THE OPEN UNIVERSITY OF SRI LANKA
ADVANCED CERTIFICATE IN SCIENCE
TAF2523-PHYSICS – 1
FINAL EXAMINATION
DURATION – THREE HOURS

Date : 09th December 2021   Time : 0930-1230 Hrs.

Part -A(MCQ)

- The Question paper(Part A) consists of 25 multiple choice questions
- Answer all the questions
- Answers for the Multiple Choice Questions, should be provided by placing X in the relevant cage indicating the most appropriate answer in the MCQ answer sheet provided
- At the end of the examination you should submit the question paper with answer sheet.
- Maximum marks for this part is 40%.

$$(g = 10 \text{ m s}^{-2})$$

1).SI units of the Impulse,

(1) kg m s^{-1} (2) m s^{-1} (3) $kg^2 \text{ m s}^{-1}$ (4) g m s^{-1}
(5) g m s^{-2}

2). Dimensions of Power,

(1) $M^0L^1T^0$ (2) $M^1L^2T^{-3}$ (3) $M^0L^1T^{-2}$ (4) $M^1L^1T^{-2}$
(5) $M^1L^2T^{-2}$

3). 5.0 ±0.01 mm is a measurement taken by a properly selected measuring instrument. The percentage error associated with the measurement will be,
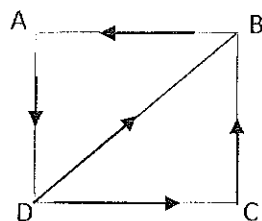
(1) 0.4 % (2) 0.5 % (3) 0.6 % (4) 0.2 % (5) 0.3 %

4).Pitch of the following micrometer screw gauge is 0.5 mm and the circular scale is divided into 50 equal divisions. What will be the reading of the scale?
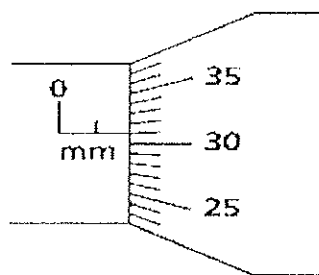
(1) 0.23 mm   (2) 0.38 mm   (3) 0.81 mm   (4) 1.81 mm   (5) 0.31 mm

5). What will be the resultant of the following system of coplanar vectors.

(1) $\overrightarrow{BD}$ (2) $3\overrightarrow{DB}$ (3) $2\overrightarrow{DB}$ (4) $\overrightarrow{DB}$ (5) $\overrightarrow{2BD}$

6). Two objects A and B are moving on a flat surface as shown in the following figure. Velocity of A and B relative to the Earth are 100 m s^{-1} and 60 m s^{-1} respectively. What will be the velocity of B relative to A (V_{BA})?

(1) $\overrightarrow{40}$ m s^{-1} (2) $\overleftarrow{40}$ m s^{-1} (3) $\overrightarrow{20}$ m s^{-1} (4) $\overrightarrow{160}$ m s^{-1} (5) $\overleftarrow{160}$ m s^{-1}

2

7). Following Velocity-Time graph represent the change in the velocity of an object with time moving on a straight line. Which graph section has the minimum acceleration.
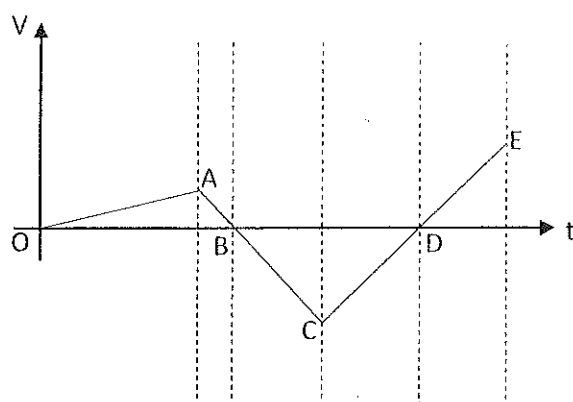

(1) O-A

(2) A-B

(3) B-C

(4) C-D

(5) D-E

08). An object is projected vertically upwards with an initial velocity of $200 \ m \ s^{-1}$ from the ground. Total time taken to reach the ground will be,

(1) 10 s   (2) 40 s   (3) 50 s   (4) 60 s   (5) 200 s

09). A bullet is fired with an initial velocity of $500 \ m \ s^{-1}$ and 30^0 with the horizontal from a flat terrain. The time taken to reach the maximum height will be,

