Academic Session 2022-2023

Term-End-2 Assessment

PHYSICS STEM

Booklet Code: 1401

Grade – 11

Student's Details

School Name (In capital letters) :											
School Id :											
Grade :											
Student's Name (In capital letters) :											
Exam Roll Number :											

General Instructions :

1. This booklet contains **21 pages.**
2. Count and verify the number of pages as soon as you receive the booklet. Inform the invigilator immediately in case of any issue with the booklet.
3. Maximum time allotted for the assessment is **3 hours (180 minutes).**
4. An additional reading time of 15 minutes has been allotted for careful reading of the questions. Don't write the answer to any question during the reading time.
5. Use only blue/black ball point to write your answers in the booklet.
6. Do all written work including rough work or calculations in the answer sheet only.
7. Don't detach / tear away any page from this booklet. Doing so would be considered as Unfair Means and would be dealt with accordingly.
8. Don't leave the examination room without the permission of the invigilator.

Signature of the Candidate_____ Signature of the Invigilator_____

Good Luck

Read the text below and answer the test items 1 to 5.

Minimum speed required to throw object to infinity away from earth's gravitational field is called escape velocity.

$$V_e = \sqrt{(2gr)}$$

Where g is acceleration due to gravity and r is radius of earth.

The value of escape speed or escape velocity of Earth V_e =11.2 km/s. This formula holds for all heavenly bodies including moon. The escape speed or escape velocity for Moon is 2.3 km/s. Moon is about five times smaller than Earth.

Q1. The ratio of the masses and radii of two planets are 2 : 3 and 4 : 9. What is the ratio of the escape speed at their surface?

A. 3 : 2

B. $\sqrt{3} : \sqrt{2}$

C. 2 : 3

D. $\sqrt{2} : \sqrt{3}$

Q2. The atmosphere on a planet is possible only if [v_{rms} is root mean square speed of ga molecules on planet and v_e is escape speed on its surface]

A. $v_{rms} = v_e$

B. $v_{rms} > v_e$

C. $v_{rms} < v_e$

D. $v_{rms} \leq v_e$

Q3. Select the correct statement/s about escape speed.

A. It is independent of mass of the planet.

B. It is independent of mass of the object.

C. It depends on radius of the planet.

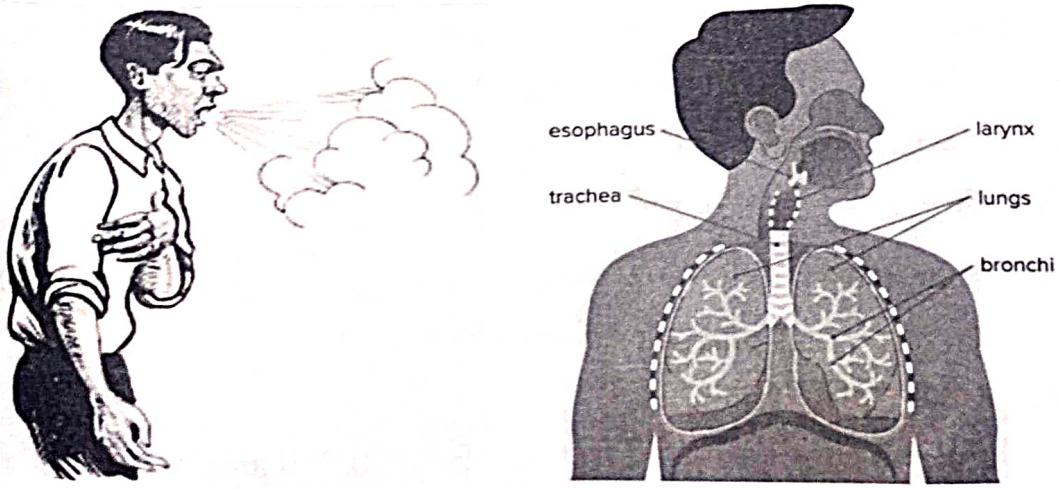
D. It depends on the angle of projection.

4. The escape speed of a projectile on the earth's surface is 11.2 kms^{-1}. A body is projected out with thrice this speed. What is the speed of the body far away from the earth? Ignore the presence of the sun and other planets.

