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Questions

centripetal acceleration → acceleration perpendicular to velocity.

1. Line of Force in a gravitational field
   → direction of force / acceleration on a small test mass

   9702/0/N/43/17

2. Define gravitational field strength
   → force per unit mass

3. Changes in vertical position of a point mass near the Earth's surface, the gravitational field strength is considered constant
   → because change in height is much less compared to radius of Earth. field lines are effectively parallel

   $\therefore g = \frac{GM}{R^2} \approx \frac{GM}{(R+h)^2}$

4. Find mass when radius = 1.5×10^8 km, T = 365 days

   $\therefore$ ~~$v = \frac{2\pi r}{T} = \frac{2\pi \times 1.5 \times 10^8}{365 \times 24 \times 60 \times 60} =$~~

   $T^2 = \frac{4\pi^2 r^3}{GM}$

   $M = \frac{4\pi^2 r^3}{GT^2}$

   9702/0/N/42/17

5. Newton's law of gravitation
   → The force between 2 point masses is directly proportional to the product of their masses and inversely proportional to the square of seperation

   ★ applies only on point masses

6. Volume of sphere = $\frac{4}{3}\pi r^3$, $\omega = \frac{2\pi}{T}$

   $\rho = \frac{M}{V}$

   $\rho V = M$

   $\frac{4}{3}\pi r^3 \rho = M$

   $F_c = F_g$

   $Mr\omega^2 = \frac{GMM}{r^2}$

   $\frac{Mr4\pi^2}{T^2} = \frac{GMM}{(nr)^2}$

YK NOTES

$$\frac{4\pi^2 r}{T^2} = \frac{G\left(\frac{4}{3}\pi r^3 \rho\right)}{r^2}$$

$$\frac{4\pi^2 r^3}{T^2} = G\left(\frac{4}{3}\pi\rho\right)$$

$$\frac{3\pi r^3}{T^2} = G\rho$$

$$\frac{3\pi r^3}{G} = T^2\rho$$

$$\boxed{\rho T^2 = \frac{3\pi r^3}{G}}$$

7. ~~$\frac{4\pi r^3}{3}$~~

$$n = \frac{4.32\times10^5}{7.15\times10^4} = \frac{864}{143}$$

$$\rho = \frac{3\pi r^3}{GT^2}$$

$$= \frac{3\pi \times (864/143)^3}{(6.67\times10^{-11} \times 15300^2)}$$

$$= 1.33 \times 10^3 \text{ kgm}^{-3}$$

9702/MJ/43/17

8. Explain how a satellite may be in a circular orbit around a planet

→ gravitational force between satellite and planet, that provides a centripetal force. gravitational force has constant magnitude

9. 6.38×10^6 m , 3.84×10^8 m $= \frac{19200}{31a} = n$

$$\rho = \frac{3\pi \times (19200/31a)^3}{G \times T^2} = 5537.6$$

8. 5.54×10^3 kgm^{-3}

VK NOTES

9702/MS/42/17

10. $g = \frac{GM}{r^2} = \frac{(6.67 \times 10^{-11}) \times 1 \times 10^{13}}{3600^2}$

$= 5.15 \times 10^{-5}$

11. ~~$w = mg$~~, $\frac{960}{9.81} = M = 97.86$

$\frac{960}{9.81} = 97.86$

~~$g = \frac{GM}{r^2}$~~

$M \times g = w$

~~$\frac{9.81 \times 3600^2}{6.67 \times 10^{-11}}$~~ $97.86 \times 5.1 \times 10^{-5} = 5.0 \times 10^{-3}$

12. Similarity between gravitational fields of 2 comets
   - → one is circular, one is a random shape
   - → ~~field~~ attraction pointed towards the comet

Difference → one is radial another is non-radial.

9702/ON/43/16

$F_c = F_g$

13. $\omega = \frac{2\pi}{T}$, $mr\omega^2 = \frac{GMm}{r^2}$

$r\omega^2 = \frac{GM}{r^2}$

$r \times \frac{4\pi^2}{T^2} = \frac{GM}{r^2}$

$$\frac{4\pi^2 r^3}{GM} = T^2$$

⇒ Physical properties that can be used to measure temperature
- → resistance of metal
- → volume of gas at constant pressure
- → emf of a thermocouple
- → density.

