PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 88

Total Marks : 23

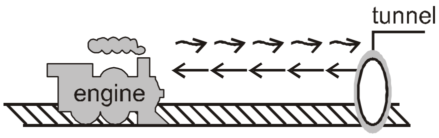
Max. Time : 24 min.

Topics : Sound Waves, Sound , Work, Power and Energy, Center of Mass

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.5	**(3 marks, 3 min.)**	**[15, 15]**
Multiple choice objective ('–1' negative marking) Q.6	**(4 marks, 4 min.)**	**[4, 4]**
Subjective Questions ('–1' negative marking) Q.7	**(4 marks, 5 min.)**	**[4, 5]**

1. The frequency of a man's voice is 300 Hz and its wavelength is 1 meter. If the wavelength of a child's voice is 1.5 m, then the frequency of the child's voice is:
(A) 200 Hz (B) 150 Hz (C) 400 Hz (D) 350 Hz.

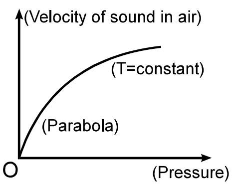
2. An engine is moving towards a tunnel with a constant speed.

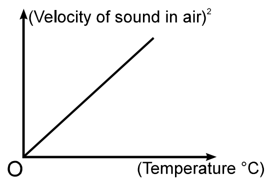


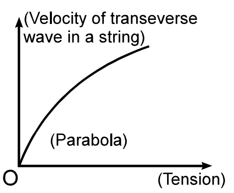
To check its own velocity, the driver sends whistles twice at an intervel of 2 minutes. The sound moves forward, gets reflected from the tunnel and again reaches to the driver. He listens two echoes of the sound, at an interval of 1 minute. If speed of sound is 300 m/sec, speed of the engine should be :
(A) 50 m/sec (B) 75 m/sec (C) 100 m/sec (D) 125 m/sec

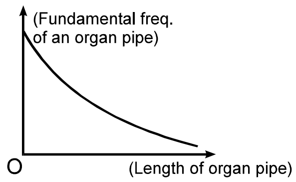
3. The equation of displacement due to a sound wave is $s = s_0 \sin^2(\omega t - kx)$. If the bulk modulus of the medium is B, then the equation of pressure variation due to that sound is
(A) $B k s_0 \sin(2\omega t - 2kx)$ (B) $-B k s_0 \sin(2\omega t - 2kx)$
(C) $B k s_0 \cos^2(\omega t - kx)$ (D) $-B k s_0 \cos^2(\omega t - kx)$

4. Which of the following is/ are correct.

(A) 

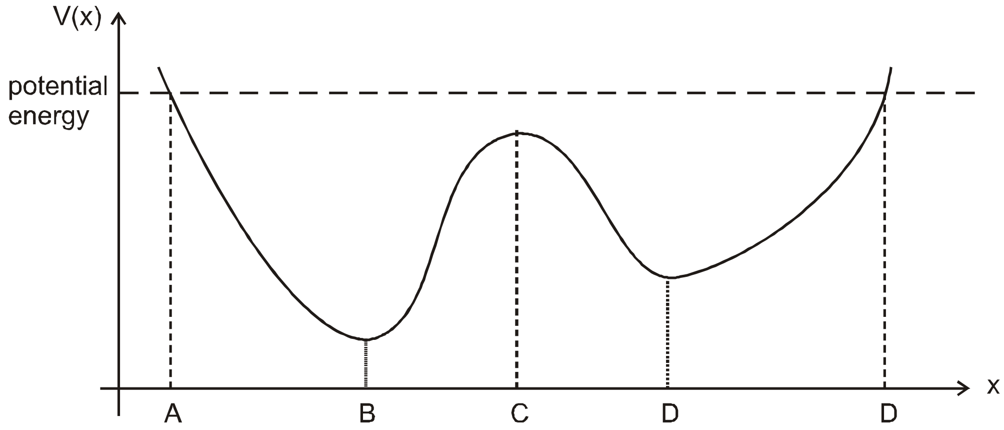
(B) 

(C) 

(D) 

5. Propagation of a sound wave in a gas is quite close to :
(A) an isothermal process
(B) an adiabatic process
(C) an isobaric process
(D) a process that does not exhibit properties close to any of the three given in (A),(B),(C)

6. A particle moves in one dimension in a conservation force field. The potential energy is depicted in the graph below.



If the particle starts to move from rest from the point A, then

(A) the speed is zero at the point A and E.

