

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION
 Physics

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Centre Number

Section I – Part B (continued)

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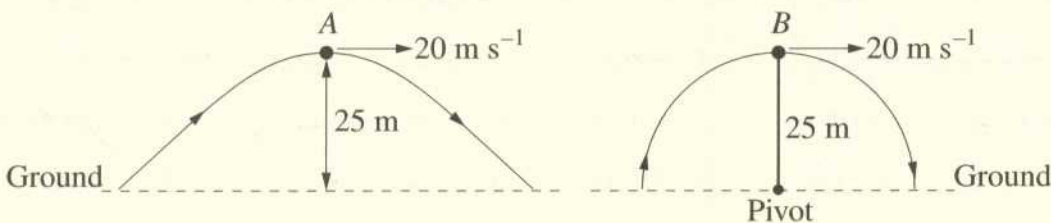
Student Number

Marks

Question 18 (6 marks)

A 30 kg object, A, was fired from a cannon in projectile motion. When the projectile was at its maximum height of 25 m, its speed was 20 m s^{-1} .

An identical object, B, was attached to a mechanical arm and moved at a constant speed of 20 m s^{-1} in a vertical half-circle. The length of the arm was 25 m.



Ignore air resistance.

- (a) Calculate the force acting on object A at its maximum height. 1

The force of object A at max height
 $g = 9.8 \text{ m/s}^2$
 $F = ma = mg$
 $= 30 \times 9.8 = 294 \text{ N}$

- (b) Calculate the time it would take object A to reach the ground from its position of maximum height. 2

$s = ut + \frac{1}{2}at^2$
 $-25 = 0 - 4.9t^2$
 $t = 2.26 \text{ s}$

- (c) Describe and compare the vertical forces acting on objects A and B at their maximum heights. 3

force on A = 294 N down
 $\text{force on B} = \left(\frac{30(400)}{25} = \frac{mb^2}{r} \right) + gm = 294 + 480$
 ~~$774 \text{ N} = 294 + 480 \text{ N}$~~ *downwards towards centre of motion/pivot*
 therefore force on B is greater than force on A at their maximum heights.

Question 19 (4 marks)

How does Einstein's Theory of Special Relativity explain the result of the Michelson-Morley experiment?

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The Michelson-Morley experiment was conducted to determine the velocity of the ether wind. It was discovered there was no ~~ether~~ ^{velocity of ether} relative to the earth. The experiment relied on the concept that two beams of light would take different times to travel the same distance across the ether and with/against the ether wind. Einstein's theory is based on the postulate that light travels at a constant velocity ^{to all} independent of the velocity of the source. This explained why the times for the two beams of light would always be equal, because they would always travel at the same velocity.

Question 20 (4 marks)

The electrical supply network uses a.c. and a variety of transformers between the generating stations and the final consumer.

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Explain why transformers are used at various points in the network.

Transformers transfer electrical energy from one circuit to another whilst changing the magnitude of ~~the~~ ^{an} alternating voltage. Transformers are used in power stations to increase the voltage to prevent energy losses due to ~~resist~~ heat created by resistance in the wires. Before reaching the consumer, at electricity sub stations, transformers are used to decrease (or 'step down') the voltage ~~so that~~ to ~~reduce the~~ safe levels for use in the home. Transformers step down the large voltages created at the power stations in substations also to ~~prevent~~ reduce the dangerousness of the powerlines on the streets. Transformers are used in the home as well as some devices need more or less voltage eg. the cathode ray tubes in TV require a greater voltage whilst energy efficient appliances require a smaller voltage.