Q5. A satellite is revolving very close to the earth. What is the percentage increase in velocity needed to make it escape from the Gravitational Field of the earth?

Read the text below and answer the test items Q6-Q7.

When a person coughs, he expels air at high speed through the trachea and upper bronchi so that the air removes excess mucus lining the pathway.



Assume that during the expulsion the volume flow rate is 7.0×10^{-3} m^3/s.

Q6. The trachea diameter is 14 mm. What percentage of 343 m/s (the speed of sound v_s) is the airspeed through the trachea? (Approximately)

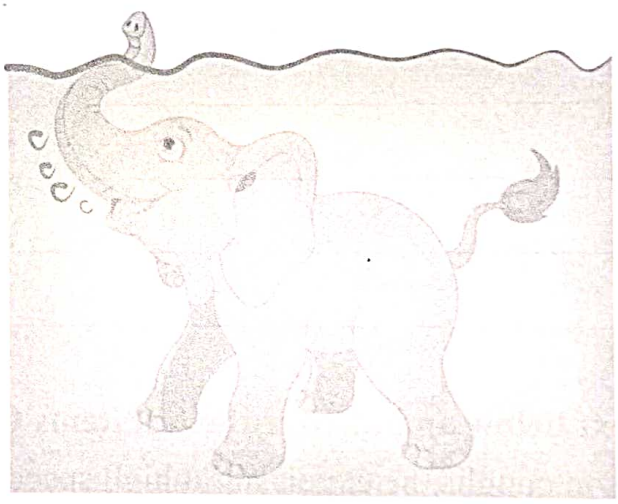
A. 23%
B. 32%
C. 13%
D. 41%

Q7. The trachea diameter shrunk to 5.2 mm. What percentage of 343 m/s (the speed of sound v_s) is the airspeed through the trachea? (Approximately)

A. 75%
B. 82%
C. 35%
D. 96%

Read the text below and answer the test items(Q8-Q9).

When a person snorkels, the lungs are connected directly to the atmosphere through the snorkel tube and thus are at atmospheric pressure.



If the length of the snorkel tube is 4.0 m or more (probably lethal situation) then the pressure difference causes blood vessels on the walls of the lungs to rupture, releasing blood into the lungs. An elephant can safely snorkel through its trunk while swimming with its lungs 4.0 m below the water surface because the membrane around its lungs contains connective tissue that holds and protects the blood vessels, preventing rupturing.

Q8. Length of a snorkel tube is 20 cm. What is the pressure difference between the internal air pressure and the water pressure against the body?
(Density of water = 998 kgm^{-3} at 20°C)

A. 0.019 atm
B. 0.050 atm
C. 0.065 atm
D. 0.09 atm

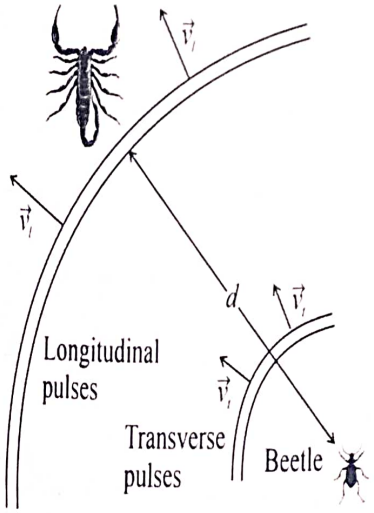
Q9. Length of the snorkel tube is 4.0 m. What is the pressure difference between the internal air pressure and the water pressure against the body?
(Density of water = 998 kgm^{-3} at 20°C)

A. 0.52 atm
B. 0.39 atm
C. 0.12 atm
D. 0.9 atm

Read the text below and answer the test items (Q10-12).

On a beach as a beetle moves along the sand in the daylight, a scorpion (nocturnal animal) can easily dash for it and feed on it without being seen or heard!

The sand scorpion uses transverse and longitudinal waves to locate the beetle. When beetle even slightly disturbs the sand, it sends waves along the sand's surface. One set of waves is longitudinal travelling with speed 150 m/s and other transverse at much lower speed of 50 m/s. The scorpion spreads its legs roughly in a circle about 5 cm in diameter, intercepts the faster longitudinal waves first and learns the direction of the prey, sensing the direction of the leg disturbed earliest. To determine distance, scorpion calculates time gap between sensing faster longitudinal and slower transverse waves.



