UNIVERSITY OF JOHANNESBURG

	Student's Mark	Question's Mark
Q 1		14
Q 2		22
Q 3		19
Q 4		19
Q 5		15
Q 6		11
Total		100

DEPARTMENT OF PHYSICS (APK)

MODULE: PHYSICAL SCIENCES FOR FET 2A

CODE: PSFT02A

NOVEMBER EXAMINATION 2016

DATE: 26 NOVEMBER 2016

FACULTY OF SCIENCE

EXAMINER/MODERATOR — **Mr. M Khwanda**, **Mr. P Molefe**

TIME — 3 Hours

MARKS — 100 MARKS

INSTRUCTIONS: ANSWER ALL THE QUESTIONS IN THE SPACES PROVIDED

NUMBER OF PAGES: 15, INCLUDING COVER PAGE

REQUIREMENTS: SCIENTIFIC CALCULATOR, NO PROGRAMMABLE CALCULATORS ARE ALLOWED

Student Number									

ID Number													

Surname and Initials: ______________________

Contact Number: ______________________

Venue: __________

Question 1: Circular Motion **[14]**

1.1 A car moves at a constant speed along a straight line as it approaches a circular turn. In which of the following parts of the motion is the car in equilibrium? Choose the correct answer and then justify your choice using applicable scientific law(s). (2)

A: As it moves along the straight line towards the circular turn

B: As is going around the circular turn

C: As it moves away from the turn along a straight line

1.2 With the aid of a suitable diagram, show that the recommended speed of the car around a banked curve is independent of the mass of the car. (6)

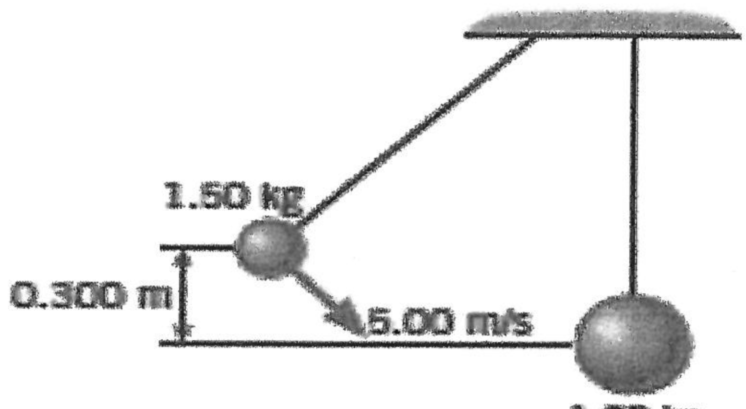
1.3 Two banked curves have the same radius. Curve A is banked at an angle of 10^0, and curve B is banked at an angle of 17^0. A car can travel around curve A without relying on friction at a speed of 21 *m/s*. Calculate the speed this car can travel around curve B without relying on friction. (6)

Question 2: Impulse and momentum [22]

2.1 State the principle of conservation of momentum. (2)

2.2 Two cars are moving with the same speed in opposite directions (Car A moving to the North while car B is moving to the South). Do you think the two cars will have the same momentum? Explain. (2)

2.3 Starting with an initial speed of 5.00 *m/s* at a height of 0.30 *m*, a 1.50 *kg* ball swings downward and strikes a 4.60 *kg* ball at rest as the drawing shows below.

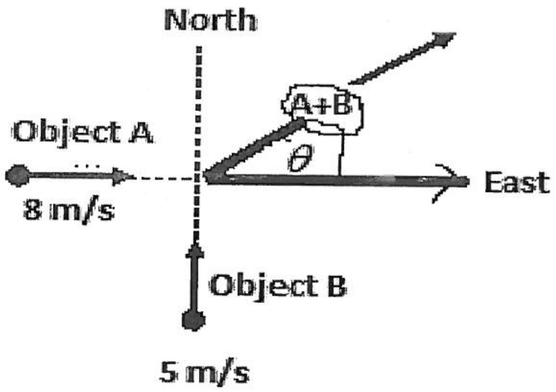


2.3.1 Using the principle of conservation of mechanical energy, calculate the speed of the 1.50 *kg* ball just before impact. (4)