VK NOTES

9702/ON/12/16

14. Why acceleration of free fall near to Earth's surface is approximately constant?
→ The lines of gravitational force are radial
→ Near the surface the lines are approximately parallel
→ parallel lines so constant field strength

15. Gravitational Potential at a point
→ work done per unit mass
→ work done in bringing a mass from infinity to a point.

16. gravitational potential near an isolated mass is always negative why?
→ gravitational force is attractive
→ gravitational potential at infinity is zero
→ potential energy decreases as masses approach

17. How movement of gas causes pressure in container
→ molecules collide with wall
→ momentum of molecule changes during collision
→ There is a force on molecule so force on wall

18. Ideal Gas
→ gas that obeys $\frac{pV}{T}$ = constant
where V is volume, T is thermodynamic temp and p is pressure

19. $\langle c^2 \rangle$
→ mean square speed of molecules

20. Volume of Atoms is negligible compared to volume of container
∴ Volume of Atoms < Volume of container

VK NOTES

21. For ideal gas Change in internal energy is change in K_E
$\therefore \frac{3}{2}kT$ (x mol and 6.02×10^{23}) if needed.

22. Features of orbit of geostationary satellite
→ above the equator
→ period 24 hours
→ orbits west to east
→ one particular orbital radius.

23. advantage of geostationary satellite - no tracking required
disadvantage of geostationary satellite - longer time delay.

24. $l_v > l_f$ → because spacing increases in vaporisation.

25. if asked how the first law of thermodynamics applies to any change
→ write about change in volume, how it affects work done
→ write about temperature, how it affects internal energy.

26. $F = -Ag\rho x$ → show that $\omega = \sqrt{\frac{A\rho g}{m}}$

$F = ma$

$\frac{F}{m} = a$

$\frac{Ag\rho x}{m} = a$

$a = -\omega^2 x$

$a = -\frac{Ag\rho}{m} x$

$\therefore \omega^2 = \frac{Ag\rho}{m}$

$\omega = \sqrt{\frac{Ag\rho}{m}}$ hence proved.

Define Ideal gas
→ $pV \propto T$ → gas obeys
where T is
thermodynamic Temperature

VK NOTES

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27. Similarity and difference between gravitational potential and electrical potential

→ similarity
- → inversely proportional to distance
- → zero at infinite distance.

→ difference
- → gp is always negative
- → ep can be positive or negative.

28. Show that a gas is an ideal gas prove that $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

ABCA
no change in energy
bec no change in temp.

29. why is potential energy of ideal gases 0
→ They have no intermolecular forces

30. Average energy of a molecule
→ $\frac{Q}{N}$ → Q → energy, N → no. of molecules

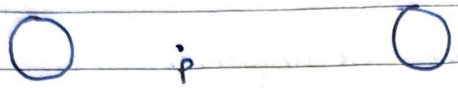
31. Thermal energy is required for melting even when there is no temperature change. (Why?
→ during melting bonds between atoms are broken
→ potential energy of atoms increases
→ little work done so thermal energy is required.

32. Causes of damping
→ loss of energy
→ resistive forces - name it.

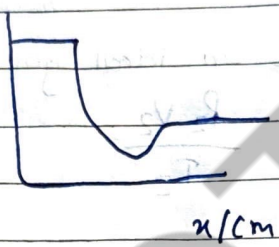
VK NOTES

33. Electric potential at a point
→ work done per unit charge
→ work done in getting a charge from infinity to a point.

34. if electric potential is always same sign then both objects have same sign



always positive V/V
same sign



∴ both spheres have same sign charge.

35. electric potential ∝ potential energy
if electric potential ↓, potential energy ↓
∴ potential energy decrease = increase in kinetic energy
∴ speed of charge increases.

36. Features of geostationary satellite
→ orbits west to east
→ Time period of 24 hours
→ above the equator
→ one particular orbital radius.

37. Electric field
→ region where charge experiences an electric force.

Electric field strength
→ Force per unit on positive charge

VK NOTES

38. if $E \propto \frac{1}{R^2}$

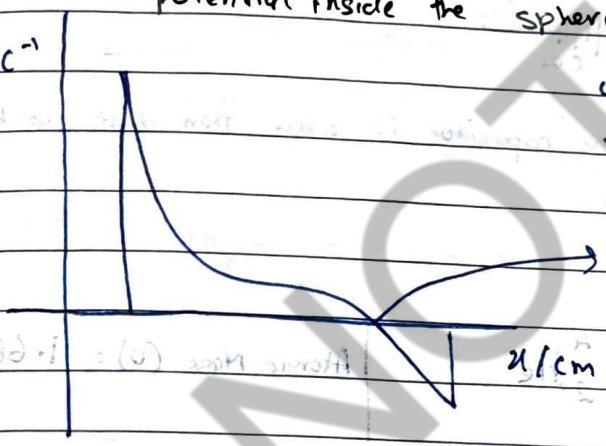
if R is doubled = 2R

then $\frac{E}{2^2} = \frac{E}{4}$

if R is tripled = 3R

then $\frac{E}{3^2} = \frac{E}{9}$

39. Electric field strength inside the electric field is 0
potential inside the sphere is maximum.

40. 

