To be filled by the candidate	Reserved for the Institute
Name : …………………………..……. Surname : …………….……………. Examination town : ………………… Seat N°: ……….. Subject : ………………………………………………………………	*Anonymous N°* : ………..

Reserved for the Institute Score :	☑ International and Intercultural GENERALIST ENGINEER COURSE # **<u>PHYSICS</u>**	Reserved for the Institute *Anonymous N°* : *:* ………..

READ THESE INSTRUCTIONS FIRST
- ✓ There are fifty questions on this paper. Answer all questions. For each question there are four suggested answers A, B, C and D. Choose the one you consider correct and using a soft HB pencil, record your answer on the separate Answer Sheet provided.
- ✓ Do not use <u>programmable calculators</u>.
- ✓ Write your name and registration number on the Answer Sheet in the spaces provided.
- ✓ Read the instructions on the Answer Sheet very carefully. Each correct answer will score you one mark. A half (0.5) mark will be deducted for a wrong answer and zero for no response. Any working should be done in this question booklet.
- ✓ Mobile phones are NOT allowed in the examination room.

- ✓ You must not take this booklet and answer sheet out of the examination room. All question booklets and answer sheets will be collected at the end of the examination.

Direction :
Each of the questions or incomplete statements in this section is followed by four suggested answers.
Select the best answer for each question.

1. A compound Y has the following properties.
   - It is a liquid at room temperature and atmospheric pressure.
   - It does not mix completely with water.
   - It does not decolourise acidified potassium manganate(VII).

What could Y be?
   - A. ethane
   - B. ethanoic acid
   - C. ethanol
   - D. ethyl ethanoate

2. The equation $AB - C = 3D$ is homogeneous. The unit of C is equal to the unit of
   - A. AB
   - B. A
   - C. $AB/3D$
   - D. $3D/AB$

3. A physical quantity is written as 10 N. This means that:
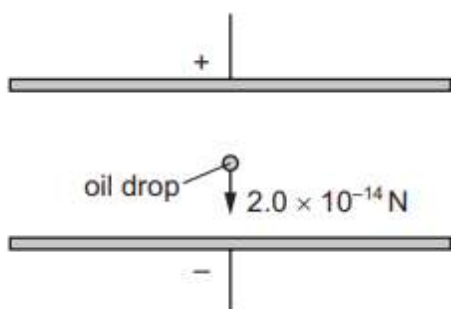   - A. 10 is the magnitude
   - B. 10 N is the magnitude

C. $10\,N$ is the unit

D. It must be a force of attraction

4. A charged oil drop is held stationary between two oppositely charged horizontal plates.

The weight of the oil drop is 2.0×10^{-14} N. The potential difference between the plates is 400V. The potential difference between the plates is now increased to 600V and the polarities of the plates reversed. What is the magnitude of the resultant force acting on the oil drop?

   A. 1.0×10^{-14} N

   B. 2.0×10^{-14} N

   C. 3.0×10^{-14} N

   D. 5.0×10^{-14} N.

5. Carvone gives the characteristic flavour to caraway and spearmint.
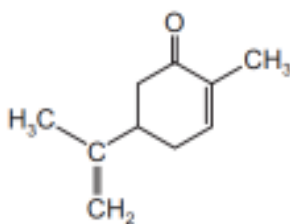
carvone

Prolonged heating of carvone with hot concentrated acidified potassium manganate(VII) produces carbon dioxide and a compound **X**.

X contains nine carbon atoms and reacts with 2,4-dinitrophenylhydrazine reagent.

What is the maximum number of molecules of 2,4-dinitrophenylhydrazine that will react with one molecule of **X**?

