SMJK Yu Hua, Kajang, Selangor
STPM Trial Examination
Physics Paper 1
November 2023

Name : ……
Section A. (15 marks)
Answer all questions.

1. The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ of the liquid. The speed is given by the equation:

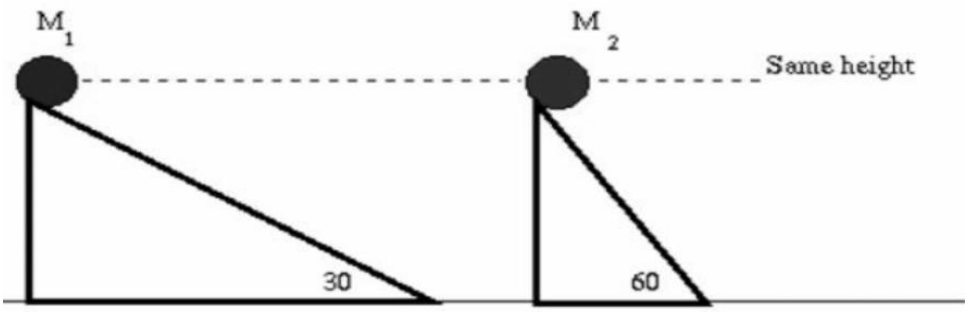
$$v = k\left(\frac{\Delta P}{\rho}\right)^{n}$$

Where k is a constant that has no units. What is the value of n?
A. ½ B. 1 C. $^3/_2$ D. 2

2. An electron with a speed of 2.0 x 10^7m/s moves horizontally into a region where a constant vertical force of 5.6 x 10^{-16}N acts on it. The mass of the electron is 9.11 x 10^{-31} kg. Determine the vertical distance the electron is deflected during the time it has moves 47 mm horizontally.
A. 8.56 mm B. 5.36 mm C. 3.12 mm D. 1.66 mm

3. Holding on to a towrope moving parallel to a frictionless ski slope, a 50 kg skier is pulled up the slope, which is at an angle of 8.0° with the horizontal. What is the magnitude of the force on the skier from the rope when the magnitude v of the skier's velocity is v = 2.0 m/s as v increases at a rate of 0.10 m/s^2?
A. 63 N B. 68 N C. 73 N D. 75 N.

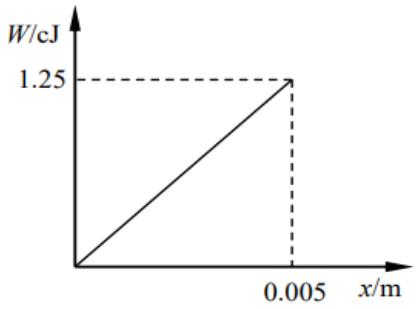
4. Consider two frictionless inclined planes as shown. Identical balls M_1 and M_2 are released at the same time.



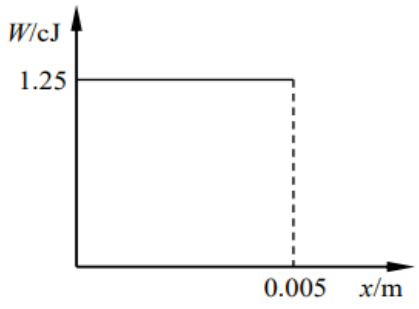
Compare the speeds of the two masses when they reach the bottoms of their respective inclines.
A. The speed of M_1 is larger than the speed of M_2.
B. The speed of M_2 is larger than the speed of M_1.
C. M_1 and M_2 are travelling at the same speed.
D. It is impossible to tell.

5. A spring of spring constant 10.0 N cm^{-2} is tied to a retort stand. A load of weight 5.0 N is then attached to the free end of the spring. Which graph represents the variation of work done by the spring with the extension?

