UNIVERSITY OF JOHANNESBURG

DEPARTMENT OF PHYSICS (APK)

MODULE: PHYSICAL SCIENCES FOR FET 1A

CODE: PSFT01A

JUNE EXAM

DATE: 8 June 2019

	Student's Mark	Question's Mark
MCQ		20
Q 1		14
Q 2		17
Q 3		15
Q 4		14
Q5		20
Total		100

FACULTY OF SCIENCE

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

TIME — 180 MINUTES

MARKS — **100**

INSTRUCTIONS: ANSWER ALL THE QUESTIONS IN THE SPACES PROVIDED

NUMBER OF PAGES: 18 BACK-TO-BACK, INCLUDING COVER PAGE WITH 5 QUESTIONS
REQUIREMENTS: SCIENTIFIC CALCULATOR, NO PROGRAMMABLE CALCULATORS ARE ALLOWED

Student Number									

ID Number													

Surname and Initials: _____

Contact Number: _____

Venue: _____

MCQ Answer table

1	2	3	4	5	6	7	8	9	10

Section A: Multiple Choice Questions **(20)**

In each of the following question, write the question item number and the correct letter that represents your choice on the table provided in page 1.

1. A particle travels along a curved path between two points P and Q as shown. The displacement of the particle does *not* depend on

A) the location of P.

B) the location of Q.

C) the distance traveled from P to Q.

D) the shortest distance between P and Q.

E) the direction of Q from P.

2. Which one of the following statements must be true if the expression $x = v_0 t + \frac{1}{2}at^2$ is to be used?

A) *x* is constant.

B) *v* is constant.

C) *t* is constant.

D) *a* is constant.

E) Both v_0 and *t* are constant.

3. A ball is thrown vertically upward from the surface of the earth. Consider the following quantities:

(1) the speed of the ball: (2) the velocity of the ball; (3) the acceleration of the ball.

Which of these is (are) zero when the ball has reached the maximum height?

A) 1 and 2 only

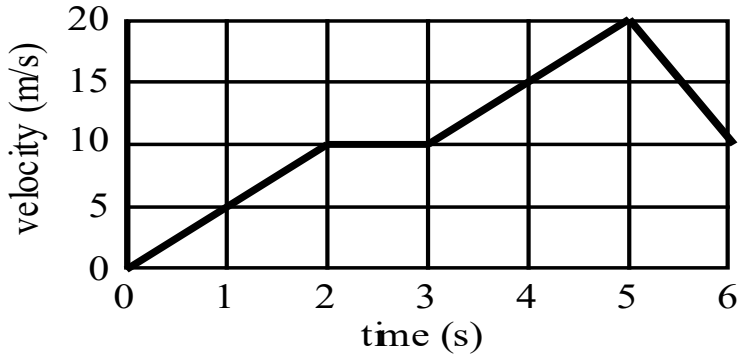
B) 1 and 3 only

C) 1 only

D) 2 only

E) 1, 2, and 3

4. An object is moving along a straight line. The graph shows the object's velocity as a function of time. During which interval(s) of the graph does the object travel *equal distances* in *equal times*?



A) 0 s to 2 s

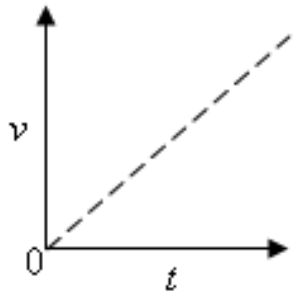
B) 2 s to 3 s

C) 3 s to 5 s

D) 0 s to 2 s and 3 s to 5 s

E) 0 s to 2 s, 3 to 5 s, and 5 to 6 s

5. The figure below shows the speed as a function of time for an object in free fall near the surface of the earth. The object was dropped from rest in a long-evacuated cylinder. Which one of the following statements best explains why the graph goes through the origin?



A) The object was in a vacuum.

B) The object was dropped from rest.

C) The velocity of the object was constant.

D) All *v* vs. *t* curves pass through the origin.

E) The acceleration of the object was constant.

6. A football is kicked at an angle θ with respect to the horizontal. Which one of the following statements best describes the *acceleration* of the football during this event if air resistance is neglected?

   A) The acceleration is zero m/s^2 at all times.

   B) The acceleration is 9.8 m/s^2 at all times.

   C) The acceleration is zero m/s^2 when the football has reached the highest point in its trajectory.

   D) The acceleration is positive as the football rises, and it is negative as the football falls.

   E) The acceleration starts at 9.8 m/s^2 and drops to some constant lower value as the ball approaches the ground.