when E = 0
the two Electric fields are equal ∴ use the distance at E = 0 for calculations

41. Define electric field line
→ direction of force on a positive charge.

42. Internal Energy
→ Sum of potential and kinetic energy of molecules in a random motion.

43. $\frac{Q_1}{Q_2} = \left[\frac{r_1}{r_2}\right]^2$ [Electric fields]

44. Electric field strength is not zero when electric potential is zero
→ because electric field is in same direction

VK NOTES

45. Parallel plate Capacitor

→ $Q = CV$

$C = \frac{Q}{V}$, Q: Charge on one plate

V: potential difference between plates

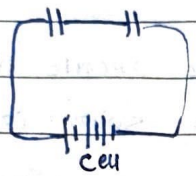
Uses of capacitor

→ smoothing circuits, store energy, time delays in circuits

46. Q is same in series V is different in series

Q is different in parallel V is same in parallel

→ If Q of one capacitor is asked then use total Q, because Q is same



→ if energy of one capacitor is asked then dont use total capacitance.

47. Nuclear physics

$^{A}_{Z}X$ $^{4}_{2}He$

Atomic Mass (u): 1.66×10^{-27} kg

X → chemical symbol

A → Nucleon Number

Z → Proton Number

} Neutrons = A - Z

48. Nuclear physics

→ Every particles has an antiparticle

→ Antiparticles have the same rest mass, but opp charge

$^{0}_{-1}e$

electron

-1.6×10^{-19} C

$^{0}_{+1}e$

position

$+1.6 \times 10^{-19}$ C

VK NOTES

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4. Nuclear Physics

→ Beta plus decay

$$^{1}_{1}p \rightarrow ^{1}_{0}n + ^{0}_{+1}e + ^{0}_{0}\nu$$

→ Beta minus decay

$$^{1}_{0}n \rightarrow ^{1}_{1}p + ^{0}_{-1}e + ^{0}_{0}\bar{\nu}$$

Nuclear Physics

→ Activity - The rate of decay of a radioactive source.

- The number of particles that decay per unit time

$$A = \frac{\Delta N}{\Delta t} \qquad \text{unit: Bq } (s^{-1})$$

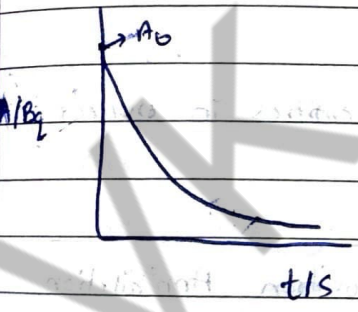
→ $A = \lambda N$ → no. of particles

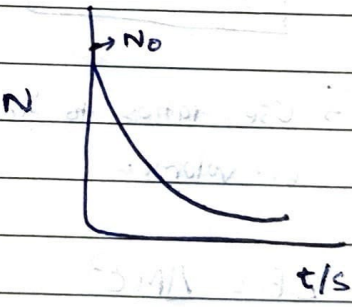
moles = $\frac{M\,(g)}{Mr}$	moles $\times 6.02 \times 10^{23}$ = particles (N)

λ → decay constant

→ probability of decay of single nucleus per unit time.

⇒ Graphs





$A = A_0 e^{-\lambda t}$ $\qquad N = N_0 e^{-\lambda T}$

$$\frac{A}{A_0} = e^{-\lambda t}$$

$$\ln\left[\frac{A}{A_0}\right] = \ln e^{-\lambda t}$$

$$\ln\left[\frac{A}{A_0}\right] = -\lambda t$$

$$-\ln\left[\frac{A}{A_0}\right] / \lambda = t$$

VK NOTES

56. Why is activity after 1 half life not as expected
→ daughter nucleus is unstable.

57. If energy in eV is given multiply with 1.6×10^{-19} and any number with no units, to find energy.

$P = AE$

Power = Activity * Energy

$P = P_0 e^{-\lambda t}$

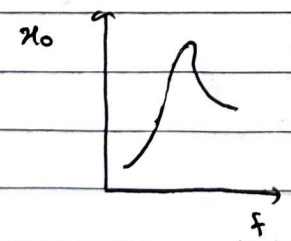
random decay - cannot predict which nucleus will decay next

spontaneous decay - not affected by external factors.