2.3.2 Assuming that the collision is elastic, calculate the velocities of both balls after collision. (4)

2.3.3 Ignoring the effect of air resistance, how high does each ball swing after collision?(4)

2.4 An object A is moving due East, while object B is moving due North. They collide and stick together in a completely inelastic collision. Momentum is conserved. Object A has a mass of 17 *kg* and a velocity of 8 *m/s* due East. Object B has the mass of 29 *kg* and an initial velocity of 5 *m/s* due North. Calculate the magnitude and direction of the total momentum of the two object system after collision. (6)



Question 3: Sound, waves and light **[19]**

3.1 A wave travelling along the negative x-axis is described mathematically by the equation $y = 0.17\, sin\, (8.2\pi t + 0.54\pi x)$, where y is the displacement (in meters), t is in seconds, and x is position of a particle in meters. Calculate the speed of the wave. (6)

3.2 Explain what you understand by the term "Doppler effect". (1)

3.3 A car is parked 20 m directly south of a railroad crossing from the west, headed directly east at a speed of 55 m/s. The train sounds a short blast of nits 289 Hz horn when it reaches a point of 20 m west of the crossing. The speed of sound in air is 343 m/s. Calculate the magnitude of the frequency the car's driver hear when the horn blast reaches the car. (5)

3.4 Show that the relation between the magnitudes of the electric and magnetic fields in an electromagnetic wave is given by $\boldsymbol{E = c\,B}$. (7)

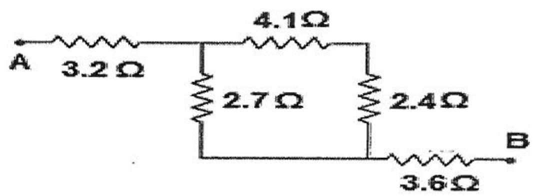
Question 4: Direct Current Electric Circuits **[19]**

4.1 A circuit consists of two bulbs (A and B) with different resistances connected in series. Bulb A has smaller resistance in compared to bulb A. When the switch is ON, all bulbs shine (emit light).Use your knowledge of electric fields to answer the following questions:

4.1.1 Explain what causes the bulbs to shine. (3)

4.1.2 Which bulb shines brighter? Explain (2)

4.2 Five resistors are connected as shown in the diagram. The potential difference between points **A** and **B** is 15 *V*. Calculate

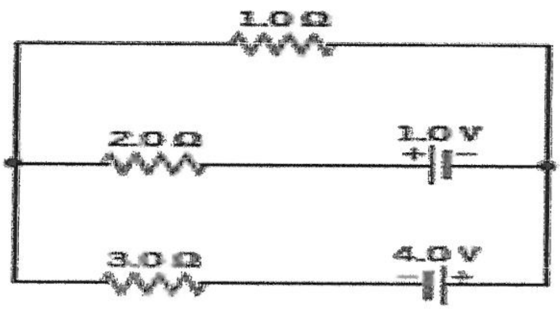


4.2.1 the equivalent resistance between the points **A** and **B**. (4)

4.2.2 the current in a 3.6 Ω resistor. (2)

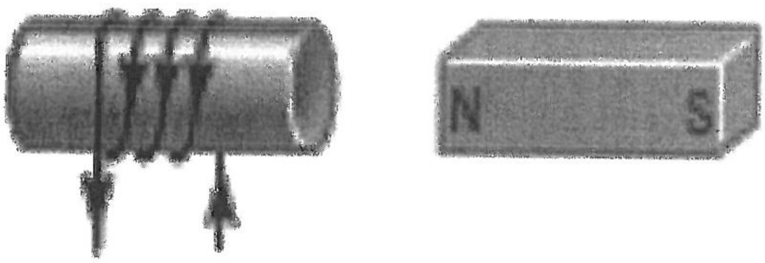
4.3 State Kirchhoff's junction rule. (1)

4.4 Label the diagram and apply Kirchhoff's rules to calculate the magnitude of current in the 2 Ω resistor (7)

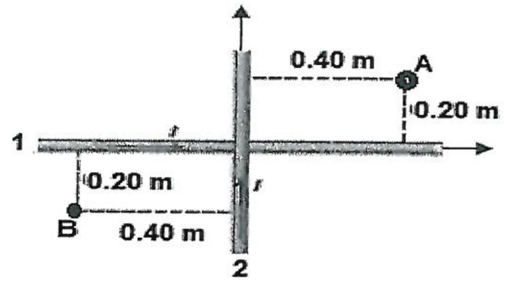


Question 5: Electromagnetism **[15]**

5.1 The diagram represents an electromagnet on the left and the permanent magnet on the right. Do you think an electromagnet will be repelled or attracted by the magnet? Explain your answer. (2)

