spring is 2 marks

A. less than when it was extended by 0.25 m.

B, the same as when it was extended by 0.25 m.

C. twice as much as when it was extended by 0.25 m.

D. four times as much as when it was extended by 0.25 m.

Question 5

A car of mass 1200 kg is travelling at 20 m s^{-1} east.

a. Calculate the kinetic energy of the car. 2 marks

b. Calculate the momentum of the car. 3 marks

The car now crashes into a tree and comes to a complete stop (that is, $v = 0$ m s^{-1}).

c. Explain what happens to the car's kinetic energy when the car crashes into the tree. 2 marks

d. Explain what happens to the car's momentum when the car crashes into the tree. 2 marks

Question 6

A Mercedes of mass 1600 kg is travelling at 100 km h^{-1} on a German autobahn.

a. Calculate the kinetic energy of the Mercedes at this speed. 2 marks

The driver of the Mercedes sees a broken down truck ahead on the autobahn and fully applies the brakes to try to stop before hitting the truck.

b. If the Mercedes' brakes apply a constant retarding force of 16.4 kN, calculate the stopping distance of the vehicle. 2 marks

Question 7

A 150 g physics cart travelling at 2.5 m s^{-1} to the right runs into the back of a stationary 350 g physics cart. Velcro cause the two carts to stick together.

a. Calculate the momentum of the 150 g cart before the collision. 1 mark

b. Calculate the velocity of the combined mass after collision. 3 marks

Question 8

Figure 17 shows the force (in N) versus time (in ms) graph for a stationary 100 g ball being hit by a racquet.

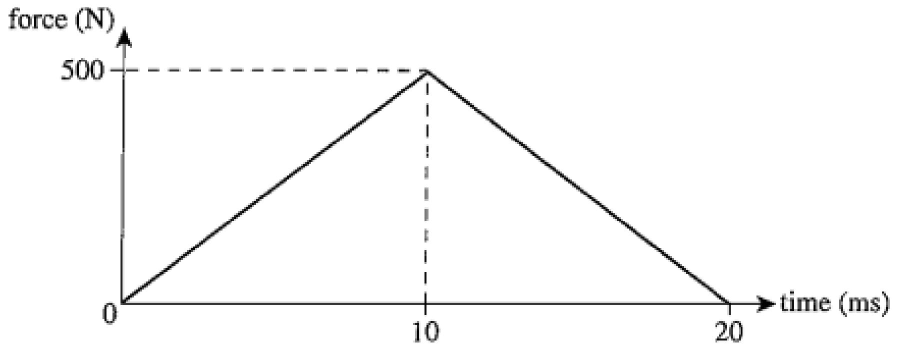


Figure 17

a. Calculate the magnitude of the impulse (in N s) given to the ball by the racquet. 2 marks

b. Calculate the speed with which the ball leaves the racquet. 2 marks

c. Calculate the magnitude of the impulse (in N s) given to the racquet by the ball. 2 marks

Question 9

The efficiency of an energy-transfer system is given by $\eta = \frac{\text{useful energy out}}{\text{total energy in}}$. The energy (J) per second is classified as a watt (W). A human walking uses 500 J s^{-1}, or 500 W. The table below shows, with some gaps, energy in, energy out, η and the percentages for various energy-transfer systems.

Fill in the missing gaps.

System	Total energy in (J)	Useful energy out (J)	η	%
incandescent light bulb	100	2		
compact fluorescent light		2	0.1	
LED	10			35
human walking	500		0.2	
medium-sized car		5.0×10^4		25

5 marks