UNIVERSITY OF JOHANNESBURG

DEPARTMENT OF PHYSICS (APK)

MODULE: PHYSICAL SCIENCES FOR FET 2A

CODE: PSFT02A

SSA JULY EXAMINATION

DATE: July 2019

	Student's Mark	Question's Mark
MCQ		20
Q 1		25
Q 2		30
Q 3		25
Total		100

FACULTY OF SCIENCE

EXAMINER/MODERATOR — **Mr. M Khwanda**, **Dr. B.M Sondezi**

TIME — 3 Hrs

MARKS — **100 MARKS**

INSTRUCTIONS: ANSWER ALL THE QUESTIONS IN THE SPACES PROVIDED

NUMBER OF PAGES: 16 SINGLE SIDED, INCLUDING COVER PAGE
REQUIREMENTS: SCIENTIFIC CALCULATOR, NO PROGRAMMABLE CALCULATORS ARE ALLOWED

Student Number									

ID Number													

Surname and Initials: _____

Contact Number: _____

Venue: _____

MCQ Answer sheet

1	2	3	4	5	6	7	8	9	10

SECTION A [20]

Write only the correct letter that represents your correct choice in the table above.

1. A ball moves with a constant speed of 4 m/s around a circle of radius 0.25 m. What is the period of the motion?

   A) 0.1 s

   B) 0.4 s

   C) 0.7 s

   D) 1 s

   E) 2 s

2. Complete the following statement: The maximum speed at which a car can safely negotiate an unbanked curve depends on all of the following factors except

   A) the diameter of the curve.

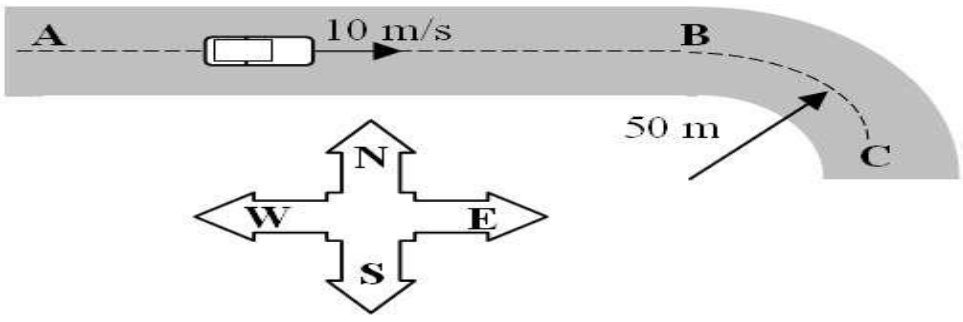
   B) the acceleration due to gravity.

   C) the coefficient of static friction between the road and the tires.

   D) the coefficient of kinetic friction between the road and the tires.

   E) the ratio of the static frictional force between the road and the tires and the normal force exerted on the car.

3. A 1800 kg Jeep travels along a straight 500 m portion of highway (A to B) at a constant speed of 10 m/s. At B, the Jeep encounters an unbanked curve of radius 50 m. The Jeep follows the road from B to C traveling at a constant speed of 10 m/s while the direction of the Jeep changes from east to south. What is the magnitude of the acceleration of the Jeep as it travels from **A** to **B**?



A) 2 m/s^2

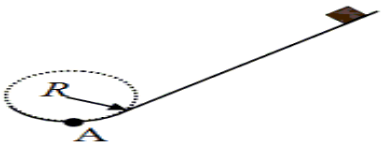
B) 5 m/s^2

C) 10 m/s^2

D) 20 m/s^2

E) zero m/s^2

4. A 25 kg box is sliding down an ice-covered hill. When it reaches point A, the box is moving at 11 m/s. Point A is at the bottom of a circular arc that has a radius R = 7.5 m. What is the magnitude of the normal force on the box at Point A?



A) 250 N

B) 280 N

C) 400 N

D) 650 N

E) 900 N

5. The potential difference across the ends of a wire is doubled in magnitude. If Ohm's law is obeyed, which one of the following statements concerning the resistance of the wire is true?

A) The resistance is one half of its original value.

B) The resistance is twice its original value.

C) The resistance is not changed.

D) The resistance increases by a factor of four.

E) The resistance decreases by a factor of four.

6. Complete the following statement: A simple series circuit contains a resistance R and

an ideal battery. If a second resistor is connected in parallel with *R*,

A) the voltage across *R* will decrease.

B) the current through *R* will decrease.

C) the total current through the battery will increase.

