NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

InSTEM

QUALIFICATION: INTRODUCTION TO SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS	
QUALIFICATION CODE: 04STEM	**LEVEL:** 4
COURSE CODE: IPH401S	**COURSE NAME**: INTRODUCTION TO PHYSICS A
SESSION: JANUARY 2020	**PAPER:** N/A
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**Ms Ilana Malan** **Ms Oksana Kachepa**
MODERATOR:	**Mr Anthony Apata**

INSTRUCTIONS
1. Answer all questions.
2. Write all the answers in ink.
3. No books, notes, correction fluid (Tippex) or cell phones allowed.
4. Pocket calculators are allowed.
5. You are not allowed to borrow or lend any equipment or stationary.
6. All **FINAL ANSWERS** must be rounded off to **THREE DECIMAL PLACES**.
7. All CONSTANT VALUES and FORMULAS on page 11.
8. Use GRAPH PAPER provided for question 16.4

THIS QUESTION PAPER CONSISTS OF 11 PAGES (Excluding this front page)

SECTION A – TOTAL MARKS 30

This section consists of nine questions. Choose the correct answer and clearly indicate your answer on your answer sheet.

Question 1 [4]

How much work is required to accelerate a 2.5 t car from 5 km/h to 60 km/h?

(a)   291.763 kJ
(b)   344.81 kJ
(c)   3781.25 kJ
(d)   347.222 kJ

Question 2 [4]

In which quadrant will the equilibrant force of the following be:

$\sum x = -3 + 2\cos 10°$ and $\sum y = -3 + 2\cos 10°$

(a)   first
(b)   second
(c)   third
(d)   fourth

Question 3 [4]

A 410 g non-elastic ball rolling at 5.2 m/s collides with a brick wall and comes to a standstill in 41 ms. Calculate the force required.

(a)   126.829 N
(b)   0.874 N
(c)   52 N
(d)   309.3396 N

Question 4 [2]

Choose the correct expression for the First Law of Thermodynamics:

(a) $\Delta U = \Delta Q + \Delta W$
(b) $\Delta Q = \Delta U + \Delta W$
(c) $\Delta W = \Delta Q + \Delta U$
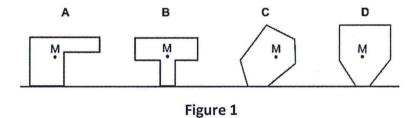(d) $\Delta Q - \Delta U = \Delta W$

Question 5 [2]

Which of the following is NOT a vector quantity?

(a)   kinetic energy
(b)   pressure
(c)   acceleration
(d)   momentum

Question 6 [2]

Four objects are standing on a flat surface in **Figure 1**. M indicates the centre of mass.
Which object will fall over?

Figure 1

(a)   A
(b)   B
(c)   C
(d)   D

2

Question 7 [4]

Figure 3 shows the velocity-time graph for a moving object. Determine the total distance moved from t = 4 s to t = 13 s.
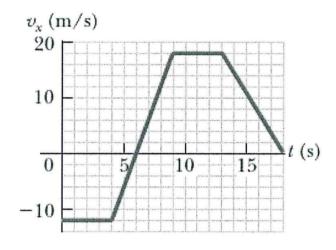

v_x (m/s)

Figure 2

(a)   12 m
(b)   99 m
(c)   87 m
(d)   111 m

Question 8 [4]

A large heavy steel ball is dropped from a height of 75 m. At the same time when the ball is released the timer starts. How far does the ball from t = 0.5 s to t = 2.7 s?

(a)   34.5312 m
(b)   75 m
(c)   35 m
(d)   23.7402 m

Question 9 [4]

Determine the phase difference in degrees between the two waves in **Figure 3**.
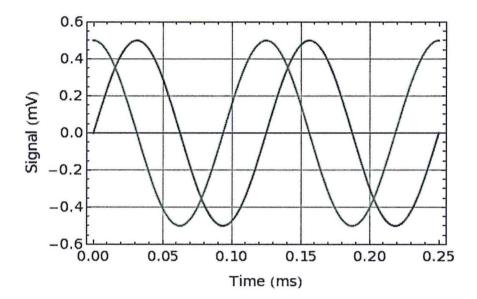

Figure 3

(a) 23^0
(b) 43^0
(c) 63^0
(d) 83^0

SECTION B – TOTAL MARKS 70

This section consists of six (6) questions. Answer ALL the questions.