(1) 5 s   (2) 10 s   (3) 25 s   (4) 50 s   (5) 500 s

10). A light inextensible rope is going through a frictionless pulley as shown in the following diagram. What will be the common acceleration and tension in the rope of the system?
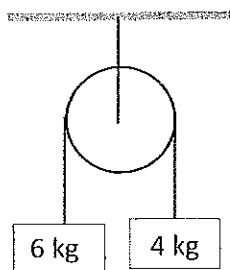

(1) $10 \ m \ s^{-2}$,20 N   (2) $0 \ m \ s^{-2}$,40 N   (3) $5 \ m \ s^{-2}$,40 N   (4) $2 \ m \ s^{-2}$, 48 N
(5) $5 \ m \ s^{-2}$, 22 N

3

11).A mass of 4 kg is attached to a system of light strings as shown in the figure. What will be the tensions T_A , T_B respectively,
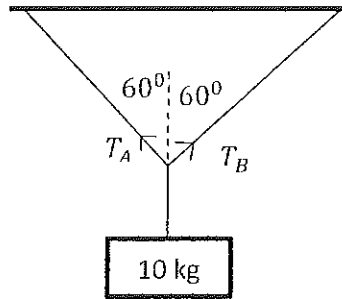
(1) 100 N, 100 N   (2) 50 N,50 N   (3) 20 N,40 N   (4) 40 N,60 N   (5) 10 N,40 N

12).A 20 kg object is kept on a surface having static coefficient of friction (μ_S) is 0.5 and dynamic coefficient of friction (μ_D) is 0.4.What will be the frictional force on the object, when 120 N force is applied horizontally on the object as shown in the diagram?


$$\mu_D = 0.4$$
$$\mu_S = 0.5 ,$$
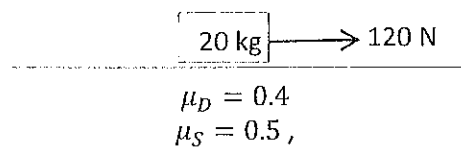
(1) 10 N   (2) 40 N   (3) 60 N   (4) 80 N   (5) 100 N

13). Young's modulus of a substance is defined as,

(1) Stress/Strain

(2) Stress × Strain

(3) Strain/Stress

(4) 1/Stress

(5) 1/Strain

14). A tuning fork with frequency f Hz is held above a tube immersed in water as shown in the following figure. The tube is resonating with the tuning fork with its fundamental mode of vibration and the length of the tube above the water level is 15 cm. what will be the value of the frequency (f) of the tuning fork?

(Neglect the end correction and take the speed of sound as 330 m s^{-1})

15 cm
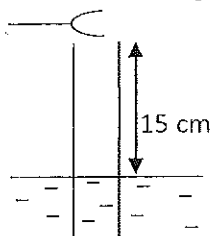
(1) 110 Hz   (2) 550 Hz   (3) 640 Hz   (4) 200 Hz   (5) 500 Hz

15. Following diagram shows the variation of the amplitude with time for a system having two sound sources with slightly different frequencies. What will be the beat frequency?
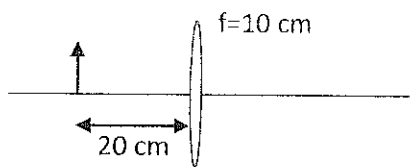

Amplitude (m)

Time (s)

0.2   0.4   0.6
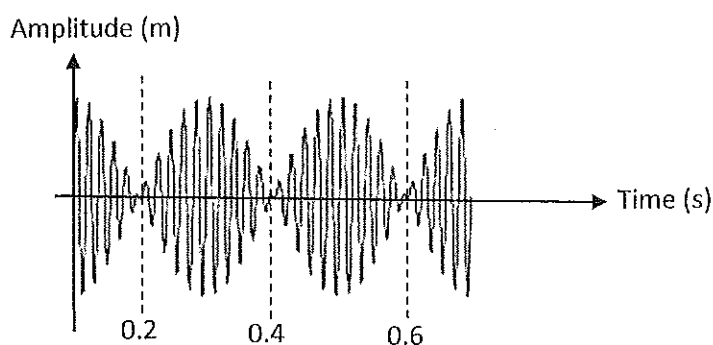
(1) 5 Hz   (2) 10 Hz   (3) 1 Hz   (4) 0.1 Hz   (5) 100 Hz

16). What would be the speed of transverse waves in a rope under tension 10 N and mass per unit length 0.1 kg m^{-1}?

