00131

THE OPEN UNIVERSITY OF SRI LANKA
FOUNDATION PROGRAMME IN OUSL
FINAL EXAMINATION 2016/2017
PYF2203-PHYSICS

DURATION: Three (03) HOURS **INDEX NO: .....**

Date: 21.10.2017 **Time**: 9.30 a.m. – 12.30 p.m.

Answer sheet

Mark the correct answer

Question No.	ANSWER				
	(a)	(b)	(c)	(d)	(e)
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Part A

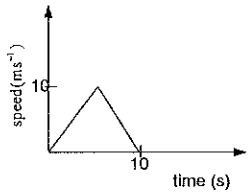
Answer all questions

(1) Dimensions of power is
(a) ML^2T^{-3} (b) M^2LT^{-2} (c) ML^2T^{-1} (d) MLT^{-2} (e) ML^2T^{-2}

(2) One of the two rectangular components of a force is 10 N and it makes an angle of 60° with the force. The magnitude of the force is
(a) 7.1 N (b) 14.1 N (c) 17.3 N (d) 20 N (e) 10 N

(3) A car covers the first half of a certain distance with speed v_1 and the second half with a speed v_2. The average speed during the whole journey is,
(a) $\frac{v_1+v_2}{2}$ (b) $\frac{v_1v_2}{v_1+v_2}$ (c) $\sqrt{v_1v_2}$ (d) $\frac{2v_1v_2}{v_1+v_2}$ (e) $\sqrt{\left(v_1^2+v_2^2\right)}$

(4) The speed-time graph of a particle moving along a straight line is shown below. The distance covered by the particle in 10s is,
(a) 25m (b) 50m (c) 100m
(d) 150m (e) 75m

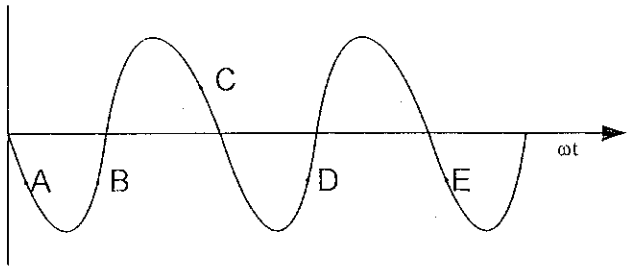


(5) A balloon is going vertically upwards with a velocity of 12 m/s. When it is 65 m above the ground, a stone is gently released from it. The time taken by the stone to each the ground is
(a) 13.o s (b) 6.5 s (c) 5.0 s (d) 3.5 s (e) 4.0 s

(6) When a force of 1N acts on a 1kg body that is able to move freely, the body receives,
(a) a speed of $1ms^{-1}$
(b) an acceleration of $1ms^{-2}$
(c) an acceleration of $9.81ms^{-2}$
(d) an acceleration of $10ms^{-2}$
(e) None of the above

(7) When the velocity of a body is doubled
(a) its Kinetic Energy doubled
(b) its Potential Energy doubled
(c) its momentum is doubled
(d) its acceleration is doubled
(e) None of the above

(8) The diagram shows the profile of a wave, which of the following pairs of points are in phase.



(a) A, B (b) B, C (c) B, D (e) B, E (e) C, D

(9) When a tuning fork A of frequency 100 Hz is sounded with a tuning fork B, the number of beats per second is 2. On putting some wax on the prongs of B, the number of beats per second becomes 1, the frequency of the fork B is
(a) 98 Hz (b) 99 Hz (c) 101 Hz (d) 102 Hz (e) 97 Hz

(10) Beats occurs because of
(a) Interference (b) reflection (c) refraction
(d) Doppler effect (e) Polarization

(11) A tuning fork, whose frequency as given by the manufacturer is 512Hz, is being tested using an accurate oscillator. It is found that they produce 2 beats per second when the oscillator reads 514Hz and 6 beats per second when it reads 510Hz. The actual frequency of the fork is,
(a) 508Hz (b) 512Hz (c) 516Hz (d) 518Hz (e) 504Hz

(12) The velocity of sound in air is affected by change in the
(a) Atmospheric Pressure
(b) Moisture content of air
(c) Temperature of air
(d) Composition of air
(e) (b), (c) & (d) of the above

(13) How many times more intense is a 90dB sound than a 40 dB sound?
(a) 2.5 (b) 5 (c) 50 (d) 10^5 (e) 10

(14) The least distance of distinct vision is 25 cm. The focal length of a convex lens is 5 cm. It can act as a simple microscope of magnifying power
(a) 4 (b) 5 (c) 6 (d) 8 (e) 3