7. Which one of the following choices is an example of a conservative force?

   A) tension

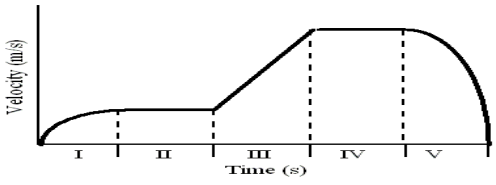
   B) normal force

   C) static frictional force

   D) motor propulsion force

   E) elastic spring force

8. A 2.0 *kg* object moves in a straight line on a horizontal frictionless surface. The graph shows the velocity of the object as a function of time. The various equal time intervals are labeled using Roman numerals: I, II, III, IV, and V. The net force on the object always acts along the line of motion of the object. Which section(s) of the graph corresponds to a condition of *zero net force*?



   A) V only

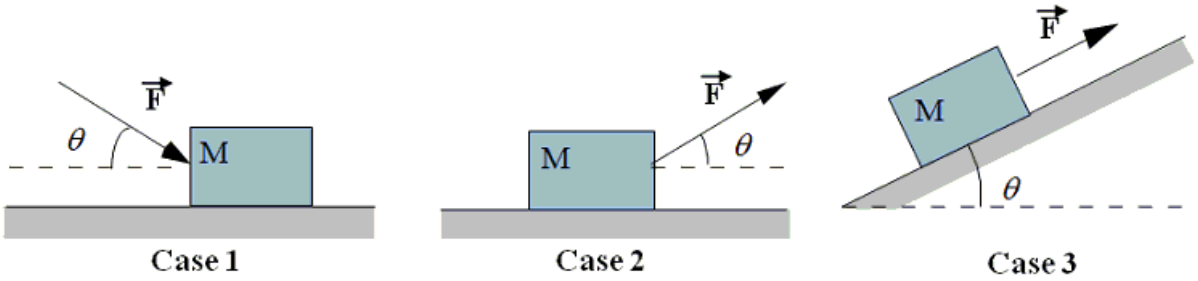
   B) III only

   C) II and IV

   D) II, III, and IV

   E) I, III, and V

9. Note the following situations: In which case will the magnitude of the normal force on the block be equal to ($Mg + F \sin \theta$)?



A) case 1 only

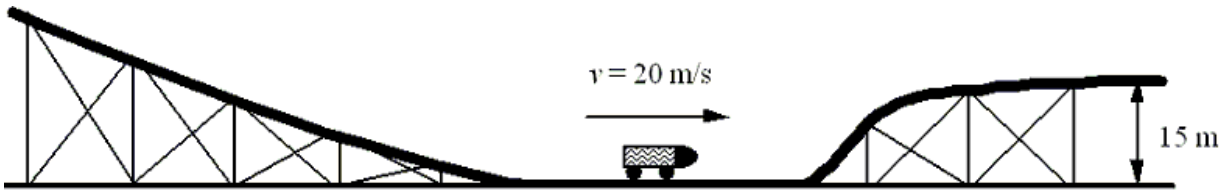
B) case 2 only

C) both cases 1 and 2

D) both cases 2 and 3

E) cases 1, 2, and 3

10. A roller-coaster car is moving at 20 m/s along a straight horizontal track. What will its speed be after climbing the 15-m hill shown in the figure, if friction is ignored?



A) 17 m/s

B) 7 m/s

C) 5 m/s

D) 10 m/s

E) 14 m/s

Section B:

Question 1: Units and Measurements **[14]**

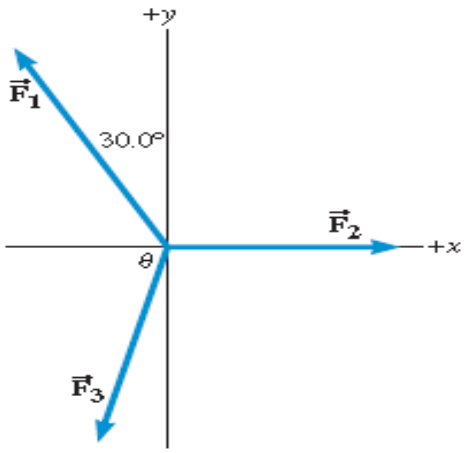
1.1 Use the unit conversion factor method to convert the following noting that:

