SAMPEL PERCUMA

Trial STPM 2021 Fizik Semester 1 SMK Taman Tasik, Selangor

Set penuh: Kertas Percubaan STPM

Sem 1 · Fizik

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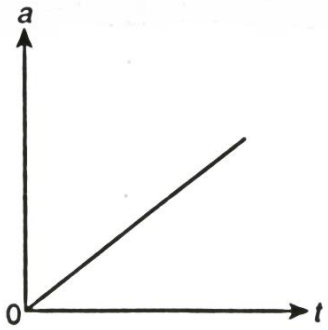
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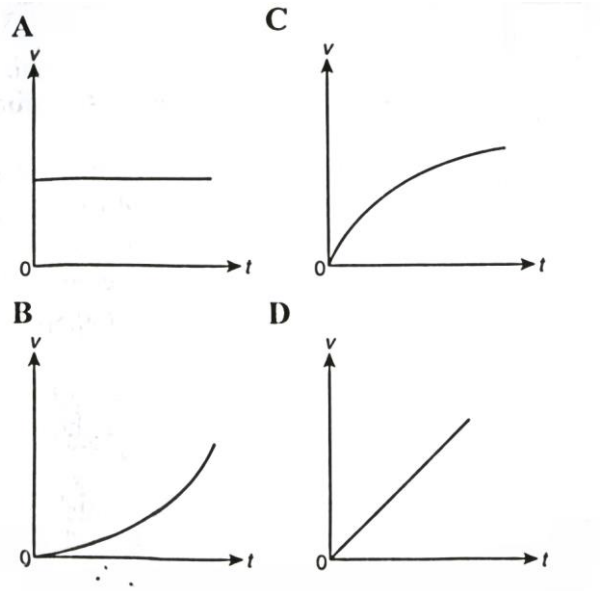
1. Which of the following quantity has different units from the other three?

   A Energy per unit volume
   B Young's modulus
   C Height x density x acceleration
   D Rate of change of momentum

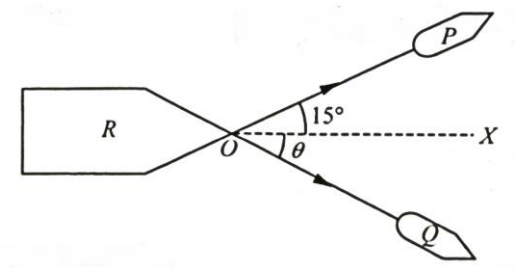
2. The graph below shows the variation of acceleration with time for an object which is initially at rest.



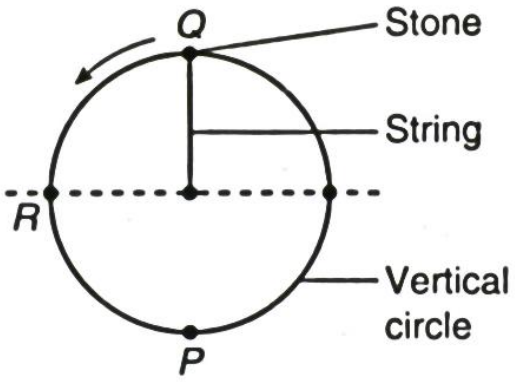
Which of the following shows the variation of velocity with time for this object?



3. The diagram below shows two tugs *P* and *Q* pulling a ship *R* from a point *O* to *X*.



7. A stone attached to the end of a string is swung in a vertical circle at constant speed as shown in the diagram below.



The tension in the string changes as the stone moves around. When it is at *P*, the tension is T_P and when it is at *Q* the tension is T_Q. What is the tension when the stone is at *R?*

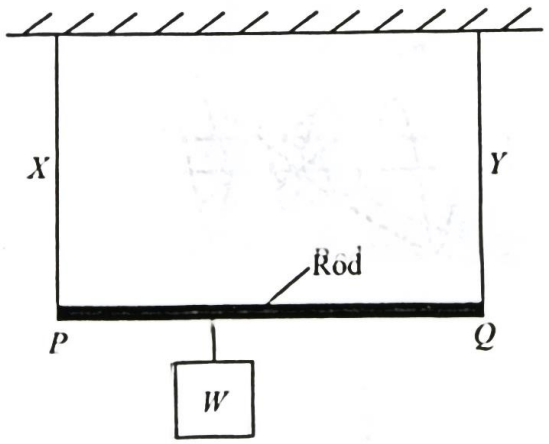
A. $T_p + T_Q$ B. $\frac{1}{2}T_p + T_Q$ C. $T_p - T_Q$ D. $\frac{1}{2}T_p - T_Q$

8. If a deep hole is dug in the ground and the acceleration due to free fall, ***g'*** is measured at the bottom of the hole, how will it compare with the value of ***g*** at the surface?

[Take the distance from the centre of the earth to the bottom of the hole to be ***r*** and the effective mass of the earth contributing to the acceleration due to free fall to be ***m***.]

