Christ Church Grammar School

Science Department
Year 11 2020

ATAR PHYSICS
UNIT 1 – Motion and Forces
TEST 2 2020

Student Name:

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Teacher: CJO JRM PCW SA
(Please circle)

Time allowed for this paper
Working time for paper: 50 minutes.

Instructions to candidates:

- You must include **all** working to be awarded full marks for a question. Answers should be expressed to an appropriate number of significant figures.
- Follow through marks for working may not be awarded if working is not clear and free body diagrams (if relevant) are not provided.
- Marks will be deducted for incorrect or absent units and / or directions.
- **No** graphics calculators are permitted – scientific calculators only.

Mark:	/ 46
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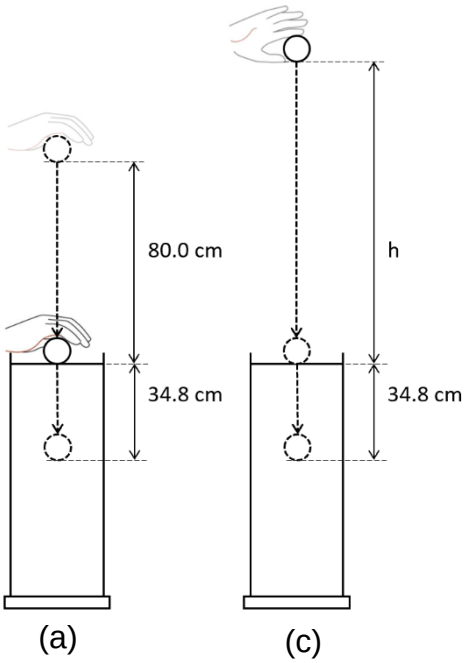
Question 1 **(11 marks)**

A year 7 student was carrying out an investigation into the viscosity of an unknown fluid by dropping marbles into large cylinders filled with the fluid. He found his result unsatisfying when a marble, of mass 25.0 g, dropped at the surface only sank a few centimetres before stopping. He decided to alter his experiment and threw the marble with great force directly downwards into the cylinder. This caused the marble to sink 34.8 cm before stopping.



(a) If the student applied a constant net force of 7.50 N over a distance of 80.0 cm before releasing the marble, calculate the speed at which the marble was released using energy and work concepts only.

(4 marks)

(b) Using energy and work concepts, calculate the magnitude of the average braking force applied to the marble once it entered the unknown fluid.

(4 marks)

A second student, thinking he was smart, thought that a much easier way to find satisfactory results was to drop the marble from a height above the cylinder. This variable would seemingly be much easier to control and measure.

(c) Using energy and work concepts only, calculate the theoretical height from which the student would need to drop the marble in order for the marble to reach the same 34.8 cm depth. (If you were unable to answer part (a), assume an entrance velocity of 20.0 m s^{-1})

(3 marks)

Question 2 **(4 marks)**

It is often said that friction is a force that always opposes motion. In the case of boxes being transported on a conveyor belt, friction is the force that drives the boxes forwards when the belt is starting up from rest. Explain this with reference to the relevant Newton's law(s) and state whether the first statement is true or false.

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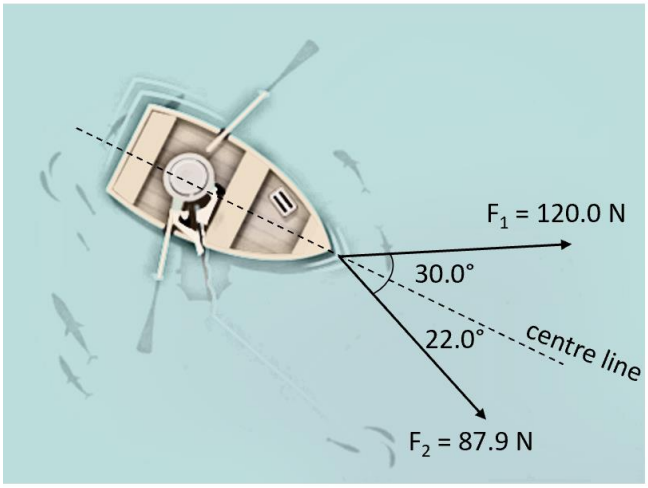
Question 3 **(5 marks)**

Using components, calculate the acceleration with respect to the centreline, of a boat of mass 185 kg subjected to the forces as shown.



Question 4 **(3 marks)**

An overloaded train of mass 850.0 tonnes is struggling to travel up a small incline, while carrying several heavy wagons of ore, managing only 5.20 m s^{-1}. Realising the journey will take too long, a second engine of mass 200.0 tonnes is called in to shunt (push) the train along. The second engine travels at 11.0 m s^{-1} until impact, and then joins to the rear of the first train. Calculate the speed of the assembly immediately after impact.

Question 5 **(9 marks)**

An explorer is being lowered down into an abyss by his friend who is slowly feeding a rope through a pulley system. Where the explorer is connected to the rope, there is a force meter which is calibrated to display his mass. He can use this to determine the mass of any treasures he collects and to ensure that he does not exceed the maximum load for the rope. While being lowered down at constant speed, the force meter reads 82.0 kg.

(a) Calculate the weight of the explorer.

(2 marks)

(b) Using energy and work concepts only, calculate the power required to be input to raise the explorer by 10.0 m over a period of 30.0 s.

(3 marks)

While hoisting the explorer up, several of the strands of the rope break after catching on a jagged rock. This causes the explorer to temporarily accelerate downwards at a rate of 7.35 m s^{-2}.

(c) Calculate the mass displayed on the force meter during this descent.

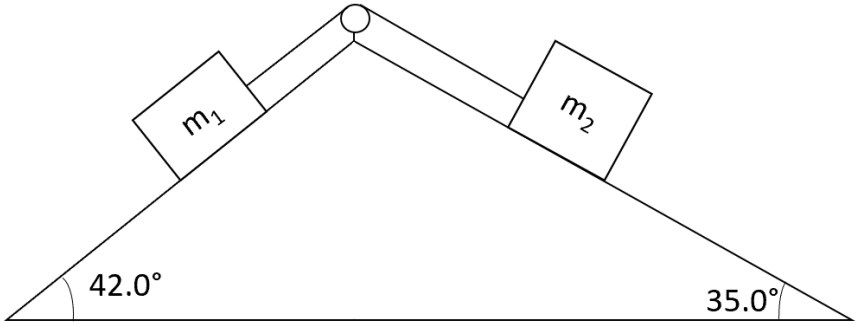
(4 marks)

Question 6 **(4 marks)**

Explain with reference to the relevant Newton's law(s) of motion, why a passenger train is designed to stop over a longer distance compared to a truck of a comparable mass for any given speed.

Question 7 **(10 marks)**

A block of unknown mass is connected by a string to a known mass (m_1) of 5.25 kg and suspended on an inclined surface via a frictionless pulley as shown in the diagram. Assume there is no friction between each mass and the surface.



(a) Calculate the mass m_2 if the two masses are stationary and in equilibrium as shown.

(4 marks)

Now consider another scenario, in which the mass of m_2 is changed and the two masses are now not in equilibrium. The masses are accelerating at a rate of 0.232 m s^{-2} such that m_2 is sliding down the slope.

(b) Calculate the magnitude of tension in the rope.

(3 marks)

(c) Calculate the mass of m_2. (If you could not solve part (b) use T = 25.4 N)

(3 marks)

END OF TEST