(15) A source of sound is moving with a velocity of $50ms^{-1}$ towards a stationary observer. The observer measures the frequency of the source as 1000Hz. What will be the apparent frequency of the source when it is moving away from the observer after crossing him? The velocity of sound in the medium is $350ms^{-1}$.
(a) 750Hz (b) 857Hz (c) 1143Hz (d) 1333Hz (e) 1000Hz

(16) Velocity of sound in air is 320 m/s. A pipe closed at one end has a length of 1 m. Neglecting end corrections, the fundamental frequency of the air column in the pipe.
(a) 80 Hz (b) 240 Hz (c) 320 Hz (d) 400 Hz (e) 160 Hz

(17) A monochromatic beam of light passes from a denser to a rarer medium. As a result its,
(a) Velocity increases
(b) Velocity decreases
(c) frequency decreases
(d) frequency increases
(e) wavelength decreases

(18) The speed of light in the glass of refractive index 1.5 is $2\times10^{8}\,ms^{-1}$. In a certain liquid the speed of light is $2.5\times10^{8}\,ms^{-1}$. The refractive index of the liquid is,
(a) 0.64 (b) 0.80 (c) 1.20 (d) 1.44 (e) 1.6

(19) The angle of a prism is 30°. The rays incident at 60° at the refracting face surfer a deviation of 30°. The angle of emergence is,
(a) 0° (b) 30° (c) 60° (d) 90° (e) 45°

(20) A plane mirror is approaching you at 10 cm/s. You can see your image in it. The image will approach you with a speed.
(a) 5 cm/s (b) 10 cm/s (c) 15 cm/s (d) 20 cm/s (e) 2.5 cm/s

(21) Two wires of the same material have diameters in the ratio 2:1. If they are stretched by the same force, their elongations will be in the ratio,
(a) 8:1 (b) 1:8 (c) 2:1 (d) 1:4 (e) 4:1

(22) When the terminal velocity is reached, the acceleration of a body moving through a viscous medium is,
(a) zero (b) positive (c) negative (d) depends on other factors
(e) None of the above

(23) 32 units of a liquid flow per unit time through a capillary tube connected to a pressure head. If a tube of half the radius and same length is connected to the same pressure head, the quantity of water flowing per unit time will be,
(a) 1 unit (b) 2 units (c) 4 units (d) 8 units (e) 16 units

(24) Water rises to a height of 2cm in a capillary tube held vertically. When the tube is tilted 60° from the vertical, the length of the water column in the tube will be,
(a) 1.0cm (b) 2.0cm (c) 3.0cm (d) 4.0cm (e) 5.0cm

(25) The surface tension of water is $7\times10^{-2}\,Nm^{-1}$. The work required to break a drop of water of radius 0.5 cm in the identical drops each of radius 1mm is,
(a) $8.8\times10^{-4}\,J$ (b) $8.8\times10^{-5}\,J$ (c) $4.4\times10^{-4}\,J$ (d) $4.4\times10^{-5}\,J$
(e) None of the above

Part B

Answer four (04) questions only

(Q.1) (a) What is (i) Static Frictional Force
(ii) Kinetic Frictional Force
(iii) Static coefficient of Friction
(iv) Kinetic coefficient of Friction

(10 marks)

(b) Write down the Laws of friction

(15 marks)

(c)

m_1

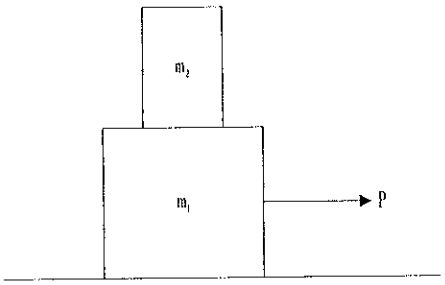
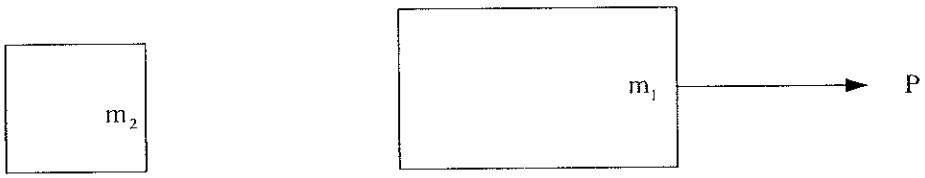


Figure shows that two blocks of mass and m_2 are placed one on the top of the other are lying on a rough horizontal surface. The coefficient of friction between the blocks and the block of mass m_1 and horizontal surface is μ. A force P is appliedon the lower block of mass m_1.