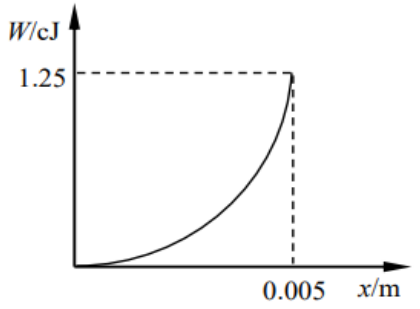
A



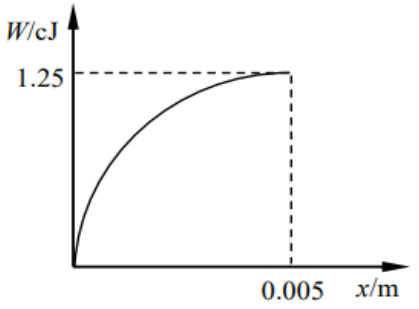
B



C



D



6. The bob of a pendulum is projected from the point X with a speed *u* so that the bob is able to complete a vertical circle. The speed of the bob at the highest point Y is *v*.



What is the ratio of $\frac{u}{v}$?

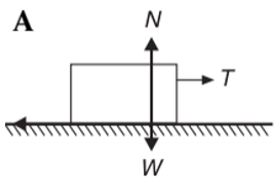
A. $\sqrt{2}$ B. $\sqrt{3}$ C. 2 D. $\sqrt{5}$

7. The diagram below shows a block of weight W being pulled by force T on a rough horizontal surface.

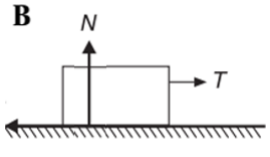


If the block is not tilted up, with N the normal reaction of the horizontal surface on the block and F the friction between the block and the surface, which of the following diagrams shows the correct line of reaction force?

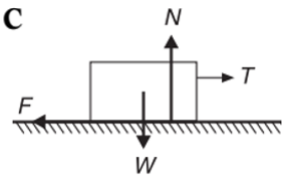
A



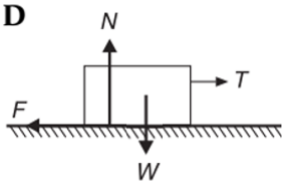
B



C



D



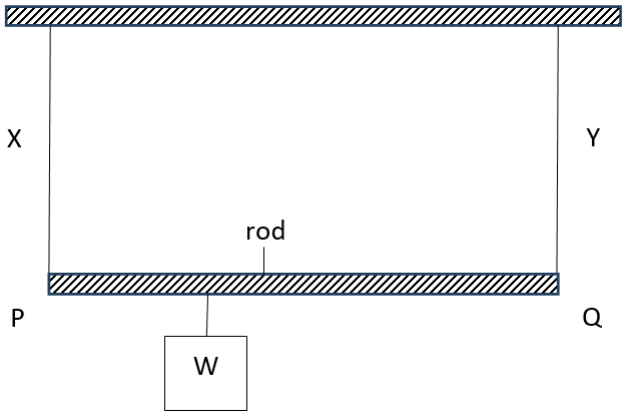
8. Star X of mass 2M and star Y of mass M perform circular motion about the common centre of mass under their gravitational attraction. What is the ratio of $\frac{\text{radius of X orbit}}{\text{radius of Y orbit}}$?

   A. ¼ B. ½ C. 1 D. 2

9. At what height above the surface of the earth, the value of acceleration due to gravity g, is reduced to one fourth of its value on the surface of the earth? [Radius of the earth = R].

   A. $\sqrt{2}$R B. ½ R C. R D. 2R

10. A 101.0 cm long rod of negligible weight which is supported at both of its ends by two equally long wires X and Y is shown in the diagram. The cross-sectional areas of X and Y are 1.80 mm^2 and 3.10 mm^2 respectively. The Young's Modulus of wire X and Y are 2.10 x 10^{11} Pa and 1.60 x 10^{11} Pa respectively. At what distance from P should the weight, W be suspended along the rod so that it remains horizontal?

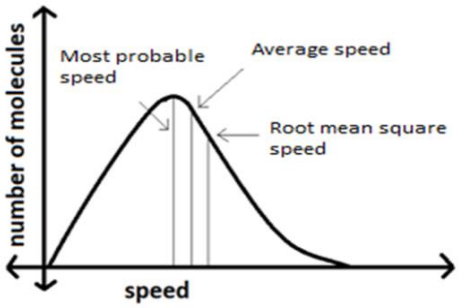


   A. 55.6 cm B. 57.3 cm C. 59.2 cm D. 61.0 cm

11. The molecule of a monoatomic gas has only three translational degrees of freedom. Thus, the average energy of a molecule at temperature T is

