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UNIT 06: Farm Power

QUESTIONS

Q.01 For the same compression ratio, the thermal efficiency of an ideal Diesel cycle is lower than that of an ideal Otto cycle because:

A. Heat addition occurs at constant pressure in Diesel cycle
B. Diesel cycle has lower expansion ratio
C. Otto cycle rejects less heat
D. Diesel cycle has higher mean effective pressure

Q.02 A tractor engine develops 45 kW brake power at 2200 rpm. The brake torque produced is approximately:

A. 156 N·m
B. 195 N·m
C. 235 N·m
D. 285 N·m

Q.03 In a four-stroke CI engine, fuel injection generally begins:

A. At BDC of suction stroke
B. Just before TDC of compression stroke
C. At TDC of power stroke
D. During exhaust stroke

Q.04 The main purpose of turbocharging in a tractor engine is to:

A. Reduce compression ratio
B. Increase volumetric efficiency
C. Reduce lubricating oil consumption
D. Reduce engine weight

Q.05 The ignition delay period in a CI engine is mainly influenced by:

A. Fuel cetane number
B. Fuel octane number
C. Lubricating oil viscosity
D. Exhaust gas temperature only

Q.06 The clutch used in most agricultural tractors is:

A. Cone clutch
B. Dog clutch
C. Single plate dry clutch
D. Fluid coupling

Q.07 The function of a tractor differential is to:

A. Increase engine power
B. Allow rear wheels to rotate at different speeds
C. Reduce steering effort directly
D. Increase PTO speed

Q.08 The final drive in a tractor mainly serves to:

A. Increase speed and reduce torque
B. Increase torque and reduce speed
C. Control fuel injection timing
D. Improve lubrication

Q.09 Which braking system is commonly employed in modern agricultural tractors?

A. Band brake only
B. Disc brake
C. Electromagnetic brake only
D. Dynamic brake

Q.10 The Ackermann steering mechanism is designed to:

A. Increase wheel slip
B. Ensure pure rolling during turning
C. Increase turning radius
D. Reduce tyre diameter

Q.11 A three-point linkage system is classified as:

A. Mechanical draft control device only
B. Hydraulic and mechanical implement attachment system
C. Electrical hitching device
D. Pneumatic coupling system

Q.12 The PTO speed standardized for many tractors is:

A. 250 rpm
B. 540 rpm
C. 1500 rpm
D. 2500 rpm

Q.13 The rolling resistance of a tractor primarily depends upon:

A. Tyre-ground interaction
B. Engine displacement
C. Fuel injection pressure
D. PTO speed

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A. Increase fuel viscosity
B. Maintain nearly constant speed under varying loads
C. Increase compression ratio
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Q.16 In a battery, the electrolyte of a lead-acid cell is:

A. Hydrochloric acid
B. Sulphuric acid
C. Nitric acid
D. Distilled water

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B. Less than one
C. Equal to zero during load operation
D. Fractional

Q.18 A three-phase wattmeter method using two wattmeters can measure:

A. Only balanced loads
B. Only inductive loads
C. Total power of balanced and unbalanced loads
D. Reactive power only

Q.19 Power factor improvement reduces:

A. Current drawn from supply
B. Frequency
C. Voltage rating
D. Mechanical power

Q.20 A DC motor differs from a DC generator because:

A. Construction is entirely different
B. Energy conversion direction is opposite
C. Commutator is absent in motors
D. Generator has no armature

Q.21 The semiconductor material most commonly used in agricultural electronic devices is:

A. Copper
B. Silicon
C. Aluminium
D. Brass

Q.22 An operational amplifier ideally has:

A. Infinite gain
B. Zero gain
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D. Negative gain only

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A. Binary to decimal
B. Decimal input into coded binary output
C. Analog signal to digital signal directly
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Q.24 The gauge factor of a strain gauge is defined as:

A. Stress per unit strain
B. Ratio of change in resistance per unit resistance to strain
C. Force divided by area
D. Resistance divided by temperature

Q.25 A thermocouple operates on the principle of:

A. Hall effect
B. Piezoelectric effect
C. Seebeck effect
D. Faraday law

Q.26 Match the Following (Engine Components)

List-I	List-II
P. Intercooler	1. Maintains coolant circulation
Q. Water Pump	2. Reduces charge air temperature
R. Flywheel	3. Stores rotational energy
S. Injector Nozzle	4. Atomizes fuel