(1) 20 m s^{-1} (2) 40 m s^{-1} (3) 10 m s^{-1} (4) 30 m s^{-1}
(5) 50 m s^{-1}

5

25). An object is placed near a convex lens (f=10 cm) as shown in the following figure. What will be the distance to the image from the lens?

f=10 cm

20 cm

(1) 10 cm

(2) 20 cm

(3) 30 cm

(4) 50 cm

(5) 80 cm

End of Part A

- Answer any four (04) questions only.
- If more than (04) question are answered only the first four will be marked.
- Each question earns fifteen (15) marks, amounting to total of 60% marks.
- You have to show the steps involved in solving problems. No marks are awarded for the mere final answer without proper steps.

1). (a) The equation $F = \dfrac{GMm}{R^2}$ is expressing Newton's law of gravitation, F is the force, M,m are masses and R is the distance between M and m. Find the units and dimensions of G.   (02 Marks)

(b) The relation between the period of oscillations with spring constant (k) and mass (m) attached to the lower end of the spring is given by the equation

T=Ck^{x}m^y (C is a constant) Find x and y.   (03 Marks)

(c) Following Readings were taken by using a vernier caliper and a meter ruler to find the volume of a **hollow cylinder**.

a-inner diameter, b-outer diameter and c-height of the cylinder
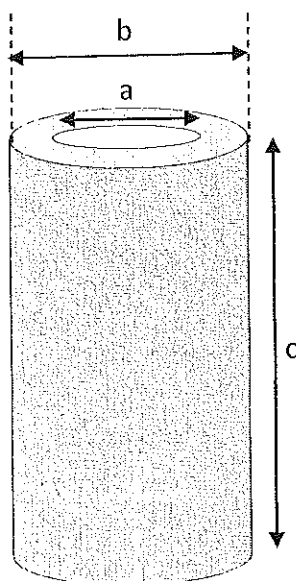
(i) Following diagrams shows the corresponding positions of the vernier scale and main scale when taking a and b readings. Find the values of a and b by using the following diagrams. (Assume that the vernier caliper has no zeroth error and least count of the instrument is 0.1 mm)   (04 Marks)

Measurement of 'a'
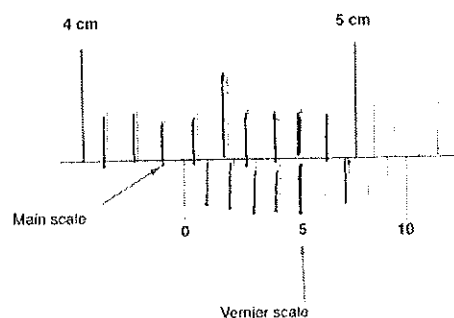
Measurement of 'b'
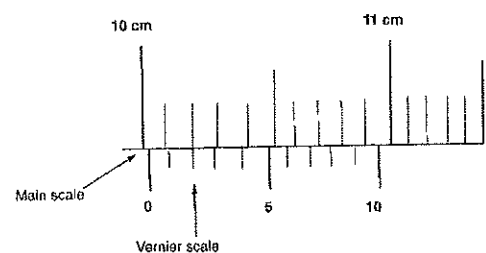
(ii) Measurement 'c' was 20 cm and it was taken by the meter ruler. Find the percentage error associated with this measurement.
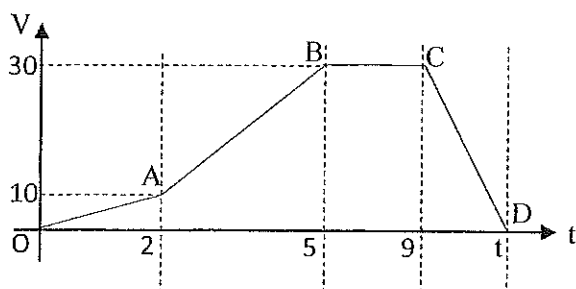(02 Marks)

(iii) Find the mass of the cylinder (Take the density of the material as
6000 kg m^{-3})

(04 Marks)

2). (a) A system of coplanar vectors act on an object is shown below. Find the direction and magnitude of the resultant vector. (03 Marks)

$20\sqrt{3}$ N

60^0

30^0

10 N

10 N
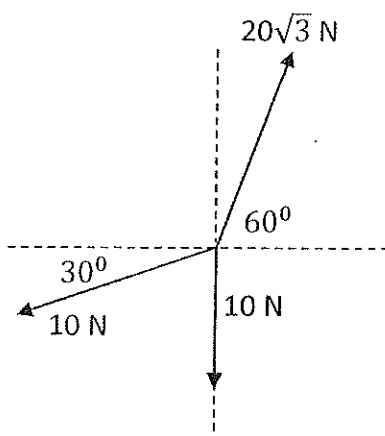
(b) Following velocity time graph shows the variation of the velocity of an object moving on a straight line. Answer a to d based on the given graph.