(B) the acceleration vanished at the points A, B, C, D, E

(C) the acceleration vanished at the points B, C, D.

(D) the speed is maximum at the point D.

7. A railway carriage of mass M_c filled with sand of mass M_s moves along the rails. The carriage is given an impulse and it starts with a velocity v_0. At the same time it is observed that the sand starts leaking through a hole at the bottom of the carriage at a constant mass rate λ. Find the distance at which the carriage becomes empty and the velocity attained by the carriage at that time. (Neglect the friction along the rails.)

Answers Key

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1. (A) **2.** (C) **3.** (A) **4.** (C) **5.** (B)

6. (A)(C) **7.** $v = v_0$, $S = V_0 \frac{M_s}{\lambda}$

Hint & Solutions

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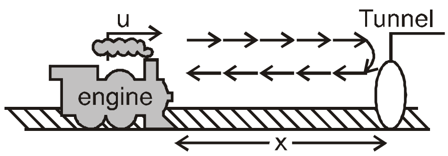
1. (A) $f_1 \lambda_1 = f_2 \lambda_2$

$(300)(1) = (f_2)(1.5)$

$200 \text{ Hz} = f_2$

2. $\frac{2x}{300} = t_0$ .... (1)



Now in 2 minutes, the engine moves by (u) (120) so time taken by sound to reach the driver again is

$\frac{2(x-120u)}{300} = t_0 - 120 + 60$ .... (2)

From equation (1) and (2),

$\frac{2 \times 120u}{300} = 60$

$\Rightarrow u = \frac{300}{4} = 75$ m/sec

3. The equation of pressure variation due to sound is

$p = -B\frac{ds}{dx} = -B\frac{d}{dx}[s_0 \sin^2(\omega t - kx)]$

$= B k s_0 \sin(2\omega t - 2kx)$

4. Velocity of sound in air (V) = $\sqrt{\frac{\gamma RT}{M}}$

$\Rightarrow V^2 \alpha T$ (in kelvin)

not $V^2 \alpha T$ (in ^{0}C)

Hence (B) is incorrect.

Velocity of transverse wave in a string :

$V = \sqrt{\frac{T}{\mu}} = V^2 \alpha T$

Hence (C) is a correct graph.

5. Sound waves propagate so fast in a gas that there is no time for the exchange of energy with the medium (gas).

Hence, it is quite close to an adiabatic process.

Hence (B).

6. $V_A + K_A = V_E + K_E$

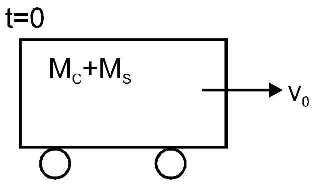
$V_A = V_E$ & $K_A = 0$ $\quad \therefore K_E = 0$

$$F = \frac{dV}{dx} = 0,$$

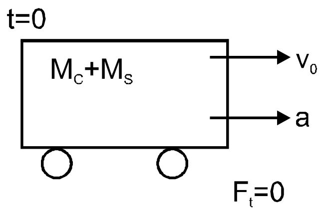
Slope = 0 at points B, C & D

Ans. (AC)

7.



At t,



$$F = m\frac{dv}{dt} + (v - v_0)\frac{dm}{dt}$$

$$0 = m\frac{dv}{dt} + (v - v_0)\frac{dm}{dt}$$

$$\Rightarrow \frac{dv}{dt} = 0$$

$\Rightarrow v = \text{constant}$

$\Rightarrow v = v_0$ **Ans.**

Also $S = v_0 t$

$$S = V_0 \frac{M_s}{\lambda}$$ **Ans.**