A. P-2, Q-1, R-3, S-4
B. P-1, Q-2, R-4, S-3
C. P-3, Q-4, R-1, S-2
D. P-2, Q-4, R-1, S-3

Q.27 A four-cylinder diesel engine develops 52 kW brake power with a mechanical efficiency of 80%. The indicated power is:

A. 41.6 kW
B. 52.0 kW
C. 65.0 kW
D. 72.5 kW

Q.28 In a turbocharged CI engine, the parameter most directly responsible for increased power output is:

A. Increased scavenging pressure
B. Increased air mass inducted per cycle
C. Reduced piston speed
D. Increased crankshaft length

Q.29 Which tractor transmission arrangement provides uninterrupted power flow during gear shifting?

A. Sliding mesh gearbox
B. Constant mesh gearbox
C. Synchromesh gearbox
D. Power shift transmission

Q.30 The coefficient of traction is defined as:

A. Drawbar pull / Tractor weight on drive wheels
B. Rolling resistance / Drawbar pull
C. Engine torque / Wheel torque
D. Wheel slip / Drawbar power

Q.31 Assertion (A): Wheel slip beyond an optimum limit reduces tractor field efficiency.

Reason (R): Excessive wheel slip increases energy loss through soil deformation.

A. Both A and R are true and R explains A
B. Both A and R are true but R does not explain A
C. A is true, R is false
D. A is false, R is true

Q.32 The principal advantage of a planetary gear set in tractors is:

A. High noise generation
B. Compact design with high torque transmission capability
C. Reduced lubrication requirement
D. Elimination of differential

Q.33 A tractor climbs a slope of 10°. If its weight is 40 kN, the grade resistance is approximately:

A. 4.0 kN
B. 6.9 kN
C. 8.5 kN
D. 10.2 kN

Q.34 Which of the following combinations is most suitable for deep tillage in heavy soils?

A. Two-wheel tractor + rib tyres
B. Four-wheel drive tractor + lug tyres

C. Garden tractor + smooth tyres
D. Utility tractor + solid tyres

Q.35 The battery rating "120 Ah" indicates:

A. Maximum voltage output
B. Charge storage capacity
C. Internal resistance
D. Charging efficiency

Q.36 In a three-phase induction motor, rotor current frequency is:

A. sf
B. f/s
C. s^2f
D. f^2/s

Q.37 Which starter is generally employed for medium-sized DC motors?

A. Direct-on-line starter
B. Three-point starter
C. Auto-transformer starter
D. Rotor resistance starter

Q.38 A transistor operating in the saturation region acts as:

A. Amplifier
B. Oscillator
C. Closed switch
D. Open switch

Q.39 The primary purpose of an Analog-to-Digital Converter (ADC) in precision agriculture is:

A. Produce analog voltage from binary data
B. Convert sensor signals into digital data for processing
C. Increase transmission power
D. Reduce battery voltage

Q.40 A load cell used in tractor drawbar testing primarily measures:

A. Temperature
B. Pressure

C. Force
D. Speed

Q.41 The gauge factor of a metallic strain gauge is usually close to:

A. 0.02
B. 2
C. 20
D. 200

Q.42 A thermocouple measures temperature based on:

A. Capacitive effect
B. Piezoresistive effect
C. Thermoelectric EMF generation
D. Photoelectric effect

Q.43 Which controller is most effective in minimizing steady-state error and improving dynamic response simultaneously?

A. P Controller
B. I Controller
C. PI Controller
D. ON-OFF Controller

Q.44 The principal advantage of PLCs over relay-based control systems is:

A. Larger size
B. Fixed logic only
C. Easy reprogramming and flexibility
D. Higher mechanical wear

Q.45 Which electric vehicle component replaces the conventional fuel injection system?

