



NANYANG TECHNOLOGICAL UNIVERSITY  
SINGAPORE

ENTRANCE EXAMINATION  
PHYSICS (Sample)

Time Allowed : **2 hours**

**INSTRUCTIONS**

1. This question and answer booklet contains 30 multiple choice questions and 4 short questions.
  2. Answer **ALL** questions.
  3. This is a **CLOSED-BOOKED** examination.
- 

**SECTION A**

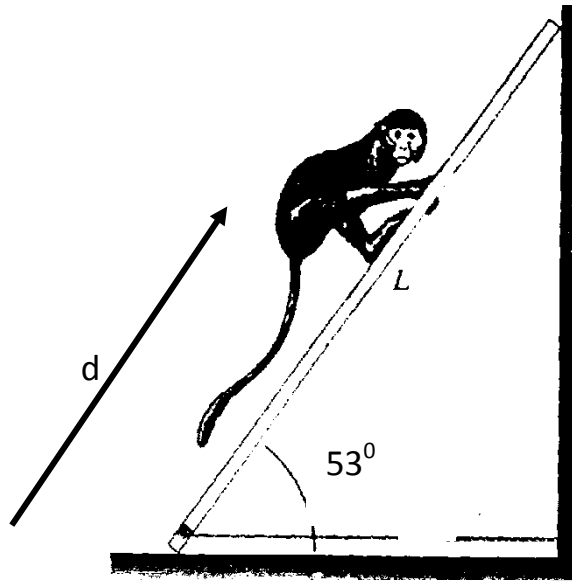
This section consists of **THIRTY (30)** multiple choice questions. Answer **ALL** questions in this section. Sample paper will only show 3 multiple choice questions for reference only.

1. A woman exerts a constant horizontal force on a large box. As a result, the box moves across a horizontal floor at a constant speed " $v_0$ ". If the woman suddenly stops applying a horizontal force to the box, then the box will
  - A. immediately come to a stop.
  - B. continue moving at a constant speed for a while and then slow to a stop.
  - C. immediately start slowing to a stop.
  - D. continue at a constant speed.
  - E. increase its speed for a while and then start slowing to a stop.
2. Two monochromatic radiations X and Y of different wavelength are incident normally on a diffraction grating. The second order intensity maximum for X coincides with the third order intensity maximum for Y.

What is the ratio  $\frac{\text{wavelength of X}}{\text{wavelength of Y}}$  ?

- A.  $\frac{1}{2}$       B.  $\frac{2}{3}$       C.  $\frac{3}{2}$       D.  $\frac{2}{1}$       E.  $\frac{3}{1}$

3. A  $10.0\text{ kg}$  monkey climbs up a  $120\text{ N}$  uniform ladder of length  $L$ , as shown in figure below.



The upper and lower ends of the ladder rest on frictionless surfaces. The lower end is fastened to the wall by a horizontal rope that can support a maximum tension of  $110\text{ N}$ . The maximum distance  $d$  that the monkey can climb up the ladder before the rope breaks is

- A.  $0.219L$    B.  $0.438L$    C.  $0.659L$    D.  $0.876L$    E.  $1.000L$
-

## **SECTION B**

This section consists of **FOUR (4)** questions. Answer **ALL** questions in this section. This sample paper only shows 2 questions for reference only.

### **Sample Question 1:**

A piece of rock with mass 2.7 kg is released from a great height and falls vertically through the atmosphere. It experiences a resistive force  $F_v$  given by

$$F_v = kv^2$$

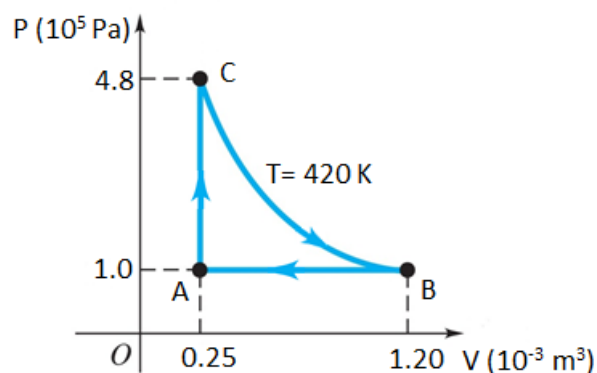
where  $k$  is a constant and  $v$  is the instantaneous velocity of the rock. The terminal velocity of the rock is measured to be  $51 \text{ m s}^{-1}$ . This rock falls through 1.5 km vertically at the terminal velocity before hitting the sea. The specific heat capacity of this rock is determined to be  $0.80 \text{ kJ kg}^{-1} \text{ K}^{-1}$ . You may ignore the upthrust on the rock due to air and assume that the acceleration of free fall is constant at  $g = 9.8 \text{ m s}^{-2}$ .

- i) Sketch a diagram to indicate forces acting on the rock.
- ii) Calculate the constant  $k$ ;
- iii) Calculate the work done by the weight of the rock when it falls through 1.5 km.
- iv) If all the work done by weight is converted to heat, calculate the rise in temperature of the rock over the 1.5 km fall assuming that no heat is lost to the surrounding.
- v) Calculate the heat generated per unit time by the rock when it falls through 1.5 km.

[10 marks]

### Sample Question 2:

The figure below shows how a fixed mass of hydrogen gas undergoes a cycle of changes in pressure, volume and temperature. Along the path from C→B, the temperature is constant at 420 K. The hydrogen gas has a molar mass of  $2 \text{ g mol}^{-1}$  and is assumed to behave ideally.



- i) Calculate the root mean square speed of the hydrogen molecules along the segment C→B.
- ii) Given that the change in internal energy along the segment B→A is  $-238 \text{ J}$ , use the first law of thermodynamics to calculate the heat lost by the system along the segment B→A.
- iii) Given that the change in internal energy along the segment B→A is  $-238 \text{ J}$ , what is the change in internal energy along the segment A→C? Explain your answer.
- iv) Compute the work done by the gas in the cycle A→C→B→A.

[10 marks]

SAMPLE