2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Centre Number

Section I – Part B (continued)

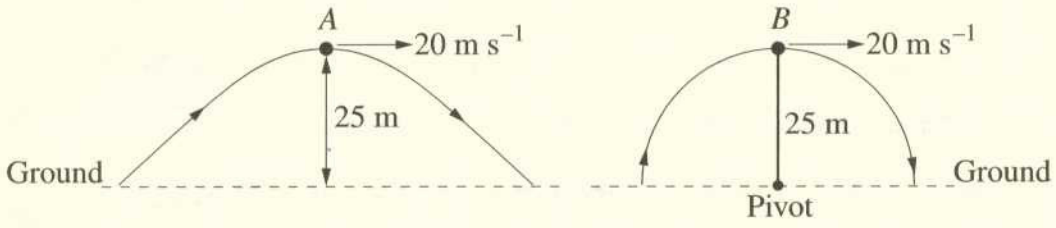
Student Number

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**

$F = ma$

$= 30 \times 9.8$

$= 294$ N.

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

$u = ?$

$s = 25$ $v = 0$ $a = -9.8$ $v^2 = u^2 + 2as$ $s = 0$ $u = 22.13$ $a = -9.8$

$0 = u^2 + 2 \times -9.8 \times 25$ $t = ?$

$490 = u^2$ $s = ut + \frac{1}{2}at^2$

$22.13 \text{ m s}^{-1} = u$ $0 = 22.13t - 4.9t^2$

$= -t(4.9t - 22.13)$.

$4.9t = 22.13$.

$t = 4.518$ sec

$4.518 \div 2 =$

2.26 sec

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

for object A the only force is gravitational force and is given by $F = ma = 294$ N.

for object B there are two forces, gravitional and centripetal, therefore the force is the sum of gravity and circular force ie $F = ma + \frac{mv^2}{r}$

$= 30(9.8 + \frac{20^2}{25})$

$= 774$ N.

$a = r\omega^2$

$v = r\omega$.

$\frac{v}{r} = \omega$

Marks

Question 19 (4 marks)

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

~~Time~~ speed of light is constant for all observers in all reference frames. The Michelson-Morley experiment was to determine the existance of the aether. Using a half silvered mirror they made light travel perpendicular and parallel to the 'etherswind' (assumed to be blowing past the Earth). The expected there to be interference, but a null result resulted. They then concluded that light is either constant or that the aether did not exist. Einstein's Theory explained why they obtained a null result. Since speed of light is constant for all observers in all reference frames, it could explain why no ~~interf~~ interference was observed.

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.

- When the electricity is generated from the power station, ~~it~~ it is not sufficient enough to ~~provide~~ be provided to many individual domestics and industries. Also, because of the wire's resistance, the electricity is lost when is transmitted. Thus to increase the ~~amount~~ voltage of the electricity, step-up transformer is used, so that less amount of the electricity is lost ($P = \frac{V^2}{R}$, if $V \uparrow$, $R \downarrow$)
- When the electricity is transmitted to the last power plant, the voltage is too high to utilise in domestics. Thus the step-down transformer should be used to decrease the voltage to 220~240V.
- In Conclusion, transformers are needed to modify voltage, ~~to~~ suitable to various points in the network

$P = VI$ ½