	Comparison between *g* and *g'*	**Reason**
A	***g* = *g'***	***r*** and ***m*** decreases by the same fraction
B	***g* > *g'***	$g'\alpha\frac{1}{r^2}$ but $m \propto r^2$, hence g'α r^2
C	***g* < *g'***	***r*** becomes smaller but ***m*** remains the same
D	***g* = *g'***	Once inside the earth, the gravitational force is zero

10. A 99.0 cm long rod *PQ* of negligible weight which is supported at both of its ends by two equally long wires *X* and *Y* is shown in the diagram below.



The cross-sectional areas of *X* and *Y* are 1.50 mm^2 and 3.00 mm^2 respectively. The Young's modulus of wires *X* and *Y* are 1.80 x 10^{11} Pa and 1.20 x 10^{11} Pa respectively. A weight *W* is suspended from the rod such that *X* and *Y* are stretched. At what distance from *P* should the weight be suspended along the rod so that it remains horizontal?

A 24.6 cm B 42.4 cm C 56.6 cm D 74.4 m

11. The variation of probability function with molecular speed for a gas at temperatures T_1, and T_2, whereby $T_1 < T_2$, is shown in the graph below.

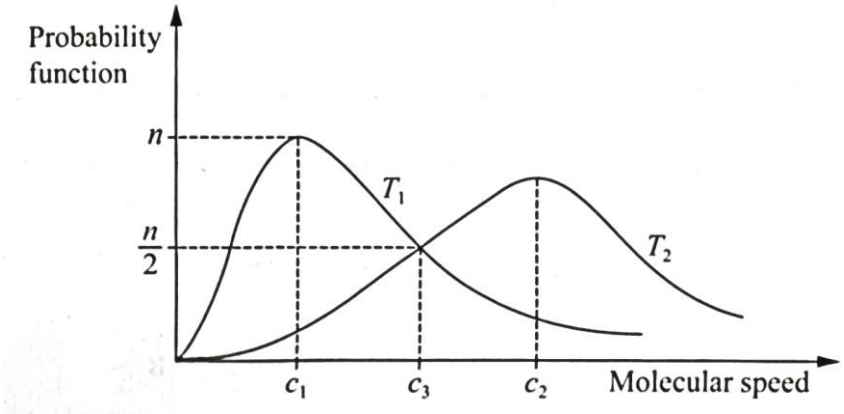
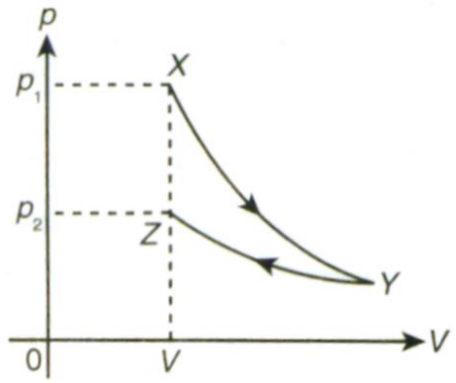


Figure 6

Which statement is ***true*** of the above graph?

A The r.m.s. speed is greater than the molecular speed c_2 at T_2.
B The molecular speed c_3 is the r.m.s. speed of the gas at both temperatures.
C At T_2, less than half of the number of molecules *n* move faster than the molecular speed c_1
D When the temperature increases from T_1 to T_2, the number of molecules *n* with the most probable speed is half of the original number of molecules.

15. In the ***p*-*V*** graph shown below, ***XY*** represents an adiabatic change and ***YZ*** represents an isothermal change that take place in a sample of ideal gas.



The internal energy of the gas at ***X, Y*** and Z are $\boldsymbol{U_X}$, $\boldsymbol{U_Y}$ and $\boldsymbol{U_Z}$ respectively. Which of the following statements is true?

A $U_X = U_Y, U_X > U_Z$
B $U_X > U_Y, U_X = U_Z$
C $U_X = U_Y = U_Z$
D $U_X > U_Y, U_Y = U_Z$

SECTION B [*15 marks*]

*Answer **all** the questions in this section.*

16. a. A drag force, F is acting on a pebble of cross-sectional area, A moving with velocity, v in a medium of density, ρ. Using dimensional analysis to predict a physics equation of F in terms of A, v and ρ.

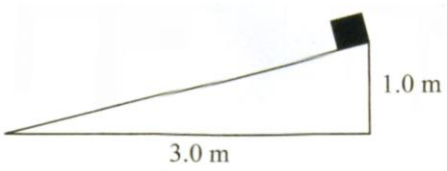
[3 marks]

SECTION C [*30 marks*]

*Answer any **two** questions in this section.*

18. a. i. State work-energy Theorem. [1 mark]

b. The diagram below shows a body of mass 5.0 kg placed on an inclined plane with base length 3.0 m. The body slides down the inclined plane without friction.