A. Differential gear
B. Motor controller
C. Crankshaft pulley
D. Injector nozzle

Q.46 A microcontroller differs from a microprocessor because it contains:

A. Only CPU
B. CPU with memory and I/O on a single chip

C. No memory unit
D. No arithmetic unit

Q.47 The maximum thermal efficiency achievable between two temperature limits is represented by:

A. Otto efficiency
B. Diesel efficiency
C. Carnot efficiency
D. Brayton efficiency

Q.48 The hydraulic lift capacity of a tractor is primarily determined by:

A. PTO speed only
B. Hydraulic pressure and cylinder dimensions
C. Wheel diameter only
D. Fuel tank size

Q.49 In tractor stability analysis, overturning is most likely when:

A. Center of gravity moves outside the stability base
B. Engine speed decreases
C. PTO disengages
D. Fuel level increases

Q.50 A smart agricultural machine uses GPS receiver, sensors, microcontroller, CAN communication and electric actuators. This system is best classified as:

A. Conventional mechanical control system
B. Electro-hydraulic precision farming system
C. Passive monitoring device
D. Manual steering mechanism

Q.51 A naturally aspirated diesel engine develops 60 kW. After turbocharging, the volumetric efficiency increases from 78% to 104%, while all other parameters remain unchanged. The approximate brake power developed is:

A. 70 kW
B. 75 kW
C. 80 kW
D. 86 kW

Q.52 Which combination correctly represents increasing order of tractor power transmission efficiency?

A. Belt Drive < Chain Drive < Gear Drive
B. Gear Drive < Belt Drive < Chain Drive
C. Chain Drive < Gear Drive < Belt Drive
D. Gear Drive < Chain Drive < Belt Drive

Q.53 Assertion (A): An intercooler improves the performance of a turbocharged tractor engine.

Reason (R): Cooling compressed air increases its density before entering the cylinder.

A. Both A and R are true and R explains A
B. Both A and R are true but R does not explain A
C. A is true, R is false
D. A is false, R is true

Q.54 A tractor weighing 45 kN develops a drawbar pull of 18 kN. The coefficient of traction is:

A. 0.25
B. 0.40
C. 0.50
D. 0.75

Q.55 In a CI engine fuel injection system, the component primarily responsible for maintaining injection pressure is:

A. Fuel filter
B. Injection pump
C. Fuel tank
D. Governor Spring

Q.56 Match the Following

List-I	List-II
P. Differential Lock	1. Improves traction in slippery fields
Q. PTO Shaft	2. Implements powered externally
R. Draft Control	3. Automatic depth adjustment
S. Final Drive	4. Torque multiplication

UNIT 06: Farm Power

ANSWERS & EXPLANATION

Q.01 For the same compression ratio, the thermal efficiency of an ideal Diesel cycle is lower than that of an ideal Otto cycle because:

A. Heat addition occurs at constant pressure in Diesel cycle
B. Diesel cycle has lower expansion ratio
C. Otto cycle rejects less heat
D. Diesel cycle has higher mean effective pressure

Answer: A

Explanation: In the Otto cycle, heat is added at constant volume, producing a higher peak temperature and pressure. In the Diesel cycle, heat addition occurs at constant pressure over a finite volume change. For the same compression ratio, this results in a lower thermal efficiency. The expansion ratio remains the same for both cycles under comparison. Therefore, constant-pressure heat addition is the reason.

Q.02 A tractor engine develops 45 kW brake power at 2200 rpm. The brake torque produced is approximately:

A. 156 N·m
B. 195 N·m
C. 235 N·m
D. 285 N·m

Answer: B

Explanation: Power: $P = \frac{2\pi NT}{60} : 45000 = \frac{2\pi \times 2200 \times T}{60} : T = 195.3\ N \cdot m$. Brake torque is the turning effect available at the crankshaft. It directly depends on power and engine speed. Hence the correct answer is 195 N·m.

Q.03 In a four-stroke CI engine, fuel injection generally begins:

A. At BDC of suction stroke
B. Just before TDC of compression stroke
C. At TDC of power stroke
D. During exhaust stroke

Answer: B

Explanation: In compression ignition engines, air alone is compressed to a high pressure and temperature. Fuel is injected near the end of the compression stroke, slightly before TDC. The hot compressed air causes self-ignition. Injection timing significantly influences combustion efficiency and engine performance. Therefore, fuel injection begins just before TDC.

Q.04 The main purpose of turbocharging in a tractor engine is to:

A. Reduce compression ratio
B. Increase volumetric efficiency
C. Reduce lubricating oil consumption
D. Reduce engine weight

Answer: B

Explanation: Turbochargers utilize exhaust gas energy to compress incoming air. More air enters the cylinder, improving volumetric efficiency. Increased air supply permits more fuel burning and higher power output. Engine size need not increase to obtain additional power. Hence the primary objective is improved volumetric efficiency.