Q10. Longitudinal wave gives direction of its prey to scorpion because in longitudinal wave

A. sand particles oscillate perpendicular to direction of propagation of wave.
B. sand particles move perpendicular as well as parallel to direction of propagation of the wave.
C. sand particles oscillate along the direction of propagation of wave.
D. sand particles move in the direction of propagation of wave.

Q11. Find one similarity and one dissimilarity between case given above and the case of find distance of object from a lightening flash by counting time interval between lighten flash and hearing the thunder (assuming sound travels in straight line).

Q12. Consider d as distance between beetle and scorpion and Δt as time interval betw interception of longitudinal and transverse waves. Find the value of d, for $\Delta t = 5$ m.

Q13. When two waves pass through a string, net displacement of a particle on the strin sum of the displacements produced by the two waves individually. If we state s principles for net velocity of the particle and the net kinetic energy of the particle, it be valid for

A. the velocity but not the kinetic energy

B. both the velocity and the kinetic energy

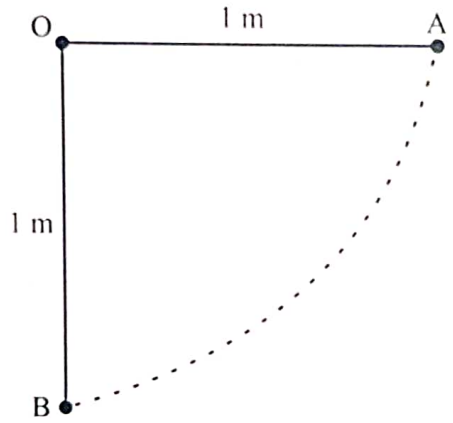
C. the kinetic energy but not the velocity

D. neither the velocity nor the kinetic energy

Q14. Two bodies m_1 and m_2 ($m_1 > m_2$) have equal linear momentum. Which will have more kinetic energy?

Q15. Two springs A and B with constants k_A and k_B ($k_A > k_B$) are given. Both strings are stretched by the same force. On which spring more work is to be done?

Q16. The bob of a pendulum is released from a horizontal position A (as shown). The l
of the pendulum is 1 m. What is the speed with which the bob arrives at the lowe
point B? It is given that it dissipates 10% of its initial energy against air resistance.
(Take g =10 m/s^2)



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Q17. A block of mass m moving at speed 'v' collides head on with another block of mass 2m at rest. The lighter block comes to rest after the collision. Find the coefficient of restitution.

Q18. Analyze the statements below.

(a) The Young's modulus of rubber is greater than that of steel.

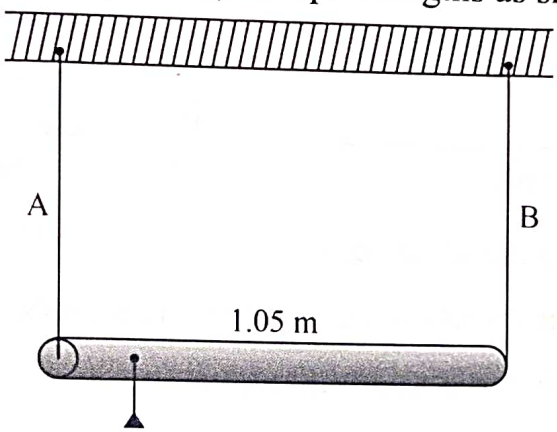
(b) The stretching of a coil is determined by its shear modulus.

Are they true? Justify your answer.

Q19. How much pressure is required to compress a litre of water by 0.10%? Bulk
of elasticity of water = 2.2×10^9 N/m^{-2} .