A 1   **B** 2   **C** 3   **D** 4

6. Two forces each of magnitude 2.0 N act on an object. If the angle between them is 60^0, then their resultant is

   A. 2.8N

   B. 0.0N
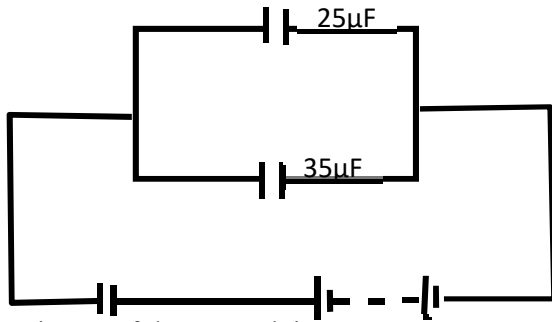
   C. 3.5N

D. 4.0N

7. Which of the following pairs has one base unit and one derived unit?
   A. coulomb and kilogram
   B. joule and watt
   C. second and Kelvin
   D. ampere and mole

8. A neutron has a mass of 1.68×10^{-17} kg. The speed of a neutron having a de Broglie wavelength of 0.20 nm is
   A. 3.00×10^{8} m s^{-1}
   B. 2.01×10^{8} m s^{-1}
   C. 2.53×10^{6} m s^{-1}
   D. 1.97×10^{3} m s^{-1}

9. The figure below shows a network of 3 capacitors.

The total capacitance of the network is   18V
   A. $100\mu F$
   B. $24\mu F$
   C. $14.6\mu F$
   D. $0.75\mu F$

10. A sealed tank of gas contains a mixture of nitrogen and oxygen. The tank is at room temperature. What is the same for the particles of nitrogen and oxygen in the tank?

   A. internal energy
   B. mean kinetic energy
   C. mean speed
   D. root mean square speed

11. During an adiabatic expansion, the volume of a gas increased from 1.5×10^{-3} m^3 to 2.4×10^{-3} m^3 against constant atmospheric pressure of 100 kPa. Identify the INCORRECT statement among the following.
   A. The system does 90 J of work against the atmosphere.
   B. The internal energy of the system reduces by 90 J
   C. The temperature of the gas reduces
   D. 90 J of heat energy is added to the system.

12. In the hydrolysis of bromoethane by aqueous sodium hydroxide, what is the nature of the attacking group and of the leaving group?

	attacking group	leaving group
A	electrophile	electrophile
B	electrophile	nucleophile
C	nucleophile	electrophile
D	nucleophile	nucleophile

13. In an isolated charged capacitor, if a polar substance is used as dielectric, this increases the Capacitance by
    A. Increasing the charge
    B. Increasing the p.d between the plates
    C. Decreasing the charge
    D. Decreasing the p.d between the plates.

14. The diagram shows a network formed by five identical 2.0Ω resistors.
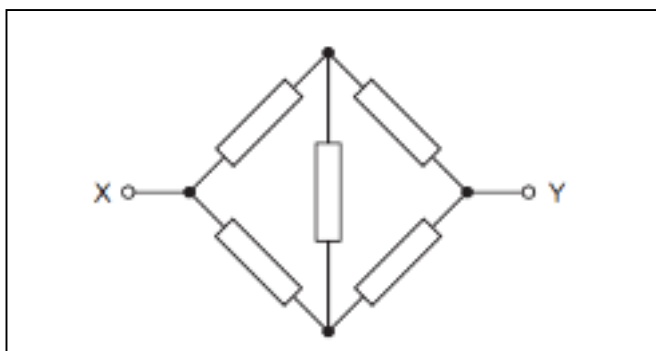
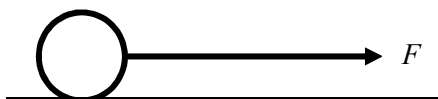A potential difference of 10V is applied across XY. What current flows between X and Y?
A 2.0A
B 2.5A
C 4.0A
D 5.0A

15. The figure below is that of a ball propelled along a horizontal frictionless runway by a constant force, F

After 20 seconds of motion, F, stops acting on the objects. What is the acceleration of the object before and after the 20 seconds?