Q.05 The ignition delay period in a CI engine is mainly influenced by:

A. Fuel cetane number
B. Fuel octane number
C. Lubricating oil viscosity
D. Exhaust gas temperature only

Answer: A

Explanation: Cetane number measures the ignition quality of diesel fuel. Higher cetane fuel ignites more readily and reduces ignition delay. Shorter delay improves smooth engine operation and reduces diesel knock. Octane number is important for SI engines, not CI engines. Therefore cetane number is the controlling factor.

Q.06 The clutch used in most agricultural tractors is:

A. Cone clutch
B. Dog clutch
C. Single plate dry clutch
D. Fluid coupling

Answer: C

Explanation: Single plate dry clutches are simple, economical and capable of transmitting high torque. They are easy to maintain under farm conditions. Tractor applications require reliable power transmission from engine to gearbox. The design also permits smooth engagement and disengagement. Hence single plate dry clutch is commonly used.

Q.07 The function of a tractor differential is to:

A. Increase engine power
B. Allow rear wheels to rotate at different speeds
C. Reduce steering effort directly
D. Increase PTO speed

Answer: B

Explanation: During turning, inner and outer wheels travel different distances. A differential permits different rotational speeds while transmitting torque. Without it, tyres would skid and wear excessively. Vehicle stability and maneuverability would be affected. Thus the differential allows wheel speed variation.

Q.08 The final drive in a tractor mainly serves to:

A. Increase speed and reduce torque
B. Increase torque and reduce speed
C. Control fuel injection timing
D. Improve lubrication

Answer: B

Explanation: The final drive provides additional gear reduction after the differential. Speed decreases while torque delivered to the wheels increases. High wheel torque is essential for traction in agricultural operations. This enables pulling heavy implements. Therefore the final drive increases torque and reduces speed.

Q.09 Which braking system is commonly employed in modern agricultural tractors?

A. Band brake only
B. Disc brake
C. Electromagnetic brake only
D. Dynamic brake

Answer: B

Explanation: Disc brakes provide efficient braking performance and heat dissipation. They offer better stopping capability under muddy agricultural conditions. Maintenance requirements are relatively low. Modern tractors increasingly employ oil-immersed disc brakes. Hence disc brakes are most common.

Q.10 The Ackermann steering mechanism is designed to:

A. Increase wheel slip
B. Ensure pure rolling during turning
C. Increase turning radius
D. Reduce tyre diameter

Answer: B

Explanation: Ackermann geometry ensures all wheels rotate about a common instantaneous center. This minimizes lateral tyre slip during turning. Reduced slip lowers tyre wear and steering effort. Proper steering geometry improves maneuverability. Therefore it ensures pure rolling motion.

Q.11 A three-point linkage system is classified as:

A. Mechanical draft control device only
B. Hydraulic and mechanical implement attachment system
C. Electrical hitching device
D. Pneumatic coupling system

Answer: B

Explanation: The three-point linkage connects implements to the tractor through hydraulic and mechanical components. It permits lifting, lowering and draft control. The system enhances implement stability and maneuverability. Weight transfer to the tractor also improves traction. Hence it is a hydraulic-mechanical attachment system.

Q.12 The PTO speed standardized for many tractors is:

A. 250 rpm
B. 540 rpm
C. 1500 rpm
D. 2500 rpm

Answer: B

Explanation: The PTO transfers power from tractor to implements. Standardization ensures compatibility among various machines. One of the most common PTO standards is 540 rpm. Many agricultural implements are designed around this speed. Therefore 540 rpm is the standard value.

Q.13 The rolling resistance of a tractor primarily depends upon:

A. Tyre-ground interaction
B. Engine displacement
C. Fuel injection pressure
D. PTO speed

Answer: A

Explanation: Rolling resistance originates from tyre deformation and soil deformation. Soil condition, tyre inflation pressure and wheel load affect it. It directly influences tractor drawbar performance. Engine parameters have little direct effect. Therefore tyre-ground interaction governs rolling resistance.

Q.14 Which tyre type provides maximum traction in agricultural fields?

A. Rib tyre
B. Lug tyre
C. Slick tyre
D. Solid tyre

Answer: B

Explanation: Lug tyres possess deep tread bars that penetrate soil effectively. They generate higher tractive force and reduce wheel slip. Agricultural tractors commonly use lug tyres on drive wheels. They perform well in soft field conditions. Thus lug tyres provide maximum traction.

