

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION
 Physics

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Centre Number

Section I - Part B (continued)

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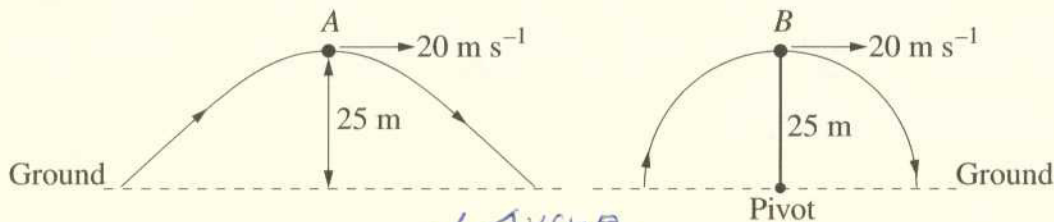
Student Number

Marks

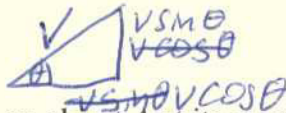
Question 18 (6 marks)

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

velocity and acceleration are constant in the horizontal plane of motion but on the vertical plane, $a = 9.8 \text{ m s}^{-2}$ (g) towards earth.
 $F = ma$ $F = 9.8 \times 30$
 ~~$F = 294 \text{ m s}^{-2}$~~ $= 294 \text{ N}$

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

~~$v = ut + at^2$~~ ~~$v = at$~~ ~~$20 = 20 + at$~~
 ~~$20 = 20 + at$~~ ~~$20 = 20 + at$~~ $a = -9.8 \text{ m s}^{-2}$
 ~~$v = 20$~~ ~~$v = 20$~~ $v = v + at$ $t = ?$
 ~~$20 = 20 + at$~~ ~~$20 = 20 + at$~~ $20 = (20 \cos 20^\circ) + -9.8t$ $v = 18.794$
 ~~$t = 4.8(20 \cos 20 - 20) = t$~~ $t = 11.8 \text{ s}$ $v = 20$
 $v = 20 \times 0.93969262$
 $= 18.794$
3

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

Force on A = 9.8×30
 $= 294 \text{ N}$
 Because only gravity is acting vertically on A.
 On B, the only force acting on it is centripetal force because the force of gravity is equal by the force of the pivot on B - Newton's 2nd Law.

Marks

Question 19 (4 marks)

How does Einstein's Theory of Special Relativity explain the result of the Michelson-Morley experiment? 4

Einstein states that the speed of light is constant and is not affected by any medium. It is in Michelson-Morley's experiment proved the ether did not exist and at the same time showed that the speed of light is constant because it took the light rays the same time to return to the observer after being reflected off the mirrors.

Question 20 (4 marks)

The electrical supply network uses a.c. and a variety of transformers between the generating stations and the final consumer. 4

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

Transformers are used at various points in the network to reduce or increase the voltage for its purpose. As carrying voltages as high as possible reduces the current, less energy is lost through heat resistance. Transformers are used to change the voltage. Household appliances usually required voltages of 240 volts downwards, but as it is more economical to transport high voltages, transformers are needed to convert the voltage for suitable use.