UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

MODULE: PHYSICS PH1AEET

DFC CAMPUS

JUNE EXAMINATION

DATE: 31/05/2014	**SESSION: 08:30 – 11:30**
ASSESSOR:	**MR. MJ.MVELASE**
INTERNAL MODERATOR:	**DR J CHANGUNDEGA**
DURATION: 3 HOURS	**MARKS: 100**

NUMBER OF PAGES: 8 PAGES, INCLUDING 2 INFORMATION SHEETS

INSTRUCTIONS:INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)
ANSWER ALL QUESTIONS IN SAECTION A ON THE ANSWER BOOK PROVIDED
ANSWER ALL QUESTIONS IN SAECTION B ON THE MCQ GRID PROVIDED

ANSWER ALL QUESTIONS IN THE ANSWER BOOK PROVIDED

QUESTION 1

A car travels 35km in a direction 60° above the horizontal to the east, and then 20km due north.

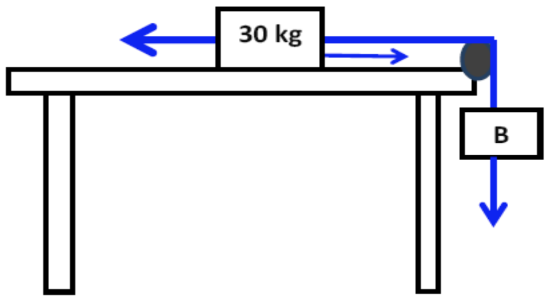
Calculate the magnitude and direction of the car's resultant displacement. (10)

[10]

QUESTION 2

2.1. State Newton's second law (3)

2.2. A block of mass 30kg is lying on a table with a roughness of μ = 0.3. This block is supported bya suspended 20 kg block on the other end of the table as indicated on the diagram below.



Calculate

2.2.1. The force F required for the 20 kg block to accelerateby $0.6 m.s^{-2}$. (4)

2.2.2. What is the tension in the cord? (2)

2.3. A traffic light of a particular weight hangs from a cable tied to two other cables fastened to supports. The upper cables make angles of θ_1=40° and θ_2=50° with the horizontal. The cable making θ_1=40°with the horizontal is 150 N.

Calculate:

2.3.1. The tension T_2 in the cable makingan angle of 50^o (4)

2.3.2. The weight of the traffic light (4)

[17]

QUESTION 3

3.1. State Newton'slaw of Gravitation (3)

3.2. Calculate the mass of the Earth if the assumption that it is a sphere with a radius 6.37×10^{6}m is made. $G=6.67\times10^{-11}Nm^{2}kg^{-2}$ (3)

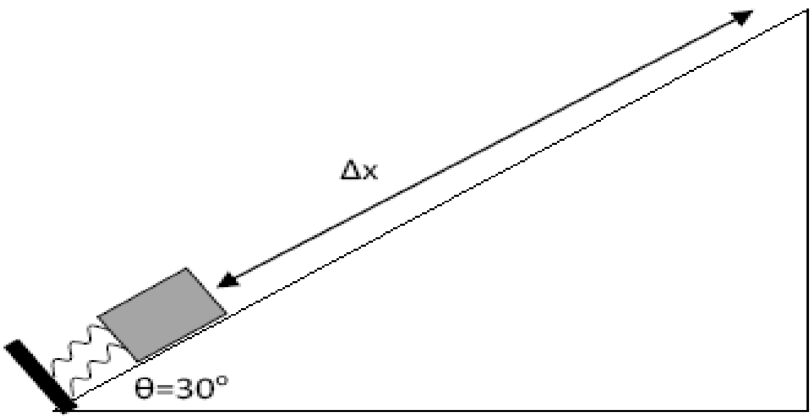
3.3. Cristiano Ronaldo kicked a ball at an angle of 30^{o} relative to the ground. If the initial speed of the ball is $40 m.s^{-1}$; calculate:

3.3.1. The maximum height reached by the ball (3)

3.3.2. The total time of the flight of the ball (3)

3.3.3. The horizontal range of the ball (3)

3.4. A 5 kg object is held against a spring with a stored potential energy of 200 J as shown below. The system is inclined at 30^{o} as shown in the diagram below.



Calculate

3.4.1. The maximum distance Δ***x***a 5 kg object would climb when released from the spring if it reaches the top of the incline with a velocity of $5m.s^{-1}$. (5)

3.4.2. The height reached in question 3.4.1. (2)

[22]

QUESTION 4

4.1. Find the wavelength of the spectral line corresponding to the transition in hydrogen from the n=6 to the n=3 state. (3)

4.2. Calculate the de Broglie wavelength of an electron beam accelerated through a potential difference of 300 V. (3)

4.3. The isotope of $^{239}_{92}U$ undergoes two successive beta decays. What is the name of the resulting isotope? (3)

4.4. The isotope $^{11}_{6}C$ decays to $^{11}_{5}B$. What kind of particle is emitted? (1)

4.5. If radium has a decay constant of 4.02×10^{-4} per year, calculate the percentage of a given amount of radium will decay during a period of 1000years. (3)