Q.15 The governor in a diesel engine is primarily used to:

A. Increase fuel viscosity
B. Maintain nearly constant speed under varying loads
C. Increase compression ratio
D. Reduce cooling requirement

Answer: B

Explanation: Load changes cause engine speed fluctuations. The governor automatically adjusts fuel supply to compensate. Speed regulation is essential for field operations requiring constant PTO speed. Stable speed improves efficiency and performance. Therefore governors maintain nearly constant engine speed.

Q.16 In a battery, the electrolyte of a lead-acid cell is:

A. Hydrochloric acid
B. Sulphuric acid
C. Nitric acid
D. Distilled water

Answer: B

Explanation: Lead-acid batteries use dilute sulphuric acid as electrolyte. Chemical reactions between lead plates and sulphuric acid store electrical energy. During charging and discharging, electrolyte concentration changes. Such batteries are widely used for tractor starting systems. Therefore sulphuric acid is correct.

Q.17 The slip of an induction motor can never be:

A. Positive
B. Less than one
C. Equal to zero during load operation
D. Fractional

Answer: C

Explanation: Slip is the difference between synchronous speed and rotor speed divided by synchronous speed. Under load, rotor speed is always less than synchronous speed. Therefore slip remains positive. Zero slip would eliminate induced rotor current and torque production. Hence slip cannot be zero during loaded operation.

Q.18 A three-phase wattmeter method using two wattmeters can measure:

A. Only balanced loads
B. Only inductive loads
C. Total power of balanced and unbalanced loads
D. Reactive power only

Answer: C

Explanation: The two-wattmeter method is versatile and widely used. It measures total power in three-phase systems regardless of load balance. No neutral connection is required. The algebraic sum of wattmeter readings gives total power. Hence it works for balanced and unbalanced loads.

Q.19 Power factor improvement reduces:

A. Current drawn from supply
B. Frequency
C. Voltage rating
D. Mechanical power

Answer: A

Explanation: For a given real power, improving power factor decreases current demand. Lower current reduces losses and voltage drop. Electrical equipment operates more efficiently. Utility penalties may also be avoided. Therefore current drawn from supply decreases.

Q.20 A DC motor differs from a DC generator because:

A. Construction is entirely different
B. Energy conversion direction is opposite
C. Commutator is absent in motors
D. Generator has no armature

Answer: B

Explanation: A DC generator converts mechanical energy into electrical energy. A DC motor converts electrical energy into mechanical energy. Their construction is largely similar. The fundamental difference lies in energy conversion direction.

Q.21 The semiconductor material most commonly used in agricultural electronic devices is:

A. Copper
B. Silicon
C. Aluminium
D. Brass

Answer: B

Explanation: Silicon possesses suitable electrical properties and thermal stability. It forms the basis of transistors, ICs, sensors and microcontrollers. Modern agricultural automation systems depend heavily on silicon devices. Manufacturing technology is also well established. Therefore silicon is the dominant semiconductor.

Q.22 An operational amplifier ideally has:

A. Infinite gain
B. Zero gain
C. Unity gain only
D. Negative gain only

Answer: A

Explanation: An ideal operational amplifier is assumed to have infinite open-loop gain. This assumption simplifies circuit analysis. Other ideal properties include infinite input impedance and zero output impedance. Real amplifiers approximate these characteristics.

Q.23 An encoder converts:

A. Binary to decimal
B. Decimal input into coded binary output
C. Analog signal to digital signal directly
D. Frequency to voltage

Answer: B

Explanation: Encoders convert active input lines into coded outputs. They reduce the number of output lines needed for representation. Priority encoders are commonly used in digital systems. The conversion is essentially from input position to binary code.

Q.24 The gauge factor of a strain gauge is defined as:

A. Stress per unit strain
B. Ratio of change in resistance per unit resistance to strain
C. Force divided by area
D. Resistance divided by temperature

Answer: B

Explanation: Gauge factor measures strain gauge sensitivity. It relates fractional resistance change to mechanical strain. Higher gauge factor indicates greater sensitivity. This parameter is important in force and torque measurement systems.

Q.25 A thermocouple operates on the principle of:

A. Hall effect
B. Piezoelectric effect
C. Seebeck effect
D. Faraday law

Answer: C

Explanation: When two dissimilar metals form a junction and experience a temperature difference, a voltage is generated. This phenomenon is known as the Seebeck effect. Thermocouples are widely used for engine exhaust and combustion temperature measurements. They are rugged and inexpensive. Hence Seebeck effect is the operating principle.

