Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

Mid-Year Examination 2018
Secondary Three

ADVANCED PHYSICS

Section D **2 hours**

Wednesday **9 May 2018** **8:45 – 10:45**

Calculators may be used

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section D (20 marks)
Answer **all** questions. Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES
Section D is to only be taken by students studying Advanced Physics.
You are advised to spend no longer than 30 minutes on Section D.

Examiner's Use	
Section D	
1	
2	
3	
Total	
	20
	%

Given Formulae:

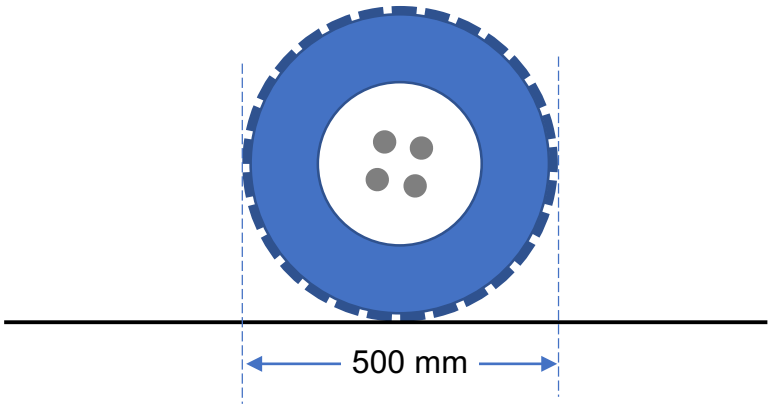
$$v = r\omega$$

$$a = \frac{v^2}{r}$$

$$F = \frac{Gm_1m_2}{r^2}$$

Section D (20 marks)

1 A car wheel of diameter 500 mm rotates at 6 complete revolutions per second.



(a) Calculate the angular speed of the wheel. State your answer in radians per second.

angular speed of wheel = ... [2]

(b) Calculate the linear speed of the car along the road.

linear speed of car = ... [2]

(c) Calculate the centripetal acceleration of the edge of the wheel towards the centre of the wheel.

centripetal acceleration = ... [2]

2 The Space Shuttle has a maximum orbital height of 620 km above sea level.

You are given the following information:

Mass of Earth	= 6.0×10^{24} kg
Radius of Earth (to sea level)	= 6370 km
Gravitational constant, G	= 6.67×10^{-11} m^3 kg^{-1} s^{-2}

(a) Calculate the gravitational field strength at this maximum height.

gravitational field strength = …… [3]

(b) The mass of an astronaut on the surface of the Earth is 80 kg. Calculate the gravitational force on the astronaut when he is aboard the Space Shuttle orbiting at a height of 620 km.

gravitational force on astronaut = …… [2]

(c) Explain why the astronaut appear to be weightless when he is in the Space Shuttle orbiting the Earth.

……

……

…… [1]

3 A ball is to be kicked so that, at the highest point of its path, it just clears a horizontal cross-bar on a pair of goal-posts. The ground is level and the top of the cross-bar is 2.50 m from the ground. The ball is kicked from ground level with an initial velocity of 12.0 m s^{-1}.

(a) Calculate the angle of projection of the ball as it is kicked and leaves the ground.

angle of projection = …… [3]

(b) Determine the time the ball is in the air until it passes over the cross-bar.

time = …… [2]

(c) Calculate the horizontal velocity of the ball as it passes over the cross-bar.

horizontal velocity = …… [2]

(d) Calculate the horizontal distance of the point where the ball is kicked from the goal-post.

distance from goal-post = …….. [1]

2018 MYE ADVANCED PHYSICS ANSWERS (SECTION D)

1. **(a)** $\omega = \frac{\theta}{t} = \frac{6 \times 2\pi}{1}$ = 37.7 rad s^{-1}

(b) v = r ω = 0.500/2 x 37.7 = 9.4 m s^{-1}

(c) $\boldsymbol{a} = \frac{\boldsymbol{v^2}}{\boldsymbol{r}} = \frac{\boldsymbol{9.4^2}}{\boldsymbol{r}}$ = 355 m s^{-2}

2. **(a)** $g = \frac{GM}{r^2} = \frac{\mathbf{6.67 \times 10^{-11} \times 6.0 \times 10^{24}}}{\mathbf{(6{,}370{,}000 + 620{,}000)^2}}$ = 8.19 m s^{-2}

(b) W=mg =80 x 8.19 = 655 N

(c) The astronaut has the same acceleration as the spacecraft he is in.

3. **(a)** $v_Y^2 = u_Y^2 + 2a_Y Y$
$0 = (u\sin\theta)^2 + 2(-10)2.5$
$(12\sin\theta)^2 = 50$
$\sin\theta = \frac{\sqrt{50}}{12}$
$\theta = 36.1°$

(b) $v_Y = u_Y + a_Y t$
$0 = 12\sin 36.1° - 10t$
$t = 0.707$ s

(c) $v_x = u_x = u\cos\theta$
$= 12\cos 36.1°$
= 9.70 m/s

(d) $x = u_x t$
$= 12\cos 36.1° \times 0.707$
x= 6.85 m