

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION
 Physics

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Centre Number

Section I – Part B (continued)

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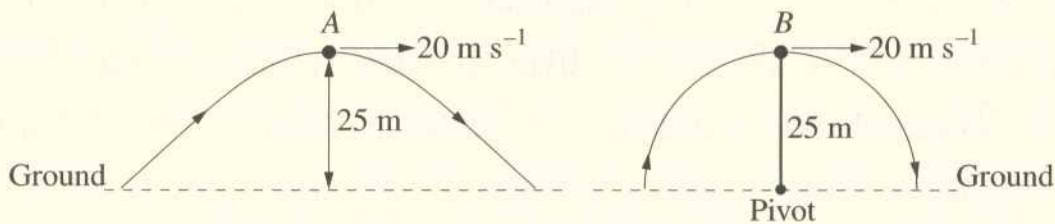
Student Number

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

$$\begin{aligned}
 s &= \dots & F &= m \times a & m &= 30 & a &= -9.8 \\
 u &= 20 \cos \theta & F &= 30 \times 9.8 & & & & \\
 t & & F &= 294 & & & &
 \end{aligned}$$

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

$$\begin{aligned}
 s &= 25 \text{ m} & v^2 &= u^2 + 2 \times a \times s & v &= u + at \\
 u &= \sqrt{490} & 0 &= u^2 + 2 \times -9.8 \times 25 & 0 &= \sqrt{490} + -9.8t \\
 v &= 0 & u^2 &= 490 & t &= \frac{\sqrt{490}}{9.8} \\
 a &= -9.8 & u &= \sqrt{490} & & \\
 t & & & & &
 \end{aligned}$$

$t = 2.26$ seconds (2 ap)

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

The projectile in object A is undergoing a parabolic trajectory. The force is applied downwards towards the earth due to gravitational attraction.

The mechanical arm is undergoing centripetal force which is always directed towards the centre (ground).

While both forces are towards the ground one is due to gravitational attraction while the other is due to centripetal force.

to reach the ground
i.e. $t = 2.26$ s

Question 19 (4 marks)

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

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Einstein's theory of special relativity states that light has a constant velocity regardless of frame of reference. In the Michelson-Morley experiment light was shone at all possible angles onto a viewing plate, in order to locate interference patterns from the "aether wind". No ~~such~~ interference was found, although Einstein's special relativity shows that at the speed of earth (only a fraction of c) the velocity of light is both high and constant, therefore creating no interference patterns. Einstein stated that ~~the~~ light was self-propagating electro-magnetic radiation, therefore discarding the need for the existence of an aether wind, proven by the 'null' result of the Michelson Morley exp.

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 in transmission networks to step down the electric supply. A high current in transmission lines results in a high power loss, therefore low current and high voltage is produced at generating stations to minimize power loss as the electrical supply travels to the sub-stations. Because these high voltages are dangerous and too high for most home electrical appliances, the voltage must be stepped down at sub-stations before it reaches the final consumer.