D) the rate of energy dissipation in *R* will increase.

E) the equivalent resistance of the circuit will increase.

7. Which one of the following statements concerning momentum is true?

A) Momentum is a force.

B) Momentum is a scalar quantity.

C) The SI unit of momentum is kg . m^2/s.

D) The momentum of an object is always positive.

E) Momentum and impulse are measured in the same units.

8. A stationary bomb explodes in space breaking into a number of small fragments. At the location of the explosion, the net force due to gravity is zero newtons. Which one of the following statements concerning this event is true?

A) Kinetic energy is conserved in this process.

B) All of the fragments must have equal kinetic energies.

C) The sum of the kinetic energies of the fragments must be zero.

D) The vector sum of the linear momenta of the fragments must be zero.

E) The mass of any one fragment must be equal to the mass of any other fragment

9. Two objects constitute an isolated system. In an elastic collision between the two objects, which one of the following statements is a false statement?

A) The total kinetic energy is conserved.

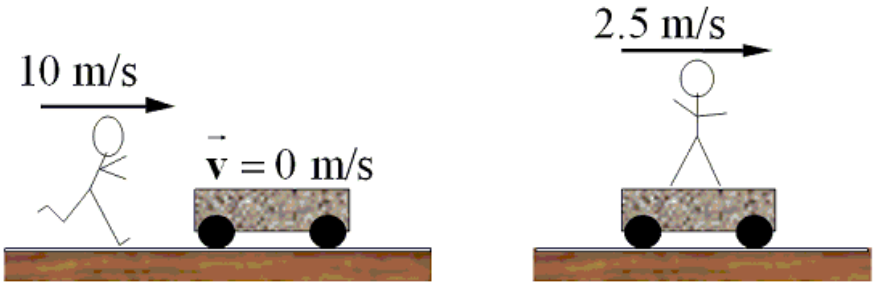
B) The kinetic energy of each object is the same before and after the collision.

C) The total momentum is conserved.

D) The magnitude of the force exerted by each object on the other object is equal.

E) The total kinetic energy before the collision is equal to the total kinetic energy after the collision.

10. A 50.0 kg boy runs at a speed of 10.0 m/s and jumps onto a cart as shown in the figure. The cart is initially at rest. If the speed of the cart with the boy on it is 2.50 m/s, what is the mass of the cart?



A) 150 kg

B) 175 kg

C) 210 kg

D) 260 kg

E) 300 kg

SECTION B

Question 1: Circular Motion **[25]**

1.1 Using your own words, explain what you understand by the concept "uniform circular motion". (2)

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1.2 With the aid of a suitable diagram, show that the only speed the satellite can have if the satellite has to orbit with fixed radius (r) is given by the equation, $v = \sqrt{G\frac{M_E}{r}}$, where G is the universal gravitational constant and M_E, the mass of the earth. (8)

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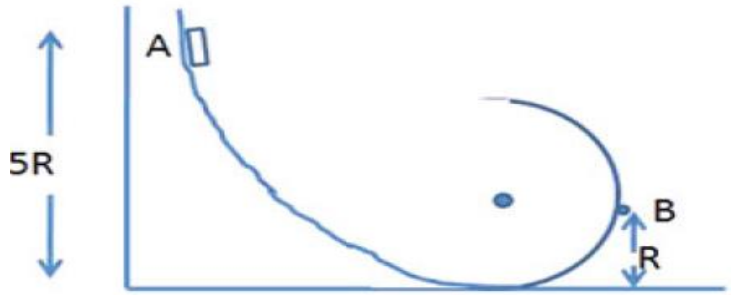
1.3 A motorcycle has a constant speed of 25.0 m/s as it passes over the top of a hill whose radius of curvature is 126 m. The mass of the motorcycle and driver is 342 kg. Calculate:

1.3.1 the centripetal force (2)

1.3.2 the normal force that acts on the cycle. (3)

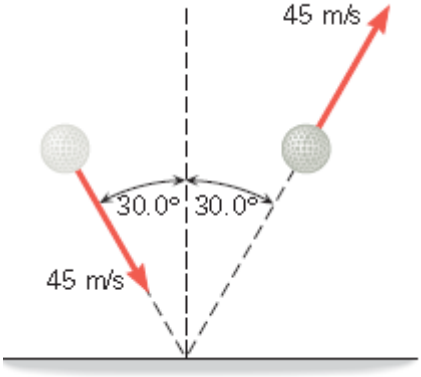
1.4 A small block of mass *m* slides along the frictionless loop-the-loop track as shown. If it starts at A at height *h* = 5*R* to the bottom of the track then show that the resultant force acting on the track at B at height *R* will be $\sqrt{65}$ mg. (10)