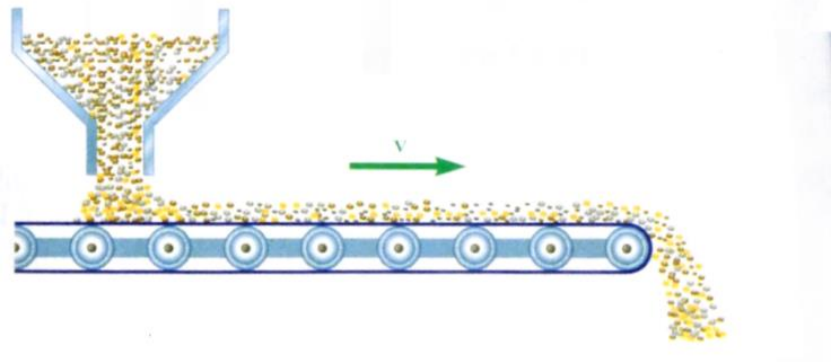


i. Using Work-energy Theorem calculate the velocity of the body when it reaches the bottom. [2 marks]

If the body slides down the inclined plane with coefficient of kinetic friction equal to 2.0, calculate

ii. Work done against friction [3 marks]

c. Figure below shows a conveyor belt carrying broken stones in a quarry moves at a speed of 0.20 m s^{-1}. The maximum power generated by the motor is 160 W.



i. Derive the relationship for power *P* in terms of the force *F* applied and the velocity *v* of the body. [3 marks]

ii. What is the maximum mass per unit time of stone that can be conveyed? [3 marks]

iii. In the horizontal direction, what is the increase in kinetic energy per unit time? [2 marks]

iv. Explain the difference in the maximum power generated and the increase in kinetic energy per unit time. [1 marks]

(i) Identify the adiabatic change and isothermal change. [1 *mark*]

(ii) What quantity is kept constant during change III? [1 *mark*]

(iii) If this cyclic process represents the changes in a heat engine, in what sequence must the three processes take place? [1 *mark*]

(iv) In each cycle, a certain amount of work is done by the gas. What aspect of the graph represents the work done per cycle? [1 *mark*]

(c) A sample of 0.20 moles of a diatomic ideal gas occupies a volume of 5.0×10^{-3} m^3 at a pressure of 100 kPa. Determine the temperature of this gas. [1 *mark*]

(d) This gas is now allowed to expand reversibly and adiabatically to double its initial volume. This change can be represented by the equation

$$pV^{\gamma} = C$$

whereby, γ and C are constants.

(i) State the values for the constants γ and C. [2 *marks*]

(ii) Determine the pressure of the gas at the end of this expansion. [2 *marks*]

(iii) If this expansion was done isothermally instead of adiabatically, state and explain qualitatively any difference in the final pressure compared to the value obtained in (ii). [2 *marks*]

@@@@@@@@@@QUESTION PAPER ENDS HERE@@@@@@@@@@@@@@@

	$T_X = \left(\frac{E_X A_X}{l}\right)e$ $= \frac{(1.80\times10^{11})(1.50\text{ mm}^2)}{l}e$ $T_Y = \frac{(1.20\times10^{11})(3.00\text{ mm}^2)}{l}e$ Taking moments about the weight, $T_X(d) = T_Y(99.0-d)$ $\left[\frac{(1.80\times10^{11})(1.50\text{ mm}^2)}{l}\right]e(d) = \left[\frac{(1.20\times10^{11})(3.00\text{ mm}^2)}{l}\right]e(99.0-d)$ $d = 56.6\text{ cm}$	
11	A r.m.s speed > c_2, most probable speed.	
12	B $C_{V,m}$ = gradient of graph $= \frac{6500-6100}{310-290}\text{ J mol}^{-1}\text{ K}^{-1}$ $= 20\text{ J mol}^{-1}\text{ K}^{-1}$ $C_{p,m} = C_V + R$ $= (20+8.31)\text{ J mol}^{-1}\text{ K}^{-1}$ $= 28.31\text{ J mol}^{-1}\text{ K}^{-1}$ $\frac{C_{p,m}}{C_{v,m}} = 1.42$	1
13	D Along PQ and RS, the rod is insulated, temperature decreases linearly. Along QR, the rod is not insulated, temperature decreases non-linearly.	1
14.	C	1
15.	D	1
Total mark for section A		**15**
Section B		
No	**Answer/working**	**Mark**
16.	Assume the physics equation is $F = kA^x v^y \rho^z$ where k, v and ρ are dimensionless constants. $[F] = \text{M L T}^{-2}$, $[A] = \text{L}^2$, $[v] = \text{L T}^{-1}$ and $[\rho] = \text{M L}^{-3}$ Relating the dimensions on both sides of the equation for consistent of dimensions $\text{M L T}^{-2} = (\text{L}^2)^x (\text{L T}^{-1})^y (\text{M L}^{-3})^z$ $\text{M L T}^{-2} = \text{L}^{2x+y-3z}\ \text{T}^{-y}\ \text{M}^z$ $1 = z,\ 1 = 2x + y - 3z$ and $-2 = -y$ $x = 1, y = 2$ and $z = 1$	1 At least 2 dimension correct 1
a. i	Therefore $F = kAv^2\rho$	1
b. i.		

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