Copy down the above two diagrams to your answer sheet and mark the forces acting on each block.

(15 marks)

(i) Calculate the acceleration of each block.
$\left(\text{Let } P > \mu g\left(m_1 + 2m_2\right)\right)$

(10 marks)

(Q2) (a) (i) Write down the three Newton's Laws of motion.

(15 marks)

(ii) State the Law of conservation of linear momentum making clear the condition under which it can be applied.

(15 marks)

(b) A car of mass 1000 kg tows a caravan of mass 600 kg up a road which rises 1 m vertically for every 20 m of its length. There are constant frictional forces of 200 N and 100 N to the motion of the car and to the motion of the caravan respectively. The combination has an acceleration of 1.2 ms^{-2} with the engine exerting a constant driving force. Find

(i) The driving force
(ii) The tension in the tow - bar

(20 marks)

(Q3). (a) Write down the laws of refraction.

(10 marks)

(b) Consider the following refraction:

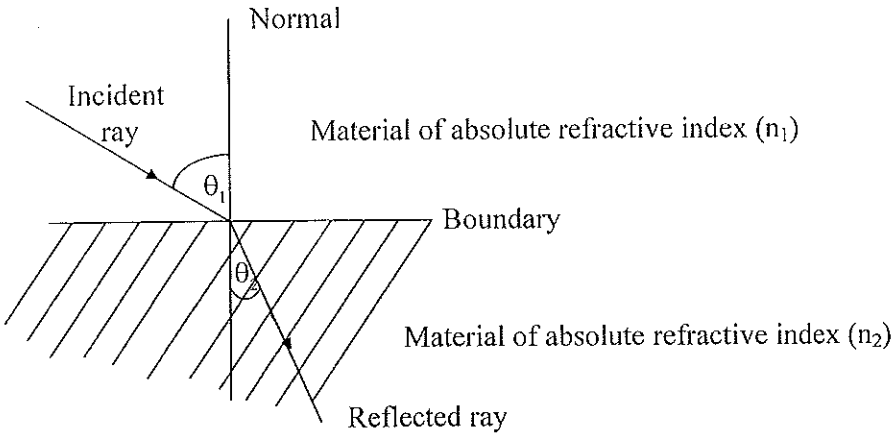


Figure 01

Show that

$$\frac{\sin\ \theta_1}{\sin\ \theta_2} = \text{constant}$$

(05 marks)

(c) The equation proved in part (b) can be written as

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

A ray of light is incident in glass on a glass-water boundary. The angle of incident is 50°C. Calculate the angle of refraction. (Refractive index of glass = 1.50, refractive index of water = 1.33)

(10 marks)

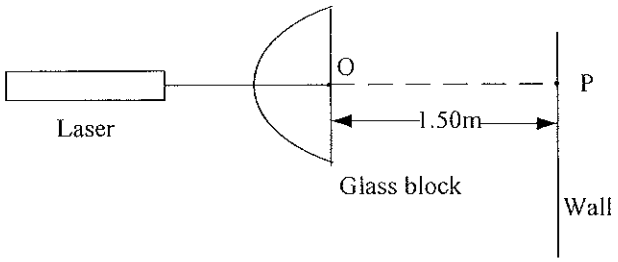
(d) When light travels from an optically more dense material to an optically less dense material it is possible for the angle of incidence to be such that the angle of refraction is 90°.

The angle of incidence at which this happens is called the critical angle c.

Show that, $\sin c = \frac{n_1}{n_2}$

(05 marks)

(e)



The diagram shows a narrow parallel horizontal beam of monochromatic light from a laser directed towards the point P on a vertical wall. A semicircular glass block G is placed symmetrically across the path of the light and with its straight edge vertical.

(i) What happens to the path of the light beam?

(05 marks)

(ii) What happens to the path of the light beam, when glass block is rotated about the center O of its straight edge?

(05 marks)

(iii) What is the maximum possible angle of rotation of the glass block such that the bright spot appears on the wall, if the refractive index of the glass is 1.5?

(05 marks)

(iv) Explain whether angle of rotation would be larger or smaller if a block of glass of higher refractive index was used.

(05 marks)

(Q4) (a) Velocity of longitudinal progressive sound wave in air is given by

$$V = \sqrt{\frac{\gamma P}{\rho}}$$

Where γ - the ratio of the principal heat capacities of the gas

P - the pressure of the gas $\left(Nm^{-2}\right)$

ρ - the density of the gas $\left(kgm^{-3}\right)$ and

V - the velocity of sound $\left(ms^{-1}\right)$

(i) Show that the above formula is dimensionally correct.