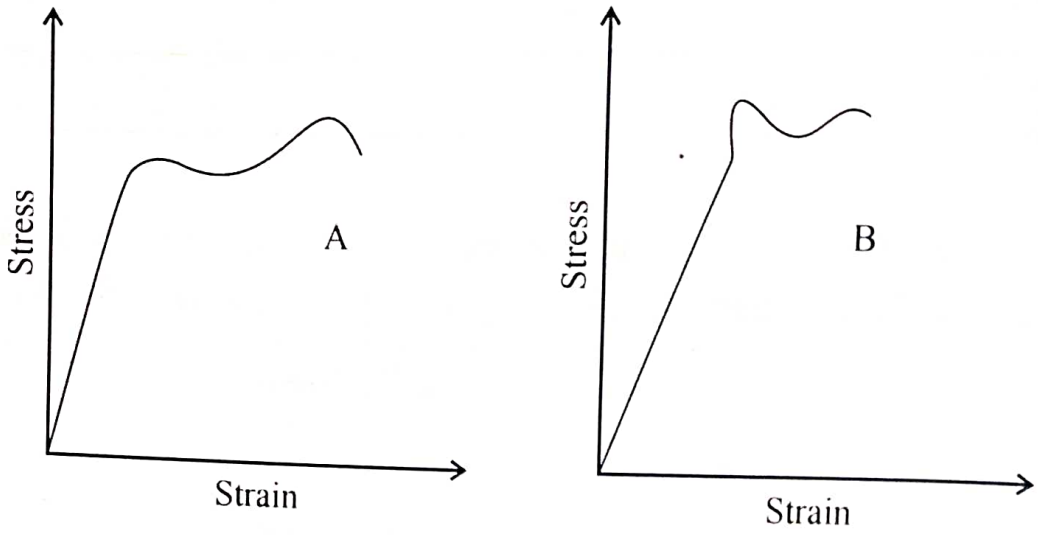
Q20. What is meant by elastic potential energy? Derive an expression for the elastic p
energy of stretched wire. Prove that its elastic energy density is equal to $\frac{1}{2}$ stress ×

Q21. A rod of length 1.05 m having negligible mass is supported at its ends by two wires of steel (wire A) and aluminium (wire B) of equal lengths as shown in figure.



The cross-sectional areas of wires A and B are 1.0 mm^2 and 2.0 mm^2, respectively. At what point along the rod should a mass m be suspended in order to produce (a) equal stresses and (b) equal strains in both steel and aluminium wires.

Q22. The stress-strain graphs for materials A and B are shown in figure.



The graphs are drawn to the same scale.

(a) Which of the materials has the greater Young's modulus?

(b) Which of the two is the stronger material?

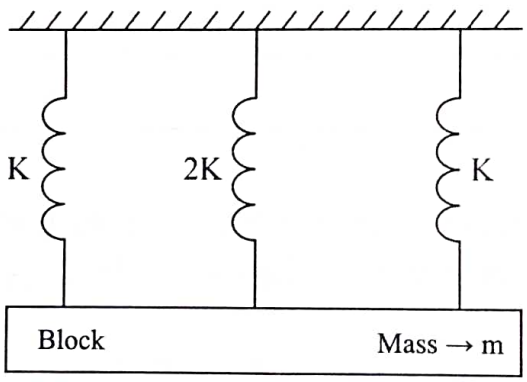
Q23. The bob of a vibrating simple pendulum is made of ice. How will the period of swing change when the ice starts melting?

Q24. *Acceleration* $a \propto -x \Rightarrow a = -kx$ *or* $\frac{d^2x}{dt^2} = -kx$,

At what points is the energy entirely kinetic and entirely potential in a simple harmonic motion.

Q25. Alcohol in a U-tube executes a simple harmonic motion of time period T. Alcohol is replaced by water with same height in the U-tube. What is the effect on the time period?

Q26. The springs of spring factor k, $2k$, k respectively are connected in parallel to a block of mass m. If the linear mass density is 0.08 kg/m and k is 2 N/m, then find the new time period.



27. (a) Write the equation for displacement of a particle executing simple harmonic motion.

(b) Use this equation to obtain the expression for velocity and acceleration of the particle. Discuss the phase relation between displacement, velocity and acceleration.

Q28. What is a Conservative Force? Prove that Gravitational Force is conservative, wh
Frictional Force is non-conservative.

)29. A sphere of the radius r falls under gravity through a liquid of viscosity η. Its average acceleration is half of initial acceleration. Show that the time taken by the sphere to attain the terminal velocity is independent of the liquid density.

Q30. What is "apparent frequency" in Doppler's effect? Derive an expression for apparen frequency if observer is moving away from source of sound wave?