1m = 100 cm and 1 mile = 1.609 km

1.1.1 The volume of a box is 100. cm^3 to m^3 (3)

1.1.2 The speed limit of 100 miles/hour to meters/second. (3)

1.2 Three forces act on an object, as indicated in the drawing. Force $\mathbf{F_1}$ has a magnitude of 21.0 N and is directed 30.0^0 to the left of the +*y* axis. Force $\mathbf{F_2}$ has a magnitude of 15.0 N and points along the axis. What must be the magnitude and direction (specified by the angle θ in the drawing) of the third force such that the vector sum of the three forces is 0 N? (8)

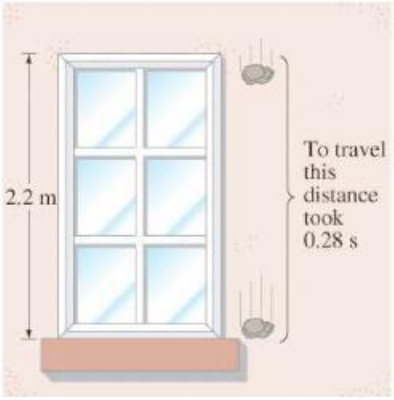


Question 2: Kinematics in one dimensions **[17]**

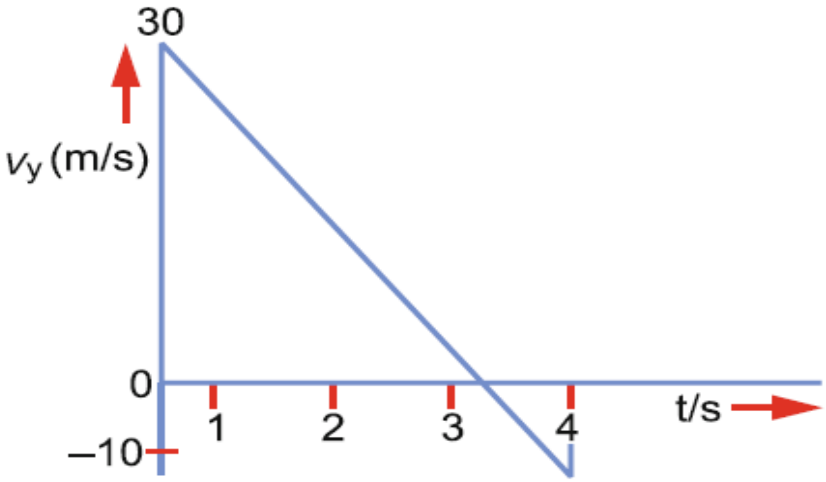
2.1 Define acceleration using your own words. (1)

2.2 Do you think the steering wheel of the car shown below can be used as an accelerator? Explain your answer. (3)

2.3 A falling stone takes 0.28 s to travel past a window 2.2 m tall as shown in the picture below. From what height above the top of the window did the stone fall? (6)



2.4 The velocity–time graph for the vertical component of the velocity of an object thrown upward from the ground which reaches the roof of a building and returns to the ground is shown on the graph.

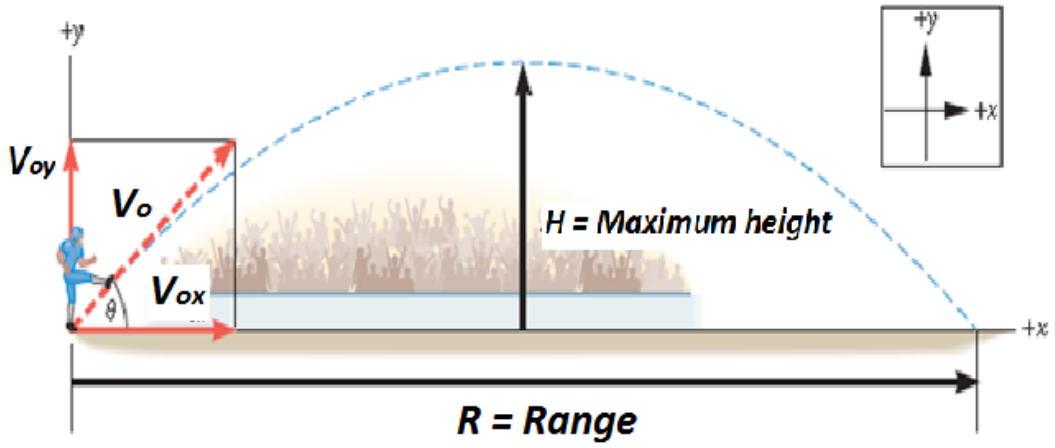


2.4.1 Calculate the height of the building. (4)

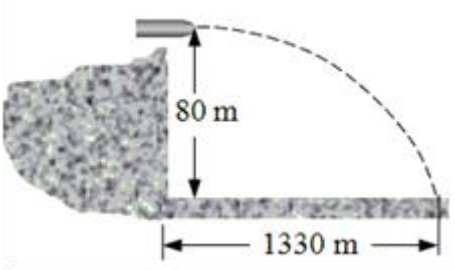
2.4.2 Draw a rough sketch of an acceleration-time graph for the whole period of the motion, label the axes correctly. (3)