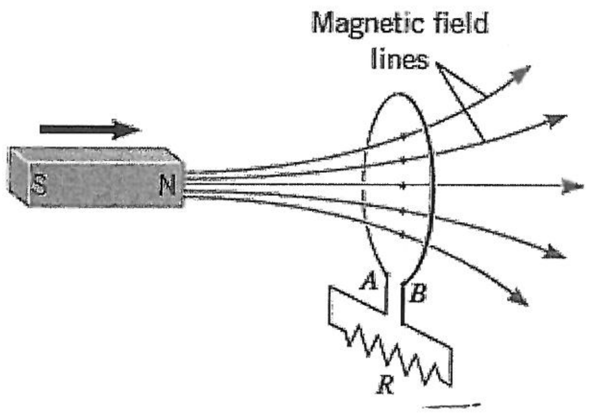


5.2 The drawing shows two perpendicular, long, straight wires 1 and 2, both of which lie in the plane of the paper. The current in each of the wires is I = 5.6 *A* in the direction indicated by an arrow. Using the applicable rule, calculate the magnitude of the net magnetic fields at point ***A.*** (3)



5.3 State Lenz's law. (1)

5.4 The diagram shows a permanent magnet approaching a loop of wire. The external circuit is attached to the loop consists of the resistance R, which could represent the filament in the light bulb. Determine the polarity of the points A and B. *Hint: Say if point A negative and point B positive or point A positive and point B negative?* Explain your answer. (3)



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5.5 A step-down transformer inside a stereo receiver has 330 turns in the primary coil and 25 turns in the secondary coil. The plug connects the primary coil to a 120 V wall socket, and there is a current of 0.83 A in the primary coil while the receiver is turned ON. Connected to the secondary coil are the transistor circuits of the receiver. Calculate:

5.5.1 the voltage across the secondary coil. (2)

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5.5.2 the current in the secondary coil and the average power delivered to the transistor circuits. (4)

Question 6: Particles and Waves [11]

6.1 Mention only one experimental evidence that shows that light is:

6.1.1 A wave ______________________ (1)

6.1.2 A particle ______________________ (1)

6.2 What is photoelectric effect? (2)

6.3 Sunlight, whose visible wavelength range from 380 nm to 750 nm, is incident on a sodium surface. The work function of sodium is $W_0 = 2.28$ eV. Calculate:

6.3.1 the maximum kinetic energy KE_{max} (in joules) of the photoelectrons emitted from the surface. (4)

6.3.2 the range of wavelengths that will cause photoelectrons to be emitted. (3)

TOTAL MARKS 100

Useful Information

$v = \frac{2\pi r}{T}$ $f_o = f_s\left(\frac{1\pm\frac{v_o}{v}}{1\mp\frac{v_o}{v}}\right)$ $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ $\frac{I_s}{I_p} = \frac{N_p}{N_s}$

$E_T = \frac{1}{2}mv^2 + mgh$ $P = mv$ $E = hf$ $hf = KE_{max} + W_0$

$R = \frac{V}{I}$ $R_s = R_1 + R_2 + R_3 + \cdots$ $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$ $P = IV$

$B = \frac{F}{/q_o/v\sin\theta}$ $r = \frac{mv}{/q/B}$ $B = \frac{\mu_o I}{2\pi r}$ $F = ILB\sin\theta$

$\mu_o = 4\pi \times 10^{-7}\, T.\frac{m}{A}$ $g = 9.8\, m/s^2$ $C = \frac{1}{\sqrt{\epsilon_0\mu_0}} = 3 \times 10^8\ m/s$

$h = 6.62 \times 10^{-34} J.s$ $1\, eV = 1.6 \times 10^{-19} J$ $u = \epsilon_0 B^2 = \frac{1}{\mu_o}E^2$

$(\Delta p_y)(\Delta y) \geq \frac{h}{4\pi}$ $(\Delta E)(\Delta t) \geq \frac{h}{4\pi}$