\*\*\* HARD Problems : 2013 Q50, 2014 Q50,2012 Q44,2010Q49,2015Q47

AAPT:http://www.aapt.org/Programs/PhysicsBowl/printexams.cfm

cap:http://cap.phas.ubc.ca/en/oldexams\_en.php

**Topics that need covering:**

1. **Mechanics/M (Jesse)**
   1. Kinematics in 1D and 2D, relative velocity
   2. Forces (Normal, Friction, Gravity…)
   3. Energy (Potential, Kinetic...)
   4. Power
   5. Universal Law of Gravitation
   6. Kepler’s Laws
   7. Circular Motion
   8. Momentum and Center of Mass
   9. Angular Kinematics and Dynamics (Torque, work, power…)
   10. Equilibrium Condition
   11. ideal mechanical advantage/actual mechanical advantage
   12. Elasticity, Hooke’s Law, Springs
   13. Simple Harmonic Motion, Pendulums
2. **Electricity and Magnetism/EM (Jesse)**
   1. Static Electricity, Coulomb’s Law
   2. Fields and Electric Forces
   3. Gauss’s Law, Ampere’s Law
   4. Potential and PE
   5. Capacitors, Dielectrics
   6. Resistance, Conductors
   7. Magnetic Field and Force
   8. Right Hand Rule(s), Lenz's Law
   9. Circuits and Transformers
   10. inductor
3. **Waves and Optics/WO (Thomas)**

**-1 problem set every week, two quizzes**

**-should be able to explain with physics concepts all W/O questions on AAPT**

* 1. Wavelength and Frequency and Speed, energy transported by waves
  2. Light and (Doppler’s Effect)
  3. Superposition and Interference, reflection and transmission of waves, inphase/outphase
  4. diffraction
  5. sound(pitch,decibel,intensity,beat
  6. Standing Waves, Resonance(open and closed)
  7. musical applications
  8. Polarization
  9. Mirrors, Reflection, Refraction, Thin Lenses, ray diagrams, camera, magnifying glass, telescope, resolutions, lens and mirrors combined, aberrations
  10. electromagnetic spectrum, Diffraction grating,diffraction
  11. Huygen’s principle
  12. Double-slit, Single-Slit Interference, Intensity(power, relative intensity)
  13. Bragg’s Law

4. **Thermal and Fluid/TF (Harry)**

**-1 problem set every week, two quizzes**

**-should be able to explain with physics concepts all TF questions on AAPT**

* 1. Density and Pressure (PV diagrams), fluid in motion, torricelli’s theorem
  2. examples and applications of bernouilli principle
  3. poiseuille’s equation(flow in tubes), viscosity, surface tension
  4. Archimedes’ Principle, Buoyant Force
  5. Pascal’s Principle, Fluid Speed, Bernoulli's Equation
  6. applications: hydraulics, flight
  7. 0th, 1st, 2nd, 3rd Laws of Thermodynamics
  8. Heat and Temperature
  9. Thermal Expansion, Units of Temperature
  10. Heat engine, Work, Entropy, Efficiency
  11. Heat Cycles (Adiabatic, Carnot, Isobaric, Isochoric,isothermal,isometric,cyclic)
  12. Ideal Gases, vapour pressure, humidity, diffusion (Fick’s law)
  13. Heat transfer(conduction equation, radiaton(emissivity, stefan-boltzmann equation)

**5. Contemporary Physics, Nuclear & Others/O (Kevin)**

* 1. Uncertainties
  2. Units
  3. Prefixes in Measurement Units
  4. Decay, Fusion, Fission
  5. BE, Mass Defect, Mass Energy
  6. E = mc^2
  7. Relativity (Special + General)
  8. relativistic mechanics
  9. Half Life
  10. Elementary Particles (Leptons, Quarks…)
  11. Nobel Prizes
  12. Famous Contemporary Physics Events

**Contests we have to prepare for:**

* **CAP (grade 11 + 12)**
  + around Apr. 14th
  + focus on MCs, goal is to be hand marked
* **OAPT (grade 11 only)**
  + around May 20th
  + soft
* **AAPT (grade 11 + 12)**
  + around Apr. 1st to 17th
  + Speed is key, breadth of knowledge
* **SIN (grade 11 + 12)**
  + around May 7th
  + focuses on mechanics(mainly), optics, electricity, more depth than breadth

Questions of each category:

\*\***M stands for Mechanics, EM stands for Electricity and Magnetism,WO stands for Waves and Optics, TF stands for Thermal and Fluids, O stands for Other.**