Q.26 Match the Following (Engine Components)

List-I	List-II
P. Intercooler	1. Maintains coolant circulation
Q. Water Pump	2. Reduces charge air temperature
R. Flywheel	3. Stores rotational energy
S. Injector Nozzle	4. Atomizes fuel

A. P-2, Q-1, R-3, S-4
B. P-1, Q-2, R-4, S-3
C. P-3, Q-4, R-1, S-2
D. P-2, Q-4, R-1, S-3

Answer: A

Explanation: Intercoolers reduce compressed air temperature in turbocharged engines. Water pumps circulate coolant through the cooling system. Flywheels smooth cyclic torque fluctuations by storing energy. Injector nozzles atomize fuel into fine droplets.

Q.27 A four-cylinder diesel engine develops 52 kW brake power with a mechanical efficiency of 80%. The indicated power is:

A. 41.6 kW
B. 52.0 kW
C. 65.0 kW
D. 72.5 kW

Answer: C

Explanation: Mechanical efficiency: ηm = BP/IP : 0.80 = 52/IP : IP = 65 kW Indicated power represents total power generated inside the cylinders before friction losses. Mechanical efficiency accounts for these losses. Hence indicated power equals 65 kW.

Q.28 In a turbocharged CI engine, the parameter most directly responsible for increased power output is:

A. Increased scavenging pressure
B. Increased air mass inducted per cycle
C. Reduced piston speed
D. Increased crankshaft length

Answer: B

Explanation: Turbocharging forces more air into the cylinders. Increased air mass allows more fuel combustion without excessive smoke formation. Consequently, cylinder pressure and power output rise. Engine displacement remains unchanged. Thus increased inducted air mass is the main reason.

Q.29 Which tractor transmission arrangement provides uninterrupted power flow during gear shifting?

A. Sliding mesh gearbox
B. Constant mesh gearbox
C. Synchromesh gearbox
D. Power shift transmission

Answer: D

Explanation: Power shift transmissions permit gear changes under load without interrupting power flow. Hydraulic clutches engage different gear sets automatically. This improves field efficiency and operator comfort. Conventional gearboxes require temporary disengagement.

Q.30 The coefficient of traction is defined as:

A. Drawbar pull / Tractor weight on drive wheels
B. Rolling resistance / Drawbar pull
C. Engine torque / Wheel torque
D. Wheel slip / Drawbar power

Answer: A

Explanation: Coefficient of traction measures the traction capability of the tractor. It is the ratio of drawbar pull to dynamic wheel load. Soil condition strongly affects this value. Higher coefficients indicate better traction performance.

Q.31 Assertion (A): Wheel slip beyond an optimum limit reduces tractor field efficiency.

Reason (R): Excessive wheel slip increases energy loss through soil deformation.

A. Both A and R are true and R explains A
B. Both A and R are true but R does not explain A
C. A is true, R is false
D. A is false, R is true

Answer: A

Explanation: Moderate wheel slip is necessary for traction generation. Excessive slip wastes power in soil compaction and soil displacement. Drawbar efficiency decreases significantly. Therefore field efficiency declines. The reason correctly explains the assertion.

Q.32 The principal advantage of a planetary gear set in tractors is:

A. High noise generation
B. Compact design with high torque transmission capability
C. Reduced lubrication requirement
D. Elimination of differential

Answer: B

Explanation: Planetary gear trains provide large speed reduction in compact space. Multiple gear meshes share the transmitted load. High torque capacity is achieved without excessive size. These advantages make them suitable for tractor final drives.

Q.33 A tractor climbs a slope of 10°. If its weight is 40 kN, the grade resistance is approximately:

A. 4.0 kN
B. 6.9 kN
C. 8.5 kN
D. 10.2 kN

Answer: B

Explanation: Grade resistance: $R = W \sin\theta = 40 \times \sin10° = 40 \times 0.1736 = 6.94$ kN. Grade resistance represents the force opposing motion due to gravity. Thus approximately 6.9 kN is correct.

Q.34 Which of the following combinations is most suitable for deep tillage in heavy soils?

