

**PHY1505**

(473083)

May/June 2013

MECHANICS (PHYSICS)

Duration 2 Hours

100 Marks

EXAMINERS .

FIRST

SECOND

PROF GJ RAMPHO

DR BM MOTHUDI

Use of a non-programmable pocket calculator is permissible**Closed book examination.****This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue.**

- This paper consists of 5 pages plus instructions for the completion of a mark reading sheet
 - This examination consists of two sections **SECTION A** and **SECTION B**
 - Answer **SECTION A** (Multiple Choice) on the mark reading sheet
 - Answer **SECTION B** (Written Solutions) on the examination answer book
 - Mark allocation for each question is indicated in brackets to the right
 - The information given at the end of Section B may be used without proof
-

SECTION A (Multiple Choice)1. Consider a vector $\vec{d} = 10\hat{i} + 10\hat{j} + 5\hat{k}$ The magnitude of this vector is

- 1) 0
- 2) 15
- 3) 20
- 4) 25
- 5) 225

(3)

[TURN OVER]

- 2 An object dropped from the window of a tall building hits the ground in 12.0 s. If its acceleration is 9.80 m/s^2 , the height of the window above the ground is.
- 1) 29.4 m
 - 2) 58.8 m
 - 3) 118 m
 - 4) 353 m
 - 5) 706 m
- (3)
- 3 A block is placed on top of a rough wooden table. When the table is tilted at an angle of 30° to the horizontal, the block slides down at constant speed. The coefficient of kinetic friction of the block with the table surface is
- 1) 0.500
 - 2) 0.577
 - 3) 0.866
 - 4) 1.73
 - 5) 4.90
- (3)
- 4 Which of the following quantities is NOT a vector?
- 1) Mass
 - 2) Displacement
 - 3) Weight
 - 4) Acceleration
 - 5) Force
- (3)
- 5 A stone is tied to a 0.5 m string and whirled at a constant speed of 4.0 m/s in a vertical circle. Its acceleration at the top of the circle is
- 1) 9.8 m/s^2 , up
 - 2) 9.8 m/s^2 , down
 - 3) 8.0 m/s^2 , down
 - 4) 32 m/s^2 , up
 - 5) 32 m/s^2 , down
- (3)

[TURN OVER]

- 6 An object of mass 1 g is whirled in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is
- 1) 0 J
 - 2) 1 J
 - 3) 2 J
 - 4) 4 J
 - 5) 16 J
- (3)
- 7 A wheel, turning at a constant rate, completes 100 revolutions in 10 s. Its angular speed is
- 1) 0.31 rad/s
 - 2) 0.63 rad/s
 - 3) 10 rad/s
 - 4) 31 rad/s
 - 5) 63 rad/s
- (3)
- 8 Mercury is a convenient liquid to use in a barometer because it
- 1) is a metal
 - 2) has a high boiling point.
 - 3) expands little with temperature
 - 4) has a high density
 - 5) looks silvery.
- (3)
- 9 The pressure exerted on the ground by a man is greatest when
- 1) he stands with both feet flat on the ground
 - 2) he stands flat on one foot
 - 3) he stands on the toes of one foot
 - 4) he lies down on the ground
 - 5) all of the above yield the same pressure
- (3)
- 10 A block of ice at 0 °C containing a piece of cork is floating on the surface of ice water in a beaker. When all the ice has melted the water level
- 1) is higher
 - 2) is lower
 - 3) is the same
 - 4) depends on the initial ratio of water to ice
 - 5) depends on the shape of the ice block
- (3)

[30]

[TURN OVER]

SECTION B**ANSWER ALL THE QUESTIONS IN THIS SECTION IN AN EXAMINATION BOOK**

1. A small ball rolls horizontally off the edge of a tabletop that is 1.20 m high. It strikes the floor at a point 1.52 m horizontally away from the edge of the table.

(a) If the instantaneous speed for the vertical motion of the ball is given by the equation

$$\frac{dy(t)}{dt} = v_0 - g t$$

where $y(t)$ is the vertical position, t time, v_0 the initial speed and g the magnitude of the gravitational acceleration, use integral calculus to derive the equation for y as a function of t (5)

(b) How long is the ball in the air? (5)

(c) What is its speed at the instant it leaves the table? (5)
[15]

2. A stone is thrown vertically upwards. On its way up it passes point A with speed v and point B with speed $v/2$. Point B is 3 m higher than point A . Use the principle of conservation of energy to determine the

(a) speed v and (5)

(b) maximum height reached by the stone above point B (5)
[10]

3. A block is projected up a frictionless inclined plane with initial speed $v_0 = 3.50$ m/s. The angle of incline is $\theta = 32.0^\circ$.

(a) Draw a free-body diagram of the block (3)

(b) How far up the plane does it go? (4)

(c) How long does it take to get there? (3)

(d) Calculate its speed when it gets back to the bottom (5)
[15]

4. Two 2.0 kg bodies, A and B , collide. The velocities before the collision are $\vec{v}_A = 15\hat{i} + 30\hat{j}$ and $\vec{v}_B = -10\hat{i} + 50\hat{j}$. After the collision $\vec{v}'_A = -5.0\hat{i} + 20\hat{j}$. All speeds are given in meters per second.