	Before 20_s	After 20_s
A	Increasing	Constant
B	Constant	Decreasing
C	Increasing	Decreasing
D	Constant	Zero

16. When a gas is compressed adiabatically, its temperature
    A. Decreases
    B. Remains the same
    C. Increases
    D. Increases then decreases

17. Polymerisation of chloroethene gives PVC. How does the carbon-carbon bond in PVC compare with that in chloroethene?
    A. longer and stronger
    B. longer and weaker
    C. shorter and stronger
    D. shorter and weaker

18. In a transmission diffraction grating, the angle of diffraction for second order maxima
    For a light of wavelength 5×10^{-5} cm is 30^0. What is the number of lines per centimeter of the granting.
    A. 4000 lines/cm
    B. 5000 lines/cm
    C. 6000 lines/cm
    D. 7000 lines/cm

19. Mohr's salt is a pale green crystalline solid which is soluble in water. It is a 'double sulfate' which contains two cations, one of which is Fe2+. The identity of the second cation was determined by heating solid Mohr's salt with solid sodium hydroxide and a colourless gas was evolved. The gas readily dissolved in water giving an alkaline solution. A grey-green solid residue was also formed which was insoluble in water. What are the identities of the gas and the solid residue?
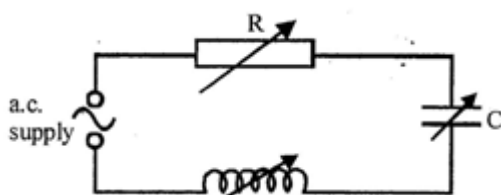
|	gas	residue
A	H_2	$FeSO_4$
B	NH_3	Na_2SO_4
C	NH_3	$Fe(OH)_2$
D	SO_2	$Fe(OH)_2$

C

20. In the figure below, the frequency of the supply is initially adjusted for electrical resonance to occur.

The resonant frequency of the circuit can be reduced by
A. increasing C
B. increasing R
C. decreasing L
D. decreasing C

21. A copper saucepan has a mass of 2.0 kg and is at a temperature of 20 °C. 2.0 kg of hot water at 80 °C is poured into the saucepan. Copper has a specific heat capacity of $390 Jkg^{-1}K^{-1}$. Water has a specific heat capacity of $4200 Jkg^{-1}K^{-1}$. Assume that there are no energy losses to the surroundings. What is the final temperature of the saucepan and water?
A. 25 °C
B. 50 °C
C. 75 °C
D. 80 °C

22. Deposits of ammonium compounds have been discovered in areas of high atmospheric pollution. They are believed to arise from the following reaction.

$$SO_3 + H_2O + 2NH_3 \rightarrow (NH_4)_2SO_4$$
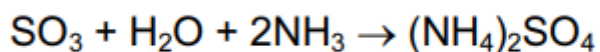
What does not occur in this reaction?
A. acid/base neutralisation

B.   dative bond formation

C.   ionic bond formation

D.   oxidation/reduction

23. An iron –cored inductor is connected in series with a voltage source, a switch and a resistor. As soon as the switch is closed, the current in the circuit.
   A. becomes steady immediately
   B. remains zero because of the inductor
   C. remains zero because of the resistor
   D. takes some time to increase to a steady value.

24. A piece of radioactive element whose half-life is 2 days has initially 8.0×10^{22} atoms. after 16 days, the number of atoms in the specimen is
   A. 3.1×10^{20}
   B. 7.5×10^{21}
   C. 5.0×10^{21}
   D. 2.5×10^{22}

25. Close to the surface of the Earth the gravitational field strength is uniform. A pair of unequal masses are joined by a light, stiff horizontal bar and suspended by a string from their centre of gravity as shown.
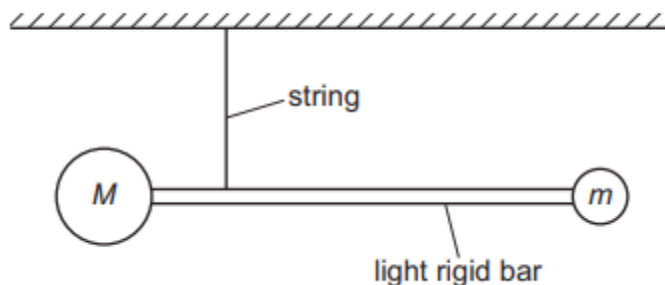

The supporting string is now cut and the system begins to fall. Air resistance is negligible. Which statement is correct?