Question 10   **[10]**
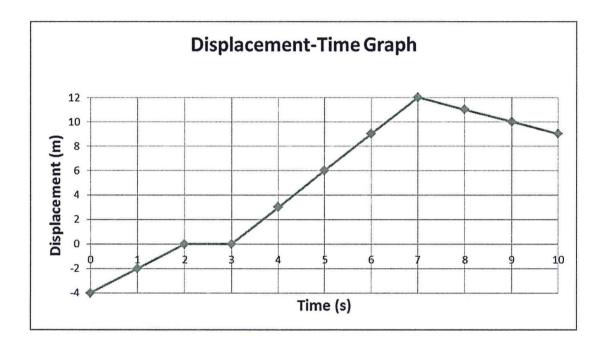
Answer the questions 10.1 – 10.4 with regards to **Figure 4**.

Displacement-Time Graph

Figure 4

10.1	When is the object stationary?	(1)
10.2	When is the object accelerating?	(1)
10.3	Describe the movement from t = 0 s to t = 6 seconds.	(3)
10.4	Determine total distance.	(2.5)
10.5	Determine total displacement.	(2.5)

Question 11 [10]

The 17 m long flagpole with a mass of 35 kg, as shown in **Figure 5**, has a non-uniform shape. It is attached to a 10 m vertical pole on the wider side of the flagpole. The centre of mass of the flagpole is a third of the length of the flagpole from the left side. A flag with a mass of 14 kg hangs vertical from the right end. A strong steel cable is attached at the centre of the flagpole at an angle of 46° to the horizontal.
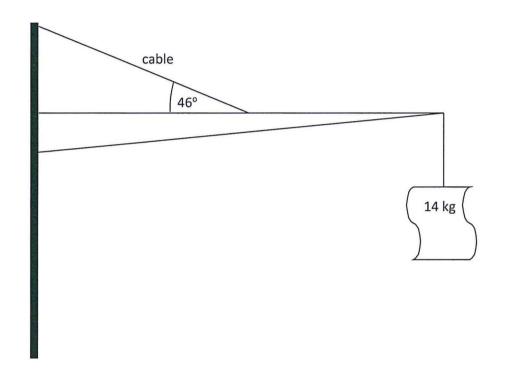

Figure 5

11.1   Determine the tension, T, in the cable for the flagpole to be in horizontal equilibrium. (6)

11.2   If the flag is moved to 10 m from the left end, what will the tension in the cable be? (4)

6

Question 12   **[12]**

Two projectiles are launched at the same time at different angles and different initial velocities. The reach the same maximum height. Projectile A is released at an angle of 34° to the horizontal with an initial velocity of 35 m/s.

12.1   Projectile B is launched at an initial velocity of 45 m/s. Determine the angle with
        the horizontal at which projectile B is launched.   (3)
12.2   Determine the difference in range when the two projectiles strike the ground.   (6)
12.3   How high is projectile A after 3 seconds?   (3)

Question 13   **[10]**

 A train carrying passengers to a ski resort in the Alps has a total mass of 55.60 t. The train maintains a constant speed of 28 km/h. The track is horizontal for 42 km and then has a steep incline towards the resort for another 5 km. The speed for the last 5 km is constant at 3 km/h.