   A. 3kT B. ¾ kT C. $^1/_3$ kT D. $^3/_2$ kT

12. For a given plot, what does the area under curve represent according to Maxwell-Boltzmann distribution?

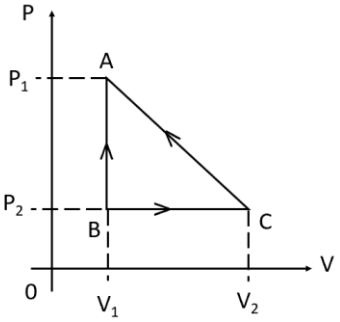


   A. Total number of molecule
   B. Total number of molecule per unit acceleration
   C. Total number of molecules per unit volume
   D. Rate of acceleration of molecules

13. One mole of an ideal gas is heated slowly so that it goes from the PV state (P_1, V_1) to ($3P_1$, $3V_1$), in such a way that the pressure is directly proportional to the volume. How much work is done in the process?

   A. ½ P_1V_1 B. $2P_1V_1$ C. $3P_1V_1$ D. $4P_1V_1$

14. In the following figure, the work done by the system in the enclosed path ABCA is

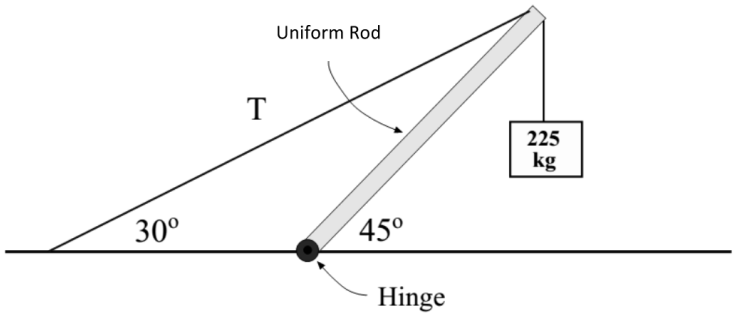


A. $-\frac{1}{2}(P_2 - P_1)(V_2 - V_1)$ B. $\frac{1}{2}(V_1 - V_2)(P_1 - P_2)$ C. $(P_2 - P_1)(V_2 - V_1)$ D. Zero

15. On a cold morning, a metal surface will feel colder to touch than a wooden surface, because of
   A. Metal has high specific heat
   B. Metal has high thermal conductivity
   C. Metal has low specific heat
   D. Metal has low thermal conductivity

Section B. (15 marks)
Answer all questions.

16. a) State the conditions for equilibrium of a rigid body. [2 marks]
   b) A mass of 225 kg hangs from one end of a uniform rod with another end hinged on the floor as shown in the diagram below. The mass of the rod is 45 kg. The system is maintained in static equilibrium by a cable attached to the upper end of the rod.

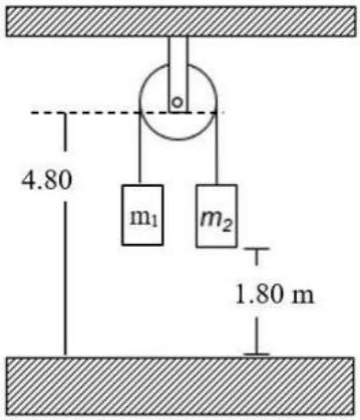


   i) the tension in the cable. [3 marks]
   ii) the magnitude of the reaction force acting on the lower end of the rod by the hinge. [3 marks]

17. A tank of volume 6.00×10^{-2} m^3 contains 1.5 moles of oxygen at a pressure of 3.12×10^5 Pa. Assuming that the gas behave as an ideal gas, calculate
   a) the temperature of the gas. [2 marks]
   b) the root mean square speed of the gas molecules. [2 marks]
   c) the internal energy of the gas. [3 marks].
   [relative molecular mass of oxygen is 32]

Section C. (30 marks)
Answer any **two** questions in this section.

18. a) State Newton's Laws of Motion. [3 marks]
    b) Derive the principle of conservation of momentum by using Newton's law of motion. [2 marks]
    c) Two masses m_1 and m_2 with mass 2.2 kg and 3.2 kg respectively are each initially 1.80 m above the ground as shown in the diagram below.