(05 marks)

(ii) Show that the velocity of sound in air is proportional to $\sqrt{T}$, where T is the absolute temperature of air. (Assume that air behave as an ideal gas).

(10 marks)

(b) Distinguish between a progressive wave and stationary wave. Your answer should refer to energy, amplitude and phase.

(10 marks)

(c) A small loudspeaker emitting a pure note is placed just above the open end of a vertical tube, 1.0m long and a few centimeters in diameter, containing air. The lower end of the tube is closed. Frequency of the note emitted by the loudspeaker is gradually raised from 50Hz to 500Hz. Calculate frequencies at which resonance occurs. You may assume that the speed of sound in air is $340ms^{-1}$.

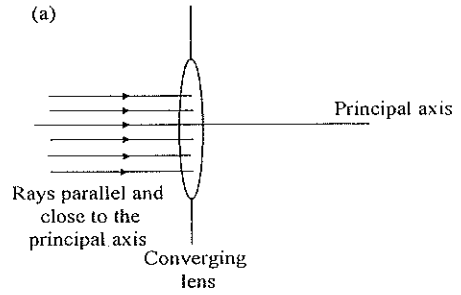
(10 marks)

(d) (i) The air temperature is now changed. It is found that as the frequency of the note emitted by the loudspeaker is raised from 50Hz, resonance first occurs for frequency 86.2Hz. Calculate the speed of sound in the column of air. You may assume that the end correction of the tube is negligible.

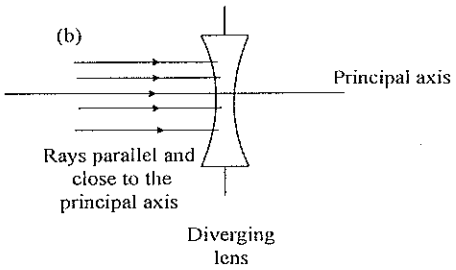
(15 marks)

(Q5) Copy down the following figures to your answer script and complete them.

(a) (05 marks)



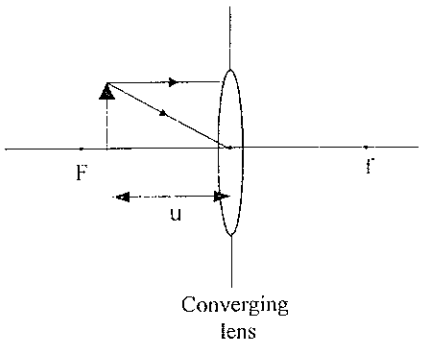
(05 marks)



(05 marks)

(05 marks)

(c)



(05 marks)

(d) Write down the lens formula which is a relation between the object distance (u), the image distance (v) and the focal length of the lens (f).

(05 marks)

(e) Write down the sign convention clearly relevant for the formula you wrote.

(05 marks)

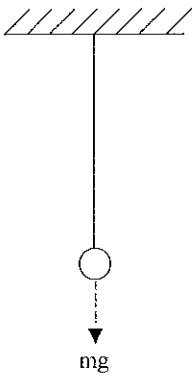
(f) An object is placed 200 cm from a converging lens of focal length 10 cm. Calculate the position of the image. Describe the nature and clearly indicate the side where the image formed.

(05 marks)

(g) A point source is placed on the axis of, and 60 cm from a thin converging lens of focal length 20 cm. A thin diverging lens of focal length 20 cm is placed on the opposite side of the converging lens and 5 cm from it. Calculate the position of the final image. Calculate the linear magnification of the final image.

(20 marks)

(Q6) (a)



Consider a copper wire with negligible mass and area A and length l subjected to a load mg as shown in the above diagram.

Write down an expressions for

(i) Tensile stress (05 marks)

(ii) Tensile strain (05 marks)

(b) Write down the Hook's law. (05 marks)

(c) Sketch a graph to show how the tensile strain of the copper wire varies with the tensile stress. Mark on your sketch the region where the wire obeys Hook's law. Also mark

(i) Limit of proportionality
(ii) Elastic Limit
(iii) Yield point
(iv) Elastic and Plastic regions
(v) Breaking stress

(10 marks)

(d) A cylindrical copper wire and a cylindrical steel wire, each of length 1.000 m and having equal diameters are joined at one end to form a composite wire 2.000 m long. This composite wire is subjected to a tensile stress until its length becomes 2.002 m. Calculate the tensile stress applied to the wire.

(The young modulus for copper = 1.2×10^{11} Pa and for the Steel = 2.0×10^{11} Pa)

(25 marks)