Question 2: Momentum and impulse **[30]**

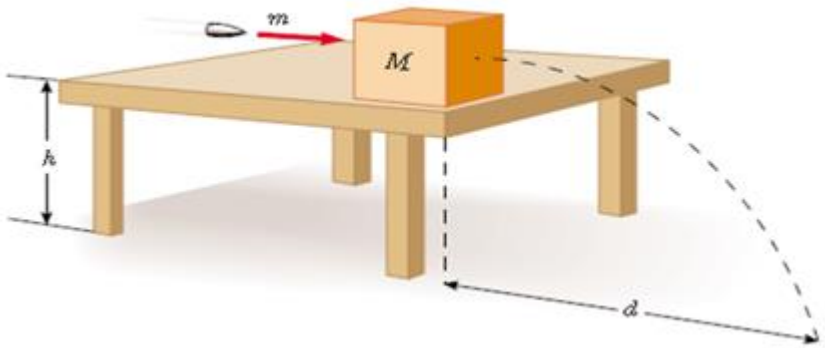
2.1 State the principle of conservation of momentum. (2)

2.2 A golf ball strikes a hard, smooth floor at an angle of 30.0^0 and, as the drawing shows, rebounds at the~~m~~ same angle. The mass of the ball is 0.047 kg, and its speed is 45 m/s just before and after striking the floor. Calculate is the magnitude of the impulse applied to the golf ball by the floor. (8)

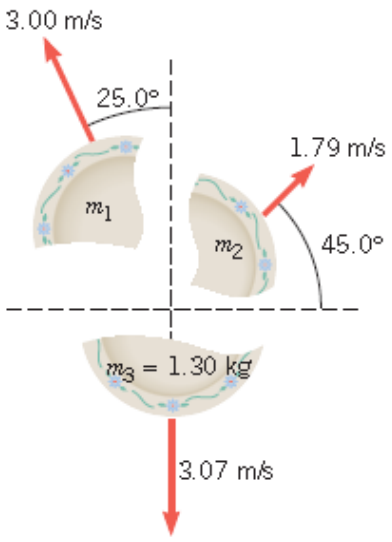


(Hint: Note that only the vertical component of the ball's momentum changes during impact with the floor, and ignore the weight of the ball.)

2.3 A bullet of mass ***m*** was fired into a block of mass M initially at rest at the edge of a frictionless table of height ***h***. The bullet remains in the block, and after impact the block lands a distance d from the bottom of the table. Calculate the initial speed of the bullet. (8)



2.4 By accident, a large plate is dropped and breaks into three pieces. The pieces fly apart parallel to the floor. As the plate falls, its momentum has only a vertical component and no component parallel to the floor. After the collision, the component of the total momentum parallel to the floor must remain zero, since the net external force acting on the plate has no component parallel to the floor. Using the data shown in the drawing, calculate the masses of pieces 1 and 2. (12)



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Question 3: Electric Circuit **[25]**

3.1 State the definition of "ohm's law " in words. (1)

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3.2 Explain why the battery becomes flat after being connected for a long time. (3)

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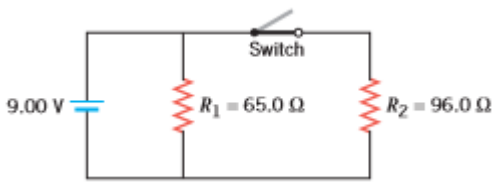
3.3 The drawing shows a circuit that contains a battery, two resistors, and a switch.



3.3.1 Is the 9.00 V on the battery an **emf** or **potential difference** when the switch on the diagram above is open? Explain your choice. (3)

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3.3.2 Explain which resistor will have more power when the switch is closed without doing any calculations. (3)

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3.3.3 Calculate the total power delivered to the circuit

3.3.3.1 when the switch is open. (1)

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3.3.3.2 when the switch is closed. (4)

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3.4 State Kirchhoff's loop rule. (2)

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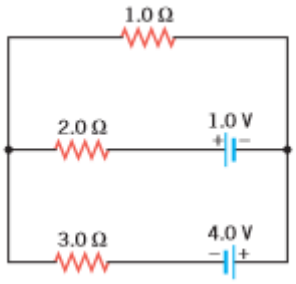
3.5 Calculate the magnitude and the direction of the current in the 2.0 Ω resistor in the drawing. (8)



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