   A.   The bar will remain horizontal as it falls.
   B.   The bar will rotate as it falls.
   C.   The resultant gravitational force will act at the centre of M.
   D.   The resultant gravitational force will act half-way between the centres of the two masses.

26. Over half a million tonnes of bromine are manufactured annually and are mainly used for making other compounds. One important use is for agricultural chemicals. What is another important use for bromine?
   A. antiseptic agents
   B. bleaches for textiles and the paper industry
   C. flame-retardants and fire extinguishers
   D. water purification

27. A long, thin metal wire is suspended from a fixed support and hangs vertically. Masses are suspended from its lower end. The load on the lower end is increased from zero and then decreased again back to zero. The diagram shows the force-extension graph produced.
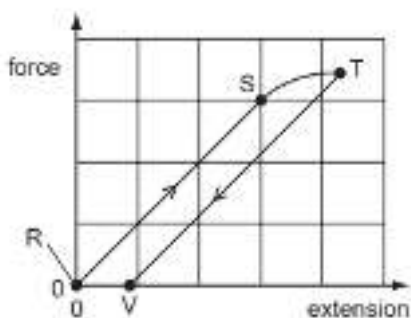
Where on the graph would the elastic limit be found?

A. anywhere between point R and point S
B. beyond point S but before point T
C. exactly at point S
D. exactly at point T

28. A hammer is dropped from the second floor of a story building. Neglecting frictional forces, which of the following properties of the hammer will remain constant as it falls?
    A. total mechanical energy
    B. momentum
    C. potential energy
    D. kinetic energy

29. An elastic material is said to be ductile if it
    A. can withstand a large stress before breaking
    B. undergoes significant plastic deformation after the elastic limit is exceeded
    C. stretches significantly when a small stress is applied on it
    D. breaks immediately after the elastic limit is exceeded

30. The figure below shows a displacement –time graph describing the motion of an object moving along a straight line.
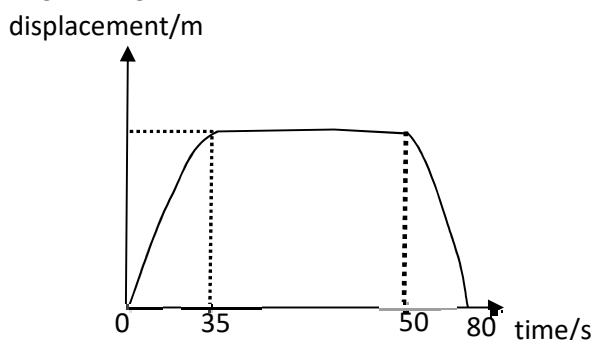
The average speed of the object during the entire motion is
A. 0.5 m s^{-1}
B. 0.25 m s^{-1}

C. 1.75 m s^{-1}
D. 0 m s^{-1}

31. Which group of particles is in order of increasing size?

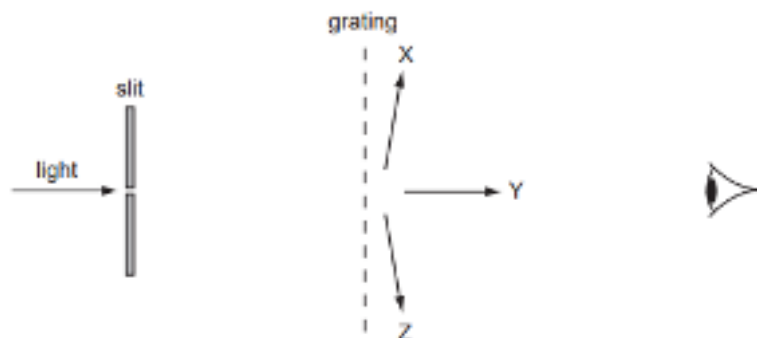A N   O   F

B N^{3-} O^{2-} F^{-}

C Na^{+} Mg^{2+} Al^{3+}

D Na^{+} Ne   F^{-}

32. A diffraction grating with 500 lines per mm is used to observe diffraction of monochromatic light of wavelength 600nm. The light is passed through a narrow slit and the grating is placed so that its lines are parallel to the slit. Light passes through the slit and then the grating.