58 What is meant by radioactive decay
→ emission of particles by unstable nucleus
→ spontaneous emission.

59. Nuclear
→ Released energy is less than calculated energy
reason?
→ kinetic energy of other elements
→ gamma photons released.

60. Natural frequency of vibration of a system
→ Frequency at which body will vibrate when there is no external force acting on it.



→ Effect: Resonance
→ peak not sharp is damped
→ resonance is useful in microwaves.

⇒ Damping
→ Loss of total energy of system due to resistive forces.

VK NOTES

61. Simple harmonic motion
→ movement is such that acceleration is directly proportional to the displacement and oppositely directed.

62. A mass is suspended from two springs earlier it was only on one spring → differences?
→ period is shorter
→ greater spring constant
→ acceleration is greater

63. Magnetic Flux
→ product of flux density and area where direction of flux is normal to area

64. Faraday's Law of electromagnetic induction
→ induced emf is directly proportional to rate of change of magnetic flux linkage

65. Magnetic field
→ a region where a magnet experiences a force.

66. Magnetic Flux Linkage
→ magnetic flux density x area x number of turns
→ area is perpendicular to magnetic field.

67. Lenz's Law
→ The direction of induced emf is such as to oppose the change that caused it.

68. $V_H = \frac{BI}{ntQ}$
- V_H: Hall voltage
- B: Magnetic Flux density
- I: current
- n: number of charge carriers
- t: height
- Q: charge

⇒ Tesla
→ magnetic field normal to current
→ Newton per ampere
→ newton per metre

VK NOTES

69. What is meant by a photon
→ discrete packet of energy of electromagnetic radiation.

70. By reference to photoelectric effect explain work function energy
→ Minimum energy of a photon required to remove an electron.

71. Photoelectric Effect
→ emission of electron when electromagnetic radiation incident on surface

72. Evidences provided by photoelectric effect for a particulate nature of electromagnetic radiation
→ max energy of electrons depends on frequency
→ max energy of electons does not depend on intensity
→ instantaneous emission of electrons.

Medical

73. Principles behind the use of ultrasound
→ Ultrasound pulses are put through using piezo-electric transducer
→ Ultrasound pulses reflect at boundary of medias
→ reflected pulses are detected by ultrasound generators
→ reflected signal is processed and displayed
→ intensity of the reflected signal gives information about the boundary
→ gel is used to minimise reflection at skin.

74. Specific Acoustic Impedance
→ product of density and speed of sound in medium.

VK NOTES

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76. Principles of Computed Tomography CT scanning
→ X-rays are used
→ object is scanned in slices
→ scans taken from many angles
→ scans of many slices are combined
→ The slices are computed
→ it forms a 3d image of whole structure.

76. Why Ultrasound is emitted in pulses
→ allows the reflected signal to be distinguished from the emitted signal
→ detection occurs in the time between emitted pulses
→ Cannot emit and detect at the same time.

77. principles of detection of ultrasound
→ piezo-electric transducer is used to detect
→ Ultrasound makes the crystals vibrate
→ vibration produces alternating pd across crystal
→ we use pd values to know more about the reflected pulse.

78. Why an aluminium filter may be placed in the x-ray beam
→ X-ray has many wavelengths
→ x-ray has low energy wavelengths which are not absorbed by the body
→ Aluminium filter absorbs most of these low energy wavelengths.

79. μ↑ more absorbtion, more white
μ↓ less absorbtion, more black

80. Electrons are accelerated through pd, electrons collide with a target metal and a spectrum of x-rays is produced why?
→ electrons decelerate on hitting target so x-ray photons produced
→ range of decelerations → photon energy depends on magnitude of deceleration

VK NOTES

81. Tracer - substance containing radioactive nuclei that is introduced into the body.

82. Annihilation - A particle interacting with its antiparticle so that mass is converted into energy.

83. Gamma photons are used to produce an image
→ the two photons travel in opposite directions
→ gamma photons are detected outside the body by detector
→ gamma photons arrive at different times ✓
→ determine the location of production.
→ image built up of tracer concentration in the tissue

84. Reasons why some stars appear brighter than others
→ star might be closer to earth
→ star might have greater luminosity

85. Standard Candle → object with known luminosity

86. λ ↑ redshifted. λ_0 is λ in lab.