**Because we are covering topics through the order of M>EM>WO>TF>O, thus questions of lower priority could require knowledge from the higher priority categories, eg a thermal and fluids question may require knowledge from mechanics. These questions are used by leader(s) of each category for their teaching examples/problem set purposes.**

AAPT (2007-2015)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Q# | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| 21 | M(e) | WO | M(e) | TF | O(e) | O(e) | O(e) | WO | M(m) |
| 22 | M(m) | TF | M(e) | TF | TF | M(e) | EM(e) | EM(e) | M(e) |
| 23 | M(e) | M(e) | EM(e) | M(e) | WO | M(m) | M(m) | M(e) | M(e) |
| 24 | WO | M(e) | M(e) | M(e) | WO | M(e) | O(m) | EM(e) | M(m) |
| 25 | EM(e) | O(e) | WO | M(e) | O(e) | M(e) | *TF* | WO | TF(m) |
| 26 | EM(e) | O(e) | EM(m) | EM(e) | O(e) | M(e) | M(e) | TF | WO |
| 27 | EM(e) | WO | EM(e) | EM(m) | *TF* | TF | WO | TF | M(m) |
| 28 | EM(m) | WO | WO | WO | M(e) | EM(e) | M(m) | WO | M(m) |
| 29 | EM(e) | EM(m) | WO | M(m) | EM(e) | M(m) | EM(e) | EM(e) | EM(e) |
| 30 | EM(e) | WO | O(e) | WO | M(m) | WO | EM(e) | O(e) | TF(e) |
| 31 | O(e) | EM(m) | M(m) | M(m) | TF | EM(m) | *TF* | M(e) | O(e) |
| 32 | O(e) | O(e) | TF | M(e) | WO | O(e) | M(m) | O | M(h) |
| 33 | EM(e) | EM(e) | TF | M(e) | WO | M(e) | M(m) | M(m) | WO |
| 34 | EM(m) | EM(e) | WO | M(e) | EM(e) | M(e) | O(e) | EM(m) | WO |
| 35 | *TF* | M(m) | TF | M(m) | M(e) | WO | EM(m) | O(m) | M(m) |
| 36 | *TF* | EM(m) | EM(e) | O(e) | M(e) | EM(e) | O(e) | WO | M(m) |
| 37 | WO | M(e) | EM(m) | EM(m) | M(e) | O(m) | WO | **TF** | O(e) |
| 38 | TF | M(e) | EM(e) | M(m) | EM(h) | EM(m) | EM(m) | EM(m) | WO |
| 39 | TF | TF | M(e) | EM(m) | M(m) | EM(m) | M(h) | M(h) | EM(m) |
| 40 | *TF* | M(m) | M(m) | M(m) | M(m) | TF | M(h) | M(m) | M(h) |
| 41 | M(e) | EM(m) | EM(e) | TF | EM(m) | O(m) | *TF* | O(e) | M(e) |
| 42 | EM(h) | EM(e) | M(m) | M(m) | EM(m) | O(m) | M(m) | WO | M(m) |
| 43 | WO | WO | WO | O(e) | WO | M(e) | M(m) | M(m) | M(e) |
| 44 | WO | TF | EM(e) | O(e) | TF | TF | O(e) | WO | O(m) |
| 45 | TF | O(m) | O(m) | EM(m) | WO | O(h) | EM(m) | M(e) | EM(m) |
| 46 | TF | M(e) | WO | O(m) | EM(e) | O(m) | O(m) | TF | M(h) |
| 47 | O(e) | O(m) | EM(m) | TF | M(m) | *TF* | O(e) | EM(e) | TF |
| 48 | O(e) | M(e) | WO | O(m) | WO | M(m) | *TF* | WO | EM(h) |
| 49 | O(m) | EM(h) | WO | TF | M(m) | WO | O(m) | M(h) | O(m) |
| 50 | O(m) | EM(h) | O | O(h) | O(m) | EM(m) | TF | O(e) | EM(h) |

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| M | e2m1 | e6m2 | e4m3 | e6m6 | e4m5 | e7m3 | e1m6h2 | e3m3h2 | e4m7h3 |
| EM | e6m2h1 | e3m4h2 | e6m3 | e1m4 | e2m3h1 | e2m4 | e3m3 | e4m2 | e1m2h2 |
| WO | 5 | 5 | 9 | 2 | 7 | 3 | 2 | 7 | 4 |
| TF | 7 | 3 | 3 | 5 | 4 | 4 | 5 | 4 | e1m1h1 |
| O | e3m2 | e3m2 | e1m1 | e3m2h1 | e3m1 | e2m4h1 | e5h3 | e4m1 | e2m2 |

CAP (1994-2014)