A. Two-wheel tractor + rib tyres
B. Four-wheel drive tractor + lug tyres

C. Garden tractor + smooth tyres
D. Utility tractor + solid tyres

Answer: B

Explanation: Deep tillage demands high tractive effort. Four-wheel drive tractors distribute power to all wheels. Lug tyres improve soil grip and reduce slippage. Such combinations perform efficiently in heavy soils.

Q.35 The battery rating "120 Ah" indicates:

A. Maximum voltage output
B. Charge storage capacity
C. Internal resistance
D. Charging efficiency

Answer: B

Explanation: Ampere-hour rating indicates the total charge that can be delivered over time. A 120 Ah battery can ideally supply 120 A for one hour. It is a measure of capacity, not voltage. Tractor starting and lighting systems depend on adequate battery capacity.

Q.36 In a three-phase induction motor, rotor current frequency is:

A. sf
B. f/s
C. s^2f
D. f^2/s

Answer: A

Explanation: Rotor frequency equals slip multiplied by supply frequency. At standstill, slip equals one and rotor frequency equals supply frequency. As speed increases, slip decreases. Rotor frequency therefore reduces. Hence rotor frequency = sf.

Q.37 Which starter is generally employed for medium-sized DC motors?

A. Direct-on-line starter
B. Three-point starter
C. Auto-transformer starter
D. Rotor resistance starter

Answer: B

Explanation: DC motors draw large starting current due to zero back EMF. Three-point starters limit starting current using series resistance. They also provide overload and no-volt protection. This makes them suitable for many DC motor applications.

Q.38 A transistor operating in the saturation region acts as:

A. Amplifier
B. Oscillator
C. Closed switch
D. Open switch

Answer: C

Explanation: In saturation, both transistor junctions are forward biased. Collector-emitter voltage becomes very small. Current flows freely through the device. Therefore the transistor behaves like a closed switch. Digital circuits often exploit this characteristic.

Q.39 The primary purpose of an Analog-to-Digital Converter (ADC) in precision agriculture is:

A. Produce analog voltage from binary data
B. Convert sensor signals into digital data for processing
C. Increase transmission power
D. Reduce battery voltage

Answer: B

Explanation: Agricultural sensors usually generate analog outputs. Microcontrollers require digital signals for computation. ADCs perform this conversion accurately. Precision farming systems heavily depend on ADCs.

Q.40 A load cell used in tractor drawbar testing primarily measures:

A. Temperature
B. Pressure
C. Force
D. Speed

Answer: C

Explanation: Load cells generally employ strain gauges. Applied force causes elastic deformation and resistance change. The resulting signal is proportional to force. Drawbar pull measurements commonly use load cells.

Q.41 The gauge factor of a metallic strain gauge is usually close to:

A. 0.02
B. 2
C. 20
D. 200

Answer: B

Explanation: Most metallic strain gauges possess gauge factors around 2. This means resistance changes approximately twice the applied strain. Semiconductor gauges have much higher values. Metallic gauges are preferred for stability and durability.

Q.42 A thermocouple measures temperature based on:

A. Capacitive effect
B. Piezoresistive effect
C. Thermoelectric EMF generation
D. Photoelectric effect

Answer: C

Explanation: Temperature differences across dissimilar metals generate an electromotive force. This thermoelectric effect forms the basis of thermocouples. The generated voltage is proportional to temperature. Engine and exhaust measurements commonly use thermocouples.

Q.43 Which controller is most effective in minimizing steady-state error and improving dynamic response simultaneously?

A. P Controller
B. I Controller
C. PI Controller
D. ON-OFF Controller

Answer: C

Explanation: Proportional action improves system response speed. Integral action eliminates steady-state error. Combining both yields better overall control performance. Agricultural automation systems frequently employ PI control.

Q.44 The principal advantage of PLCs over relay-based control systems is:

A. Larger size
B. Fixed logic only
C. Easy reprogramming and flexibility
D. Higher mechanical wear

Answer: C

Explanation: PLCs allow control logic modification through software. Hardware rewiring is largely unnecessary. Reliability and diagnostic capabilities are also superior. Modern agricultural automation uses PLCs extensively. Hence easy reprogramming is the main advantage.

Q.45 Which electric vehicle component replaces the conventional fuel injection system?

A. Differential gear
B. Motor controller
C. Crankshaft pulley
D. Injector nozzle

Answer: B

Explanation: Electric vehicles regulate power electronically through motor controllers. These devices control motor speed and torque. Fuel injection systems are absent because no combustion occurs. Motor controllers perform the equivalent power management role.