13.1   Determine the work done over the first half of the journey.   (2)
13.2   The work done over the last 5 km of the journey is 2 392. 333 MJ with the train
        experiencing a frictional force of 4 N/kg. Determine the angle of the incline.   (5)
13.3   How long will the journey take?   (3)

Question 14 [8]

14.1   Give one word for: "Turning effect of a force." (1)

14.2   The lever in **Figure 6** of length 25 m, is in a horizontal equilibrium. The centre of
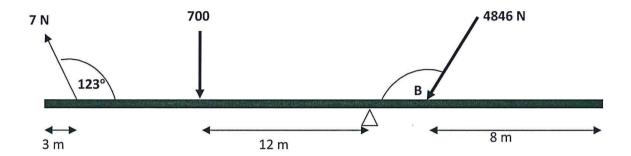gravity is in the middle of the lever. Determine the angle B. (7)

Figure 6

Question 15 [12]

15.1 Describe latent heat of a substances. (2)

15.2 The graph in **Figure 7** compares the energy in a substance as the temperature decreases. This graph is for an unknown substance of mass 40 g with a boiling point of 150⁰C. Heat is given out at a constant rate of 15 W.
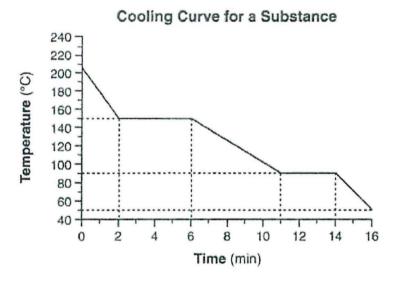
Cooling Curve for a Substance

Temperature (°C) vs Time (min)

Figure 7

15.2.1 How much heat was released during condensation? (1)

15.2.2 Determine the latent heat of vaporization. (2)

15.2.3 Determine the specific heat capacity$_{liquid}$ of the substance. (2)

15.2.4 How long will it take cool down 2 kg of the substance that has just condensed, to freezing point? (3)

Question 16   **[8]**

Answer all the questions with reference to **Figure 8.**

The object makes just ONE oscillation according to the sequence: A – B – A – C – A.

Figure 8

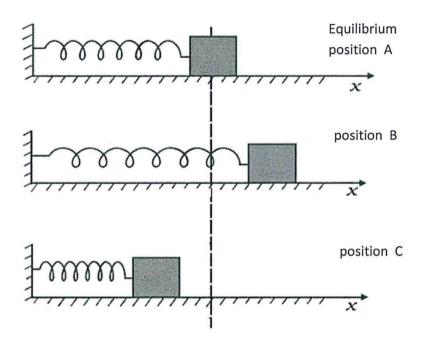16.1   What is the direction of the restoring force at C?   (1)
16.2   At which position(s) will the object have maximum potential energy?   (1)
16.3   What sign will the velocity have at point A and B, while in movement from A to B?   (1)
16.4   Draw a graph showing how the kinetic energy varies for one oscillation.   (5)

The End

Constants and formulas:

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{average velocity} = \frac{\text{displacement}}{\text{time}}$$

$$\text{average velocity} = \frac{u + v}{2}$$

$$a = \frac{v - u}{t}$$

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

$$v^2 = u^2 + 2as$$

$$F = ma$$

$$\text{moment} = Fs$$

$$\text{work} = Fs$$

$$\text{pressure} = \frac{F}{A}$$

$$E_p = mgh$$

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

$$\eta = \frac{\text{output}}{\text{input}} \times 100\%$$

$$\text{power} = \frac{\text{work}}{t}$$

$$\text{power} = F \times \text{velocity}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$F = \frac{\Delta\text{momentum}}{\Delta t} = \frac{\Delta p}{\Delta t}$$

$$f = \frac{1}{T}$$

$$\Delta U = \Delta Q + \Delta\text{work}$$

$$E/Q = mc\Delta T$$

$$E = mL$$

$$pV = nRT$$

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$\text{work} = pAs = p\Delta V$$

10^3	kilo	K	10^{-2}	centi	c
10^6	Mega	M	10^{-3}	milli	m
10^9	Giga	G	10^{-6}	micro	μ
10^{12}	Tera	T	10^{-9}	nano	n
10^{15}	Peta	P	10^{-12}	pico	p

$g = 9{,}81 \text{ m/s}^2$ $0 \text{ K} = -273{,}15 \text{ °C}$ $R = 8{,}31 \text{ J/molK}$