(a) Find the acceleration of the object for OA motion and AB motion.
(3 Marks)

(b) Find the displacement with the constant velocity 30 m s^{-1}.
(2 Marks)

(c) Gradient of CD line is -6 m s^{-2}. Find the value of 't'.
(3 Marks)

(d) Find the total displacement of the object.
(4 Marks)

(03)   (a)   State the Newton's Laws of motion,   (03 marks)

(b)Distinguish 'mass' and 'weight' of an object.   (02 marks)

(c)What is the relationship between force and momentum? (02 marks)

(d)A helicopter of total mass 1000kg is able to remain in a stationary position by imparting a uniform downward velocity to cylinder of air below it of effective diameter 6m .Calculate the downward velocity given to air.

(Assume the density of air is 1.2 kg m^{-3})   (08 marks)

04)(a) Define 'work' and 'Power '   (02 marks)

(b) In an open air wind is blowing along a horizontal direction at constant velocity V. What is the kinetic energy per unit volume of moving air .

(Take density of air as ρ .)   (04 marks)

(c)The kinetic energy of the wind can be used to rotate the blades of a wind mill   and the energy is converted into electricity. Consider a situation where the wind blowing normal to the plane of rotation of the blades of a windmill. The area swept by a rotating blade is 'A'. Assume that all the kinetic energy of the wind blowing through a cross sectional area A could be extracted by the blades , show that the rate at which the wind energy is transferred to wind mill is ½ ρAV^3

(06 marks)

d)If A= 50 m^2,V=20 ms^{-1} ρ=1.2 kgm^{-3} and windmill converts its mechanical energy to electricity with an efficiency of 30%,calculate the power output of the windmill.   (03 marks)

5). (a) Wavelength of red color is the maximum wavelength of the visible spectrum and it is around 700 nm. Find the approximate frequency of the red color.   (speed of light 3×10^8 m s^{-1}) (02 marks)

(b) Briefly explain the experiment used to determine the frequency of a tuning fork by using the sonometer. (use diagrams and include all the experimental steps in point wise)   (06 Marks)

(c) A sonometer can be used to find the frequency of an AC (Alternating current) signal as in the following setup.
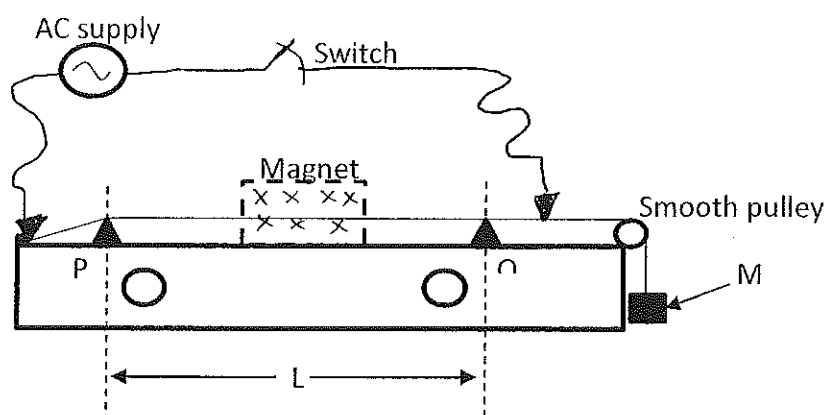

When AC signal is supplied to the steel wire in the sonometer, the section between P and Q vibrates with the 1st Overtone (2nd Harmonic) and the frequency of the vibration will be equal to the frequency of the AC signal.

(a) Draw the vibration pattern of the wire section in between P and Q for the above   mode of vibration.   (02 Marks)

(b) Write an expression for the frequency of vibration in terms of M,g,L and m. Here m is the mass per unit length of the sonometer wire.
(05 Marks)

6). A monochromatic beam of light incident on a prism with angle of prism 60^0 and with an incident angle 30^0 as shown in the following diagram. (Refractive index of the prism =1.5).
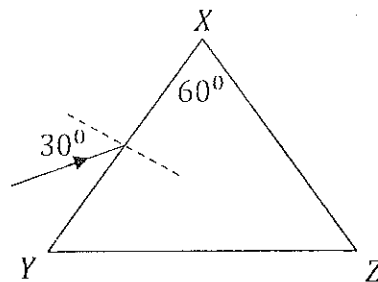
(i)   After finding all the necessary angles, complete the path of the ray.

(06 marks)

(ii) Find the deviation of the ray at each surface and total deviation of the ray.   (06 Marks)

(iii) Find the required incident angle at the XY surface for a monochromatic light ray to travel the ray along the surface XZ. (Hint: Take the incident angle on the XZ surface as the critical angle)   (03 Marks)

***