(a) What is the final velocity of B ? (7)

(b) How much kinetic energy is gained or lost in the collision? (8)
[15]

[TURN OVER]

- 5 Water is flowing down through a vertical pipe with a speed of 5.0 m/s. The cross-sectional area of the pipe at the top is 4.0 cm² and the cross-sectional area of the pipe at the bottom is 8.0 cm². The water gradually descends 10 m as the pipe increases in the cross-sectional area from 4.0 cm² to 8.0 cm².

(a) What is the speed of the water at the lower level? (7)

(b) If the water pressure at the upper level is 1.5×10^5 Pa, what is the pressure at the lower level? (8)

[15]

USEFUL INFORMATION

$$|\vec{r}|^2 = x^2 + y^2 + z^2$$

$$E_T = E_K + E_P$$

$$\int k dx = kx + C$$

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

$$\int kx dx = \frac{1}{2}kx^2 + C$$

$$E_P = mgh$$

$$s = ut + \frac{1}{2}at^2$$

$$A_1v_1 = A_2v_2$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

$$E_{K(A)} + E_{P(A)} = E_{K(B)} + E_{P(B)}$$

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$$

$$g = 9.8 \text{ m/s}^2$$

$$\rho_w = 1000 \text{ kg/m}^3$$

PART 1 (GENERAL/ALGEMEEN) DEEL 1

STUDY UNIT e.g. PSY100 X
STUDIE EENHEID by PSY100 X

--	--	--	--	--	--	--	--	--	--

PAPER NUMBER
VRAESTELNOMMER

STUDENT NUMBER
STUDENTENOMMER

--	--	--	--	--	--	--	--	--	--

c0	c0	c0	c0	c0	c0	c0	c0	c0	c0
c1	c1	c1	c1	c1	c1	c1	c1	c1	c1
c2	c2	c2	c2	c2	c2	c2	c2	c2	c2
c3	c3	c3	c3	c3	c3	c3	c3	c3	c3
c4	c4	c4	c4	c4	c4	c4	c4	c4	c4
c5	c5	c5	c5	c5	c5	c5	c5	c5	c5
c6	c6	c6	c6	c6	c6	c6	c6	c6	c6
c7	c7	c7	c7	c7	c7	c7	c7	c7	c7
c8	c8	c8	c8	c8	c8	c8	c8	c8	c8
c9	c9	c9	c9	c9	c9	c9	c9	c9	c9

INITIALS AND SURNAME
VOORLETTERS EN VAN

DATE OF EXAMINATION
DATUM VAN EKSAMEN

EXAMINATION CENTRE (E.G. PRETORIA)
EKSAMENSENTRUM (BY PRETORIA)

UNIQUE PAPER NO
UNIEKE VRAESTEL NR

--	--	--	--	--	--	--	--	--	--

c0	c0	c0	c0	c0	c0	c0	c0	c0	c0
c1	c1	c1	c1	c1	c1	c1	c1	c1	c1
c2	c2	c2	c2	c2	c2	c2	c2	c2	c2
c3	c3	c3	c3	c3	c3	c3	c3	c3	c3
c4	c4	c4	c4	c4	c4	c4	c4	c4	c4
c5	c5	c5	c5	c5	c5	c5	c5	c5	c5
c6	c6	c6	c6	c6	c6	c6	c6	c6	c6
c7	c7	c7	c7	c7	c7	c7	c7	c7	c7
c8	c8	c8	c8	c8	c8	c8	c8	c8	c8
c9	c9	c9	c9	c9	c9	c9	c9	c9	c9

For use by examination invigilator
Vir gebruik deur eksamenopsiener

IMPORTANT

1. USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET
2. MARK LIKE THIS
3. CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY
4. ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT
5. CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY
6. CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY
7. CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED
8. DO NOT FOLD

BELANGRIK

1. GEBRUIK SLEGS 'N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI
2. MERK AS VOLG
3. KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
4. VUL U STUDENTENOMMER VAN LINKS NA REGS IN
5. KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET
6. KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS
7. MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS.
8. MOENIE VOU NIE

PART 2 (ANSWERS/ANTWOORDE) DEEL 2

1	c1	c2	c3	c4	c5
2	c1	c2	c3	c4	c5
3	c1	c2	c3	c4	c5
4	c1	c2	c3	c4	c5
5	c1	c2	c3	c4	c5
6	c1	c2	c3	c4	c5
7	c1	c2	c3	c4	c5
8	c1	c2	c3	c4	c5
9	c1	c2	c3	c4	c5
10	c1	c2	c3	c4	c5
11	c1	c2	c3	c4	c5
12	c1	c2	c3	c4	c5
13	c1	c2	c3	c4	c5
14	c1	c2	c3	c4	c5
15	c1	c2	c3	c4	c5
16	c1	c2	c3	c4	c5
17	c1	c2	c3	c4	c5
18	c1	c2	c3	c4	c5
19	c1	c2	c3	c4	c5
20	c1	c2	c3	c4	c5
21	c1	c2	c3	c4	c5
22	c1	c2	c3	c4	c5
23	c1	c2	c3	c4	c5
24	c1	c2	c3	c4	c5
25	c1	c2	c3	c4	c5
26	c1	c2	c3	c4	c5
27	c1	c2	c3	c4	c5
28	c1	c2	c3	c4	c5
29	c1	c2	c3	c4	c5
30	c1	c2	c3	c4	c5
31	c1	c2	c3	c4	c5
32	c1	c2	c3	c4	c5
33	c1	c2	c3	c4	c5
34	c1	c2	c3	c4	c5
35	c1	c2	c3	c4	c5