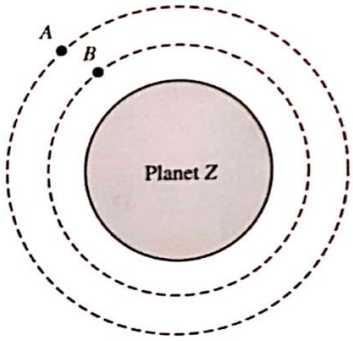
The massless frictionless pulley is fixed 4.80 m above the ground. Find
i) Acceleration of m_1 after the system is released. [3 narks]
ii) Maximum displacement of m_2 after the system is released. [1 mark]
iii) Maximum displacement of m_1 after the system is released. [3 marks]

    d) Sometimes the curiosity factor at the scene of a car accident is so great that it actually produces secondary accidents as a result, while people watch to see what is going on. If an 800 kg sports car slows to 13.0 m/s to check out an accident scene and the 1200 kg pick-up truck behind him continues traveling at 25.0 m/s, with what velocity will the two move if they lock bumpers after a rear-end collision? [3 marks]

19. a) Artificial satellites are used to monitor weather conditions on earth, for surveillance and for communications. Such satellites are known as synchronous satellites. Describe the properties of the synchronous satellite. [3 marks]
    b) Hubble space telescope, which has been operating since 1990, is expected to be deorbited in the near future since its successor, James Webb Space telescope has been launched into orbit. The old telescope orbits with a speed of 7.55 km s^{-1} around the earth. Given the radius of the earth is 6400 km and the mass of the earth is 5.98×10^{24} kg.
    i) What is the distance of its orbit above the earth surface? [3 marks]
    ii) Suppose a bad alien hides on the Hubble space telescope and was discovered by Superman. Superman is trying to scare the intruder away by throwing a 50.0 g pebble onto at it. How much kinetic energy he has to throw the pebble at to overcome the earth gravitational pull? [2 marks]
    iii) Considering the scenario in 19 b) ii), will the pebble reach the alien successfully in reality? Explain your answer. [2 marks]
    c) The movement of a spacecraft from X the surface of the earth to Y the surface of the moon along a straight line XY is shown in the diagram below. Sketch a graph to represent the variation of the potential energy U of the spacecraft with the distance from X to Y? [2 marks]



d) Two points, A and B, which are at different altitides from planet Z are shown in the diagram below.



The work done by the gravitational field to bring a spacecraft of mass 5000 kg from A to B is $5x10^{10}$ J. What is the gravitational potential at A if the gravitational potential at B is $-5x10^{7}$ J kg^{-1}. [3 marks]

20. a) i) What is meant by 'work done in an isolated gas system'? [1 mark]

ii) What is the difference between internal energy and thermal energy of a gas system. [2 marks]

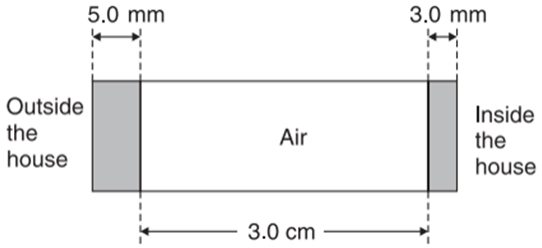
iii) State the first law of thermodynamics and the meaning of each symbol used. [2 marks]

b) An isolated system of 3.0 moles of an ideal gas is initially at pressure p_1 and volume V_1. It is then allowed to expand at constant temperature T = 350 K to new pressure p_2 and new volume $2V_1$.

i) Sketch the p-V diagram to show the expansion process and shade the region representing the work done during the process. [2 marks]

ii) Calculate the work done during the process. [3 marks]

c) The diagram below shows an insulated window glass of a house which consists of two glass panels separated by a layer of air.



The area of the window is 2.0 m x 1.5 m. The thicknesses of the outer glass, inner glass and air layer are 5.0 mm, 3.0 mm and 3.0 cm respectively. If the temperature outside the house is 45°C and the temperature inside the house is kept at 20°C, calculate the energy per hour that is prevented from entering the window. [5 marks]

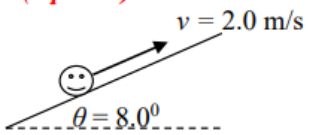
[Thermal conductivity of glass = 0.84 $Wm^{-1}K^{-1}$, thermal conductivity of air = 0.023 $Wm^{-1}K^{-1}$]