Question 3: Kinematics in two dimensions **[15]**

3.1 The ball is shot with an initial speed of $\mathbf{v_0}$ at an angle θ above the horizontal as shown on the diagram below. Use the diagram to prove that the horizontal range R is given by the equation, $R = \frac{{v_0}^2 sin2\theta_0}{g}$ (8)

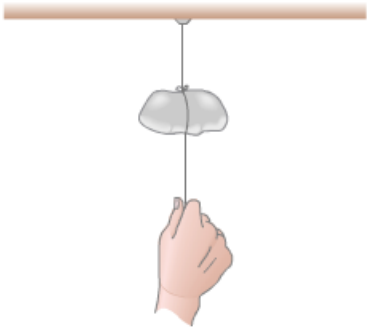


3.2 A shell is fired with a horizontal velocity in the positive x direction from the top of an 80 m high cliff. The shell strikes the ground 1330 m from the base of the cliff. The drawing is not to scale. Calculate the initial speed of the shell (7)



Question 4: Newton's laws **[14]**

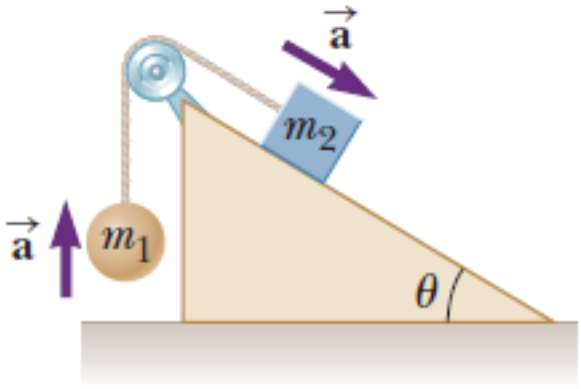
4.1 A stone hangs by a fine thread from a ceiling, and a section of the thread dangles from the bottom of the stone as shown on the diagram that follows. If a person gives a sharp pull on the dangling thread, where is the thread likely to break: below the stone or above it? Explain your answer. (3)



4.2 State Newton's second law in words. (2)

4.3 A block of mass m_2 on a rough, horizontal surface is connected to a ball of mass m_1 by a lightweight cord over a lightweight, frictionless pulley as shown on the diagram that follows. The coefficient of kinetic friction between the block and surface is μ_k. If the whole system moves as indicated by arrows. Make use of free-body diagrams to show that the acceleration of the system is given by the equation

$$a = \frac{(m_2 sin\theta - m_1 - \mu m_2 cos\theta)g}{(m_1 + m_2)} \qquad (9)$$



Free body diagram for m_1	Free body diagram for m_2

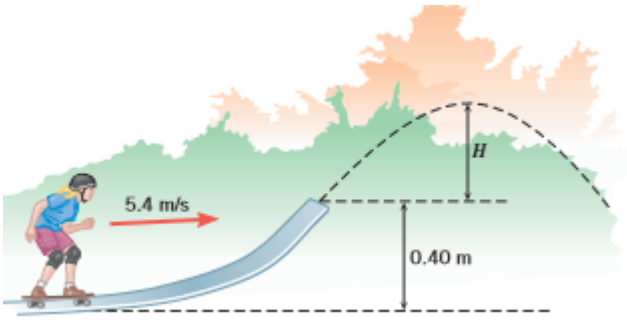
Question 5: Work and Energy **[20]**

5.1 Define the term “non-conservative force”. (2)

5.2 If W_{NC} represents external work done by non-conservative forces and $E = \frac{1}{2}mv^2 + mgh$ representing the total mechanical energy of the system, show that the work done by external non-conservative forces is equal to the change in the total mechanical energy of the system. Hence show that $W_{NC} = E - E_0$. (9)

5.3 The drawing shows a skateboarder moving at 5.4 m/s along a horizontal section of a track that is slanted upward by 48^0 above the horizontal at its end, which is 0.40 m above the ground. When she leaves the track, she follows the characteristic path of projectile motion. Ignoring friction and air resistance, calculate the maximum height H to which she rises above the end of the track.

(9)



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