

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

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Centre Number

Section I – Part B (continued)

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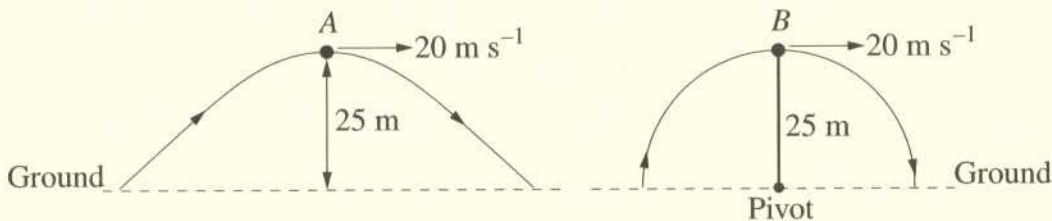
Student Number

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

The only force acting is gravity, downwards. This will be roughly equal to  $9.8 \text{ m s}^{-2}$  (Earth's gravitational acceleration).

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

$s = ut + \frac{1}{2}at^2$   $s = 25 \text{ m}, u = 0, a = 9.8 \text{ m s}^{-2}, t = ?$   
 $25 = 4.9t^2$   
 $5.1 = t^2$   
 $\therefore t = 2.26 \text{ seconds}$

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

At the maximum height for A the only force acting on it is gravity (as it is in projectile motion), this is downwards. On B (which is in circular motion) there would be centripetal force and centripetal acceleration acting downwards towards the centre of the half-circle. At the max height there would also be gravity acting downwards.

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 set up to measure the velocity of the earth through the aether. A beam was split using a half-silvered mirror and sent down, equal distant, perpendicular paths. It was expected that the light beam travelling in the plane of the aether would travel faster than the beam unaffected by the aether and an interference pattern would result when the beams were recombined. The results did not meet the predictions. Einstein suggested that the aether did not exist. It was believed that the aether was the medium electromagnetic waves (incl. light) were propagated. Einstein suggested light was constant and everything was relative to light - the foundation of special relativity.

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 at various points because they are needed to increase and decrease the voltage. Due to the fact that there is resistance in the power lines, one must try to minimise the current because power loss is proportional to  $P = I^2 R$  where the current is square. The voltage is inversely proportional to current i.e.  $P = IV$   
 $V = \frac{P}{I}$ . Therefore to minimise current transferring power from station, one must increase the voltage. This increase voltage is too large for home use so a step down transformer is needed.