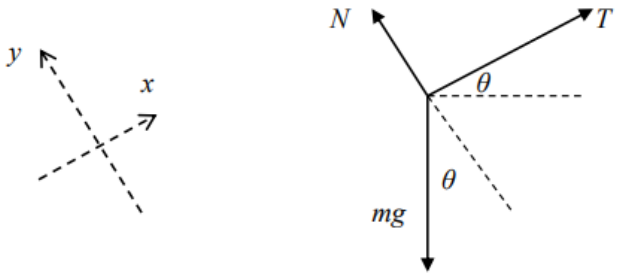
SMJK Yu Hua, Kajang, Selangor
STPM Trial Examination
Physics Paper 1
November 2023

Answers for trialstpm2023paper1 :

1. A
2. D
3. C

Diagram/Description (2 points)





N = normal force magnitude (unknown)
T = rope tension magnitude (required)
mg = gravity magnitude =50 x 9.8=490 N

$a_x = +0.1$ m/s^2
$a_y = 0$
$v_x = 2.0$ m/s

Idea (1 point)

$\Sigma \underline{\boldsymbol{F}} = m\underline{\boldsymbol{a}}$

x: $T - mg \sin\theta = m\,a_x$
y: $N - mg\cos\theta = m\,a_y$

Numbers (no points)

T = 50 x 9.80 x sin 8.0° + 50 x 0.1 = 73.1948 (v_x not needed)

Answer (1 point)

= 73 N (2sf)

4. C

Justification: For this question we need to use energy conservation. We know that since both inclines are frictionless, we know that all gravitational potential energy of the balls at the top of the inclines will be converted into kinetic energy at the bottom of the inclines. Since both balls are at the same height, and have the same mass (they are identical), we know that they must have the same gravitational potential energy at the top of each incline (EP = mgh). Therefore, by the above logic, both of the balls will have the same kinetic energy at the bottom of each incline. Since EK = ½mv ^{2} , and since the mass of each ball is equal, the only way their kinetic energies could be the same is if

their velocities were also equal. Therefore the balls M_1 and M_2 will be travelling at the same speed at the bottom of their respective inclines

5. C

$F=-kx$

$F=-dU/dx$

$\int dU = -\int F dx$

$W = -\int(-kx)dx$

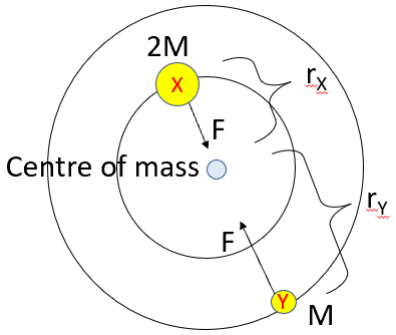
$= \frac{1}{2} kx^2$

$W \propto x^2$

$$x = \frac{F}{k}$$
$$= \frac{5.0\ \text{N}}{1000\ \text{N m}^{-1}}$$
$$= 0.005\ \text{m}$$

$$W = \frac{1}{2}kx^2$$
$$= \frac{1}{2}(1000)(0.005)^2$$
$$= 0.0125\ J \quad \text{or} \quad 1.25\ \text{cJ}$$

6. D
7. B
8. B



Use centre of mass method

$m_X r_X = m_Y r_Y$

$(2M) r_X = M r_Y$

$\frac{r_X}{r_Y} = \frac{M}{2M}$

$\frac{r_X}{r_Y} = \frac{1}{2}$

9. C.

$g_h = \frac{g}{4}$

As we know, gravity at some height is given by:

$g_h = g\left(\frac{R}{R+h}\right)^2$

$\Rightarrow \frac{g}{4} = g\left(\frac{R}{R+h}\right)^2$

$\Rightarrow \frac{R}{R+h} = \frac{1}{\sqrt{4}} = \frac{1}{2}$

$\Rightarrow 2R = R + h$

$\Rightarrow 2R - R = h$

$\Rightarrow h = R$

10. B
11. D
12. A
13. D

Suka sampel ini?

Kertas Percubaan STPM

Sem 1 · Fizik

- Semester 1: kertas percubaan (trial) negeri, subjek yang dipilih + skema
- Blueprint 30 hari Semester 1 (setiap subjek)
- Semester 3: percubaan 2024, 10 subjek, banyak negeri, soalan + skema dalam satu fail

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