Q.46 A microcontroller differs from a microprocessor because it contains:

A. Only CPU
B. CPU with memory and I/O on a single chip
C. No memory unit
D. No arithmetic unit

Answer: B

Explanation: Microcontrollers integrate CPU, RAM, ROM and I/O peripherals. This compact architecture is ideal for embedded systems. Agricultural sensors and automation systems commonly employ microcontrollers. Microprocessors usually require external memory and peripherals.

Q.47 The maximum thermal efficiency achievable between two temperature limits is represented by:

A. Otto efficiency
B. Diesel efficiency
C. Carnot efficiency
D. Brayton efficiency

Answer: C

Explanation: Carnot efficiency represents the theoretical maximum efficiency of any heat engine operating between two temperature reservoirs. It depends only on source and sink temperatures. No practical engine can exceed this value. It serves as a benchmark for comparison.

Q.48 The hydraulic lift capacity of a tractor is primarily determined by:

A. PTO speed only
B. Hydraulic pressure and cylinder dimensions
C. Wheel diameter only
D. Fuel tank size

Answer: B

Explanation: Hydraulic force equals pressure multiplied by piston area. Therefore lift capacity depends on both hydraulic pressure and cylinder size. Tractor hydraulic systems use this principle to raise implements. Larger cylinders and higher pressure increase lifting capability.

Q.49 In tractor stability analysis, overturning is most likely when:

A. Center of gravity moves outside the stability base
B. Engine speed decreases
C. PTO disengages
D. Fuel level increases

Answer: A

Explanation: A tractor remains stable while its center of gravity projection lies within the support polygon. If it shifts outside, overturning moments dominate. Slopes, loads and sudden acceleration may cause this condition. Stability analysis focuses heavily on CG location.

Q.50 A smart agricultural machine uses GPS receiver, sensors, microcontroller, CAN communication and electric actuators. This system is best classified as:

A. Conventional mechanical control system
B. Electro-hydraulic precision farming system
C. Passive monitoring device
D. Manual steering mechanism

Answer: B

Explanation: The combination of sensors, controllers, communication networks and actuators characterizes precision agriculture. Such systems automate field operations with high accuracy. GPS provides positioning while electronic control optimizes performance. Electro-hydraulic actuation executes commands. Hence it is an electro-hydraulic precision farming system.

Q.51 A naturally aspirated diesel engine develops 60 kW. After turbocharging, the volumetric efficiency increases from 78% to 104%, while all other parameters remain unchanged. The approximate brake power developed is:

A. 70 kW
B. 75 kW
C. 80 kW
D. 86 kW

Answer: C

Explanation: Power output is approximately proportional to the mass of air inducted. Volumetric efficiency rises from 78% to 104%. Therefore: Power = 60 × (104/78) = 80 kW. Turbocharging increases air availability, permitting greater fuel combustion. Hence 80 kW is correct.

Q.52 Which combination correctly represents increasing order of tractor power transmission efficiency?

A. Belt Drive < Chain Drive < Gear Drive
B. Gear Drive < Belt Drive < Chain Drive
C. Chain Drive < Gear Drive < Belt Drive
D. Gear Drive < Chain Drive < Belt Drive

Answer: A

Explanation: Belt drives experience slip and lower efficiency. Chain drives reduce slip and improve efficiency. Gear drives provide positive motion transmission with the highest efficiency. Agricultural machinery commonly utilizes gear transmission where power losses must be minimized. Therefore the correct order is Belt < Chain < Gear.

Q.53 Assertion (A): An intercooler improves the performance of a turbocharged tractor engine.

Reason (R): Cooling compressed air increases its density before entering the cylinder.

A. Both A and R are true and R explains A
B. Both A and R are true but R does not explain A
C. A is true, R is false
D. A is false, R is true

Answer: A

Explanation: Turbocharging increases air temperature during compression. Intercoolers reduce this temperature and increase air density. More oxygen enters the cylinder, improving combustion efficiency and power output. Therefore intercooling improves engine performance. The reason correctly explains the assertion.

Q.54 A tractor weighing 45 kN develops a drawbar pull of 18 kN. The coefficient of traction is:

A. 0.25
B. 0.40
C. 0.50
D. 0.75

Answer: B