

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

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Centre Number

Section I – Part B (continued)

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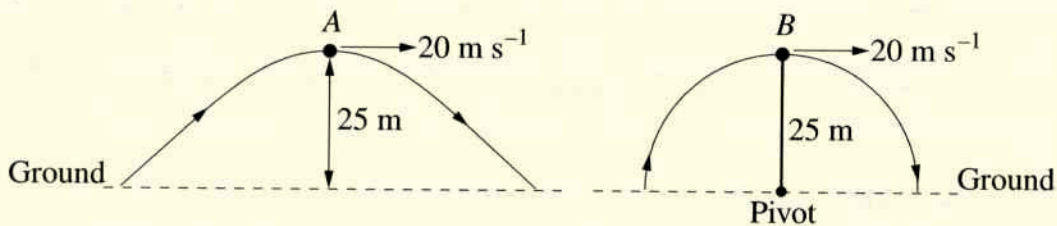
Student Number

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  $20 \text{ m s}^{-1}$ .

An identical object, B, was attached to a mechanical arm and moved at a constant speed of  $20 \text{ m s}^{-1}$  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

$$\begin{aligned}
 F &= ma \\
 &= \cancel{30} \times 9.8 \quad 25 \times 9.8 \\
 &= \cancel{294 \text{ N}} \quad 245 \text{ N}
 \end{aligned}$$

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

$$\begin{aligned}
 \Delta y &= ut + \frac{1}{2}at^2 \\
 25 &= 0 + \frac{1}{2} \times 9.8 \times t^2 \\
 25 &= 4.9t^2 \\
 t^2 &= 5.102040816 \\
 t &= \pm 2.258769767
 \end{aligned}$$

$t = 2.26 \text{ s}$

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

On A: gravity would begin to pull the cannon ball back towards earth, (air resistance)

On B: centripetal acceleration towards the pivot as it is moving a constant velocity.

Marks

Question 19 (4 marks)

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

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Michelson - Morley conducted an experiment to prove that the 'ether' existed. But after several attempts, they concluded the same result which is that ether did not exist, null result. This result confused the scientist until Einstein's Theory of Special Relativity can try to explain the phenomena. It states that the speed of light is constant to all observers in different frame of reference and that the physics mechanics in this frame of reference is true. These two theory explained the idea that no ether relative to the earth is present therefore the null results in the Michelson-Morley experiments.

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 are used to transfer electricity from a generating station to sub-power stations before it reaches people's homes. During this transfer heat loss often occurs, and by using a transformer  $P = VI$ , increasing the voltage, it minimises the heat losses as it decreases the current. Step-up and step-down transformers are used at different points depending on the needs.