An observer views the slit through the grating at different angles, moving his head from X parallel to the grating, through Y, opposite the slit, to Z parallel to the grating on the opposite side. How many images of the slit does he see?

A. 3
B. 4
C. 6
D. 7

33. When copper is extracted from its ores, the metal is not pure enough for electrical uses. The impure copper, which contains small amounts of silver and gold, is purified by electrolysis. During this process a 'sludge' forms beneath the anode which is found to contain silver and traces of gold. Why is silver found in this sludge?

A. Silver is less electropositive than copper.

B. Silver is more dense than copper and falls off the cathode.

C. Silver reacts with the electrolyte to form an insoluble chloride salt.

D. Silver reacts with the electrolyte to form an insoluble sulfate salt.

34. The activity of a particular radioactive nucleus falls from 2 x 10^3 $counts\ s-1$ in
    12 hours. The half -life of the nucleus in hours is
    A. 4.4 hours
    B. 1.0 hour
    C. 1.8 hours
    D. 6.0 hours

35. *The figure below* shows a well insulated composite rod made from iron and copper. Copper has a thermal conductivity of 400 W m^{-1} K^{-1} while that of 100 W m^{-1} K^{-1}
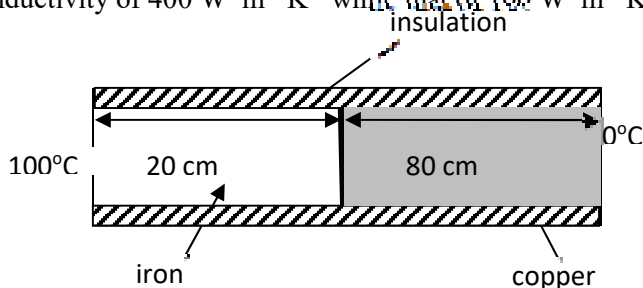
One end of the rod is maintained a 100° C while the other end is maintained a 0 ºC. Identify
The INCORRECT statement the following.
A. Electric force and gravitational force can either be attractive or repulsive
B. A space can be shielded from both fields
C. The force in each is a contact force
D. The force in each field obeys the inverse – square law.

SECTION II (Ten questions)

Question 36 -45
Direction: for each of the questions in this section, ONE or TWO of the responses given is/ are correct choose
A. If 1 and 2 are correct
B. If 2 and 3 are correct
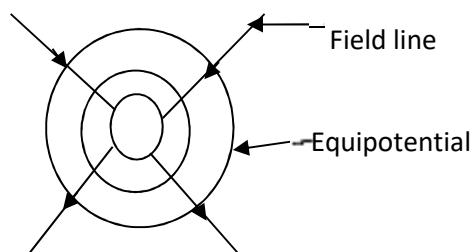C. If 1 only is correct
D. If 3 only is correct

Directions summarized			
A	B	C	D
1,2 only	2,3 only	1 only	3 Only

36. The diagram shows gravitational field lines and equipotentials for a point mass.
    The gravitational potential along an equipotential is

1. constant
2. zero
3. Positive

37. On a scale in which the mass of a ^{12}C atom is 12 the relative molecular mass of a particular sample of chlorine is 72. Which properties of the atoms in this sample are always the same?

1. radius
2. nucleon number
3. isotopic mass

38. When two charged capacitors at different p.d are connected together
    1. The total energy remains constant at $E_1 + E_2$
    2. The total charge is constant at $Q_1 + Q_2$
    3. The total capacitance is $C_1 + C_2$

39. The work done by a non – conservative force
    1. Increases
    2. Depends on the initial and final positions only
    3. Increase with the length of the path taken

40. For which reactions does the value of ΔH^θ represent both a standard enthalpy change of combustion and a standard enthalpy change of formation?

    1. $C(s) + O_2(g) \rightarrow CO_2(g)$
    2. $2C(s) + O_2(g) \rightarrow 2CO(g)$
    3. $CO(g) + \frac{1}{2}O_2 (g) \rightarrow CO_2(g)$

41. When a semiconductor diode is connected in forward bias
    1. The battery voltage opposes the junction p.d
    2. Majority charge carriers cross the depletion layer
    3. The junction voltage increases

42. A fraction of distilled crude oil contains molecules with between 15 and 19 carbon atoms. This fraction is cracked by strong heating. Why is this done?