87. Luminosity of a star
→ Total power of radiation emitted by the star.

88. By reference to heating effect, explain what is meant by r.m.s value of an alternating current.
→ it is the equivalent of the direct current that produces the same heating effect as the alternating current.

89. How are X-rays produced?
→ electrons are accelerated by an applied pd
→ electrons hit target metal
→ X-rays produced when electrons decelerate.

VK NOTES

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90. Explain how 2 metal plates could act as a capacitor
→ potential difference applied between the plates causes charge separation between the plates.

91. Define magnetic flux density
→ force per unit length
→ force per unit current
→ current is perpendicular to field.

92. Purpose of CT scanning
→ To produce a 3d image of a structure/body

93. Specific latent heat of vaporisation
→ Thermal energy per unit mass
→ Energy required to change state between liquid and gas at constant temperature.

94. Resonance
→ oscillations are at maximum amplitude
→ when driving frequency equals natural frequency.

95. Two conditions for a copper wire, placed in a magnetic field to experience a magnetic force.
→ There must be current in the wire
→ wire must be at a non-zero angle to the magnetic field.

96. 2 parallel current carrying wires are placed near each other in vacuum, explain why they exert a magnetic force on each other
→ Current in wire creates magnetic field around wire
→ both wires sit in the magnetic field created by other wire
→ Wire is perpendicular to magnetic field, so experiences a magnetic force.

VK NOTES

97. Experiments to prove:-
→ particulate nature of electromagnetic radiation
  → photo electric effect
→ wave nature of matter
  → electron diffraction

98. Hubble's law
→ speed is directly proportional to distance
→ speed is speed of recession of galaxy (from observer)
→ distance is distance of galaxy from observer.

99. if 2 current carrying wires are parallel to each other and current is passing in same direction then they attract to each other

if current is in opposite direction they will repel

100. Assumptions of the kinetic theory of gases
→ particles are in continuous random motion
→ particles have negligible volume
→ all collisions are perfectly elastic.

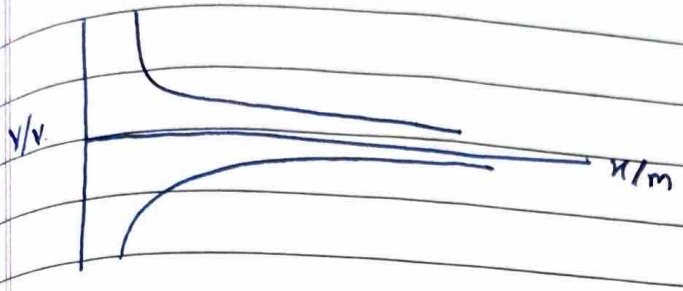
101. Why does activity of an unstable nuclei decreases with time
→ every nucleus has the same probability of decay
→ fewer nuclei remaining ∴ fewer will decay.

102. Function of quartz crystal
→ generates ultrasound
→ detects reflected ultrasound
→ applied pd causes crystals to vibrate
  vibrations cause crystals to generate EMF

VK NOTES

103. why does the object have a circular path
→ _____ is the reason for the centripital force
→ force acts perpendicular to the direction of motion
→ force has a constant magnitude.

104.

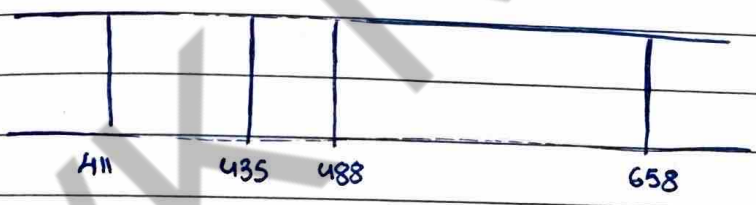


105. cephid variable → star which varies its luminosity periodically

106. angle subtended at centre of circle when arc length = radius

107. relationship between potential and electric field strength
→ field strength = potential gradient
→ negative sign included

108.



109. $\frac{hc}{\lambda} = E_1 - E_2$
(λ: given; E_1: find; E_2: given)

110. tracer always releases β^+

VK NOTES