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|  | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| 1 | M (e) | TF | M | M | M | M | M | EM | TF | EM | WO | M | M | M | EM | M | M | O | M | M | EM |
| 2 | M  (e) | M  (e) | M | EM | M | WO | M | WO | M | WO | M | M | M | WO | M | TF | M | O | TF | EM | TF |
| 3 | EM | M  (e) | WO | M | M | WO | M | WO | WO | TF | M | M | EM | EM | M | O | M | O | M | Em | M |
| 4 | EM | M  (e) | EM | M | M | M | WO | WO | M | M | M | M | M | M | M | EM | EM | TF | O | M | M |
| 5 | M  (e) | M  (e) | O | M | EM | EM | EM | WO | TF | EM | O | O | EM | EM | M | M | TF | WO | EM | M | M |
| 6 | TF | O | EM | EM | M | M | WO | M | WO | M | M | M | WO | WO | M | TF | WO | O | TF | M | M |
| 7 | WO | EM | EM | M | WO | WO | EM | EM | WO | M | WO | EM | M | TF | O | WO | WO | EM | O | M | EM |
| 8 | EM | EM | EM | M | EM | M | WO | EM | EM | TF | EM | EM | M | M | WO | M | M | O | M | M | EM |
| 9 | WO | WO | WO | M | EM | M | WO | M | M | M | WO | M | EM | EM | EM | M | O | O | WO | M | WO |
| 10 | O | TF | M | WO | WO | M | EM | O | WO | M | M | M | EM | EM | EM | EM | M | O | TF | M | M |
| 11 | M  (e) | EM | M | M | M | M | WO | M | TF | M | EM | EM | M | M | TF | WO | TF | O | O | EM | WO |
| 12 | M  (m) | M  (e) | M | M | WO | M | M | EM | EM | M | WO | M | M | M | WO | EM | TF | O | TF | WO | EM |
| 13 | WO | WO | M | WO | EM | M | EM | EM | M | EM | EM | M | M | EM | M | M | O | M | O | TF | O |
| 14 | O | M | O | EM | EM | EM | TF | M | M | M | M | EM | TF | TF | O | TF | EM | M | WO | O | TF |
| 15 | EM | TF | M | O | EM | EM | M | M | M | M | EM | EM | WO | WO | WO | M | EM | TF | M | WO | O |
| 16 | WO | M | O | EM | EM | EM | EM | TF | EM | EM | WO | M | WO | WO | M | M | EM | M | M | TF | O |
| 17 | WO | WO | EM | O | EM | EM | EM | EM | M | EM | M | M | EM | EM | EM | O | M | M | O | TF | O |
| 18 | M  (m) | EM | WO | EM | EM | EM | M | M | M | M | M | TF | TF | O | WO | WO | O | WO | TF | M | EM(e) |
| 19 | M  (m) | WO | M | EM | WO | O | M | M | EM | O | EM | EM | M | M | O | EM | TF | TF | TF | M | M(e) |
| 20 | M  (e) | EM | M | M | M | EM | WO | WO | EM | WO | M | M | EM | EM | TF | WO | M | O | WO | WO | WO |
| 21 | W/O | M | WO | M | TF | WO | M | M | M | M | M | EM |  |  |  |  | M | M | WO | M | M |
| 22 | EM | M | M | M | M | WO | M | EM | WO | WO | EM | O |  |  |  |  | EM | M | TF | M | WO |
| 23 | M  (h) | M | WO | M | M | WO | O | M | M | WO | EM | WO |  |  |  |  |  | EM | M | M | EM |
| 24 | N/A | EM | EM | M | WO | WO | WO | M | M | M | EM | EM |  |  |  |  |  |  | TF | WO | M |
| 25 | N/A | M | EM | WO | EM | M | EM | M | WO | EM | TF | WO |  |  |  |  |  |  | TF | EM | O |

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| M | 8 | 11 | 10 | 14 | 9 | 10 | 9 | 11 | 11 | 12 | 10 | 12 | 9 | 6 | 7 | 7 | 8 | 6 | 6 | 13 | 8 |
| EM | 4 | 6 | 7 | 6 | 10 | 7 | 7 | 6 | 5 | 5 | 8 | 8 | 6 | 7 | 3 | 4 | 5 | 2 | 1 | 4 | 5 |
| WO | 5 | 4 | 5 | 3 | 5 | 6 | 7 | 4 | 6 | 3 | 4 | 2 | 3 | 3 | 4 | 4 | 2 | 2 | 4 | 4 | 4 |
| TF | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 4 | 3 | 8 | 3 | 1 |
| O | 2 | 1 | 3 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 1 | 3 | 1 | 3 | 7 | 4 | 1 | 5 |