36	c1	c2	c3	c4	c5
37	c1	c2	c3	c4	c5
38	c1	c2	c3	c4	c5
39	c1	c2	c3	c4	c5
40	c1	c2	c3	c4	c5
41	c1	c2	c3	c4	c5
42	c1	c2	c3	c4	c5
43	c1	c2	c3	c4	c5
44	c1	c2	c3	c4	c5
45	c1	c2	c3	c4	c5
46	c1	c2	c3	c4	c5
47	c1	c2	c3	c4	c5
48	c1	c2	c3	c4	c5
49	c1	c2	c3	c4	c5
50	c1	c2	c3	c4	c5
51	c1	c2	c3	c4	c5
52	c1	c2	c3	c4	c5
53	c1	c2	c3	c4	c5
54	c1	c2	c3	c4	c5
55	c1	c2	c3	c4	c5
56	c1	c2	c3	c4	c5
57	c1	c2	c3	c4	c5
58	c1	c2	c3	c4	c5
59	c1	c2	c3	c4	c5
60	c1	c2	c3	c4	c5
61	c1	c2	c3	c4	c5
62	c1	c2	c3	c4	c5
63	c1	c2	c3	c4	c5
64	c1	c2	c3	c4	c5
65	c1	c2	c3	c4	c5
66	c1	c2	c3	c4	c5
67	c1	c2	c3	c4	c5
68	c1	c2	c3	c4	c5
69	c1	c2	c3	c4	c5
70	c1	c2	c3	c4	c5

71	c1	c2	c3	c4	c5
72	c1	c2	c3	c4	c5
73	c1	c2	c3	c4	c5
74	c1	c2	c3	c4	c5
75	c1	c2	c3	c4	c5
76	c1	c2	c3	c4	c5
77	c1	c2	c3	c4	c5
78	c1	c2	c3	c4	c5
79	c1	c2	c3	c4	c5
80	c1	c2	c3	c4	c5
81	c1	c2	c3	c4	c5
82	c1	c2	c3	c4	c5
83	c1	c2	c3	c4	c5
84	c1	c2	c3	c4	c5
85	c1	c2	c3	c4	c5
86	c1	c2	c3	c4	c5
87	c1	c2	c3	c4	c5
88	c1	c2	c3	c4	c5
89	c1	c2	c3	c4	c5
90	c1	c2	c3	c4	c5
91	c1	c2	c3	c4	c5
92	c1	c2	c3	c4	c5
93	c1	c2	c3	c4	c5
94	c1	c2	c3	c4	c5
95	c1	c2	c3	c4	c5
96	c1	c2	c3	c4	c5
97	c1	c2	c3	c4	c5
98	c1	c2	c3	c4	c5
99	c1	c2	c3	c4	c5
100	c1	c2	c3	c4	c5
101	c1	c2	c3	c4	c5
102	c1	c2	c3	c4	c5
103	c1	c2	c3	c4	c5
104	c1	c2	c3	c4	c5
105	c1	c2	c3	c4	c5

106	c1	c2	c3	c4	c5
107	c1	c2	c3	c4	c5
108	c1	c2	c3	c4	c5
109	c1	c2	c3	c4	c5
110	c1	c2	c3	c4	c5
111	c1	c2	c3	c4	c5
112	c1	c2	c3	c4	c5
113	c1	c2	c3	c4	c5
114	c1	c2	c3	c4	c5
115	c1	c2	c3	c4	c5
116	c1	c2	c3	c4	c5
117	c1	c2	c3	c4	c5
118	c1	c2	c3	c4	c5
119	c1	c2	c3	c4	c5
120	c1	c2	c3	c4	c5
121	c1	c2	c3	c4	c5
122	c1	c2	c3	c4	c5
123	c1	c2	c3	c4	c5
124	c1	c2	c3	c4	c5
125	c1	c2	c3	c4	c5
126	c1	c2	c3	c4	c5
127	c1	c2	c3	c4	c5
128	c1	c2	c3	c4	c5
129	c1	c2	c3	c4	c5
130	c1	c2	c3	c4	c5
131	c1	c2	c3	c4	c5
132	c1	c2	c3	c4	c5
133	c1	c2	c3	c4	c5
134	c1	c2	c3	c4	c5
135	c1	c2	c3	c4	c5
136	c1	c2	c3	c4	c5
137	c1	c2	c3	c4	c5
138	c1	c2	c3	c4	c5
139	c1	c2	c3	c4	c5
140	c1	c2	c3	c4	c5