[13]

QUESTION 5

5.1. A bicycle has wheels of radius 0.32 m. Each of the wheels has a rotational inertia of 0.08 kg.m^2 about its axle. The mass of the bicycle including the wheels and the rider is79 kg. Calculate the fraction of rotational kinetic energyof the wheels compared tothe total kinetic energy of the bicycle. (5)

5.2. Water falls over a section of Niagara Falls at the rate of 1.2×10^6 kg per second and fallsfor 50 m. How much power is generated by the falling water? (3)

[08]

Section B (Multiple Choice Questions)

1. There is no SI base unit for area because

A. an area has no thickness; hence no physical standard can be built
B. we live in a three (not a two) dimensional world
C. it is impossible to express square feet in terms of meters
D. area can be expressed in terms of square meters
E. area is not an important physical quantity

2. A gram is

A. 10^{-6} kg
B. 10^{-3} kg
C. 1 kg
D. 10^{3} kg
E. 10^{6} kg

3. The number of significant figures in 0.00150 is

A. 2
B. 3
C. 4
D. 5
E. 6

4. Two cars are 150 kilometres apart and travelling toward each other. One car is moving at 60km/h and the other is moving at 40km/h. In how many hours will they meet?

A. 2.5
B. 2.0
C. 1.75
D. 1.5
E. 1.25

5. The object with an initial velocity of 12 m.s^{-1} west experiences an acceleration of 4 m.s^{-2} west for 3 seconds. During this time the object travels a distance of

A. 18 m
B. 24 m
C. 36 m
D. 54 m
E. 144 m

6. Momentum may be expressed in

A. kg/m
B. gram.s
C. N·s
D. kg/ (m.s)
E. N/s

7. A sledge weighs 5000 N. It is pulled on level snow by a dog team exerting horizontal force on it. The coefficient of kinetic friction between sledge and snow is 0.05.How much work is done by the dog team pulling the sledge 1000 m at constant speed?

A. 2.5×10^4 J
B. 2.5×10^5 J
C. 5.0×10^5 J
D. 2.5×10^6 J
E. 5.0×10^6 J

8. Possible units of angular momentum are

A. $kg.m.s^{-1}$
B. $kg.m^{2.}s^{-2}$
C. $kg.m.s^{-2}$
D. $kg.m^2.s^{-1}$
E. none of these

9. The half-life of a radioactive substance is

A. half the time it takes for the entire substance to decay
B. usually about 50 years
C. the time for radium to change into lead
D. calculated from $E = mc^2$
E. the time for half the substance to decay

10. Possible units for the disintegration constant λ are

A. kg/s
B. s/kg
C. hour
D. day^{-1}
E. cm^{-1}

[30]

Section A+Section B = 70 + 30 =Total Marks [100]

USEFUL INFORMATION SHEET

Horizontal Motion

$$s = \bar{v}t$$

$$s = v_o t + \frac{1}{2}t^2$$

$$s = \frac{(v_0 + v)}{2}t$$

$$v = v_0 + at$$

$$v^2 = v_0{}^2 + 2as$$

$$\bar{v} = \frac{(v_0 + v)}{2}$$

$$\vec{F}_{net} = m\vec{a}$$

$$\vec{F} = -k\vec{x}$$

$$f_k = \mu_k mg$$

$$E_R = \frac{1}{2}I\omega^2$$

$$U = \frac{1}{2}kx^2$$

$$K_E = \frac{1}{2}mv^2$$

$$U = mgh$$

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Vertical motion

$$s = v_o t - \frac{1}{2}gt^2$$

$$s = \frac{(v_0 + v)}{2}t$$

$$v = v_0 - gt$$

$$v^2 = v_0{}^2 - 2gs$$

$$\bar{v} = \frac{(v_0 + v)}{2}$$

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Nuclear and Modern Physics

$$hv = hv_o + K_E$$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_o} + \frac{1}{2}mv^2$$

$$\frac{1}{\lambda} = R\left[\frac{1}{n^2{}_f} - \frac{1}{n^2{}_i}\right]$$

$$N = N_o e^{-\lambda t}$$

$$A = A_o e^{-\lambda t}$$

$$\lambda = \frac{0.693}{T_{1/2}}$$

$$c = f\lambda$$

$$\lambda = \frac{h}{p}$$

$$\lambda = \frac{h}{\sqrt{2meV}}$$

$$\Delta E = E_2 - E_1 = \frac{hc}{\lambda}$$

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Projectile Motion

$$H_{\max} = \frac{(v_o \sin\theta)^2}{2g}$$

$$R_H = \frac{v_o{}^2 \sin(2\theta)}{g}$$

$$t = \frac{2v_o \sin\theta}{g}$$

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Constants

$R = 1.097 \times 10^7 m^{-1}$

$c = 3 \times 10^8 m.s^{-1}$

$h = 6.63 \times 10^{-34} Js$

$m_p = 1.67 \times 10^{-27} kg$

$m_e = 9.11 \times 10^{-31} kg$

g = 9.8 m.s^{-2}

$e = 1.6 \times 10^{-19} C$

$G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$

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