Skill Development Exercises for Chapter 6

6-1. A fan is delivering 6,000 cfm at a pressure of 1.5 in. wg at a rotational speed of 750 rpm. If the fan speed is reduced to 600 rpm, how much air will the fan deliver, and at what pressure?

a) 4,800 cfm, 1.2 in. wg b) 4,800 cfm, 0.96 in. wg

c) 3,840 cfm, 0.96 in. wg d) 3,840 cfm, 1.2 in. wg.

e) None of the above

Answer: b

Based on Fan Law 1 with the same diameter (D) and air density (ρ), the volume flow is proportional to rpm, pressure is proportional to rpm^2, and horsepower is proportional to rpm^3. Volume reduces to (6000 × 600)/750 = 4800 cfm, and pressure reduces to 1.5×(600×600)/(750×750) = 0.96 in. wg

6-2. Given a fan operating at 4,000 cfm, 3 in. wg total pressure, and 2.5 hp, what is the fan total efficiency?

a) 85% b) 80% c) 75% d) All of the above e) None of the above

Answer: c

Using the formula (6-5) below: (4000×3)/(6362×2.5) = 0.75

$$\varepsilon = \frac{(\text{cfm})(p)}{(6362)(\text{hp})}$$

6-3. Given a fan operating at 4,000 cfm, using 1.5 hp, what is the fan total efficiency?

a) 85% b) 75% c) 65% d) None of the above

Answer: d

None of the above is correct as total pressure is also needed.

6-4. What is one effective duct length for a duct with a duct velocity of 4,000 fpm and an area of 200 in.^{2}?

a) 80 ft b) 3.3 ft c) 5.34 ft d) None of the above

e) Cannot be determined from the information given

Answer: c

Using formula (6-10)

$$L_e = \frac{\left(V_o\sqrt{A_o}\right)}{10,600} = \frac{(4000)(200)^{1/2}}{10,600} = 5.34$$

6-5. What is one effective duct length for a duct with a duct velocity of 2,000 fpm and an area of 225 in.^{2}?

a) 3.5 ft b) 3.0 ft c) 52.3 ft d) None of the above

e) Cannot be determined from the information given

Answer: a

Based on the formula for under 2500 fpm in a round duct:

$$L_e = \frac{\sqrt{A_o}}{4.3} = \frac{\sqrt{225}}{4.3} = 3.5$$

6-6. A rectangular duct is 10 in. high and 20 in. wide. What is the equivalent duct diameter of this duct?

a) 200 in.^{2} b) 254 in. c) 16 in. d) None of the above

e) Cannot be determined from the information given

Answer: c

Using the formula below:

$$D = \sqrt{\frac{4HW}{\pi}} = \sqrt{\frac{4 \times 10 \times 20}{3.142}} = 0.16 \text{ in.}$$

6-7. For any given system, the system effect factor is constant across the range of flow volumes of the fan.

a) True b) False c) Cannot be determined from the information given

Answer: b, False

6-8. A fixed fan system is drawing 3 hp to deliver 10,000 cfm. If the air flow requirement can be reduced to 7,000 cfm by decreasing the fan speed, the horsepower requirement will be reduced to:

a) 2.1 hp b) 1.0 hp c) 0.44 hp d) All of the above e) None of the above

f) Cannot be determined from the information given

Answer: c

Horsepower is proportional to rpm^3 when fan size and density remain constant. New horsepower =

$$\frac{3(7000)^3}{(10,000)^3} = 1 \text{ hp}$$

6-9. The _____ is the highest efficiency centrifugal fan design.

a) Radial b) Forward-curved c) Backward-inclined, backward-curved

d) All of the above e) None of the above

Answer: e

The aerofoil is the most efficient centrifugal fan.

6-10. Power roof ventilators _____ :

a) Usually operate without discharge ductwork b) Operate at low pressure

c) Operate at high volume d) All of the above e) None of the above

Answer: d