1. To produce alkenes.
2. To produce smaller molecules which are in higher demand.
3. To insert oxygen atoms into the hydrocarbons.

43. The motion of a simple pendulum bob shows that
    1. Energy is maximum only when velocity is maximum
    2. Maximum velocity can occur at zero displacement
    3. Maximum acceleration can occur where the velocity is zero

44. A sun protection cream contains the following ester as its active ingredient.
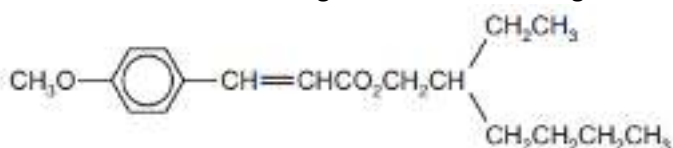
What are the products of its partial or total hydrolysis by aqueous sodium hydroxide?

1 $CH_3CH_2CH_2CH_2CH(CH_2CH_3)CH_2OH$

2

3
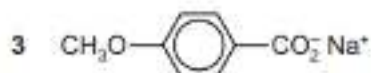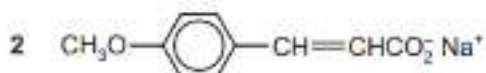
45. A coil of inductance 22H is connected to a 240V, 50Hz main a.c. Which of the following is/are correct?
    1. The reactance of the circuit is 690Ω
    2. The phase difference between the p.d across the coil and the current though it is ¼ Wavelength
    3. The maximum current through the coil is 35 mA

SECTION 3
(5Question)

Direction:
Each of the questions has four sets of graphs labeled A to D. Which of the graphs in each question best fits the relationship between x and y?

Question 46 -50

46

y	x
Current in an inductor resistor d.c series circuit	Time of flow

47

y	x
Photon energy	Frequency
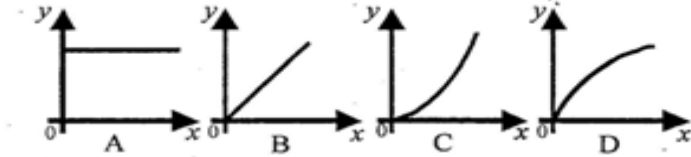
48

y	x
Fringe spacing in Young's double slit experiment	Slit separation
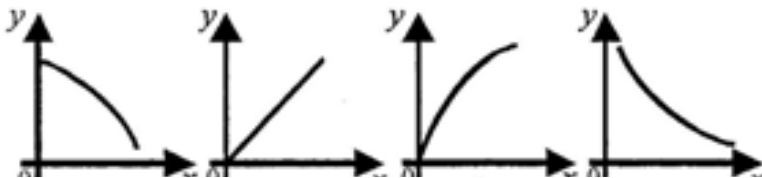
49

y	x
The amplitude of oscillation of a simple pendulum bob in air	Time
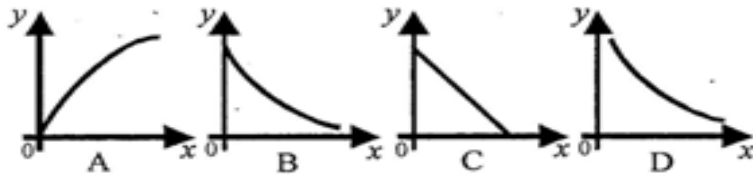
50

y	x
The natural logarithm of activity for a radio isotope	Time of decay
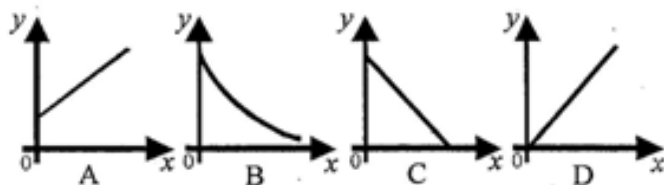
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