INI CET Radiology

Sample Paper – 6

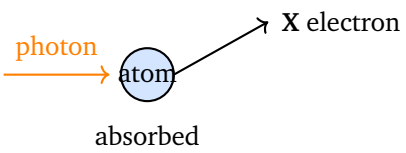
Duration: 14 Minutes **Maximum Marks: 15**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Best Response), modelled on the Radiodiagnosis (Radiology) content of **INI CET** (Institutes of National Importance Combined Entrance Test) conducted by AIIMS New Delhi.
- The **15-question** length matches the number of Radiology items you actually meet in the real 200-question paper.
- Each correct answer carries **+1 mark**. There is **negative marking of one-third (0.33) mark** for every incorrect answer; unattempted questions carry no penalty.
- Every question has **exactly one best answer**. Choose the single most appropriate option.
- Attempt this practice paper in one timed sitting of about **14 minutes**, the pace the real computer-based test demands.

Physics and Radiation Safety

Q1. The schematic below contrasts two X-ray interactions with tissue (the ejected electron is marked **X**). In the *photoelectric* effect the incident photon is completely absorbed by an inner-shell electron, whereas in *Compton* scatter the photon loses only part of its energy. Compared with Compton scatter, the photoelectric effect in the diagnostic energy range:



(A) Increases sharply as the atomic number of tissue rises and underlies bone–soft-tissue contrast

(B) Produces most of the scattered radiation that fogs the film

(C) Is independent of the atomic number of the absorber

(D) Dominates only at very high (megavoltage) photon energies

Q2. In plain radiography, increasing the **kVp** (tube potential) while holding other factors constant will:

(A) Raise image contrast and leave patient dose unchanged

(B) Have no effect on either contrast or the number of X-ray photons produced

(C) Lower image contrast (a more grey, longer grey-scale image) and increase penetration

(D) Reduce the penetrating power of the beam

Q3. The room housing a diagnostic X-ray unit, where access is restricted and dose is monitored, is designated a 'controlled area'. The internationally recognised symbol posted at its entrance is the:

(A) Blue mandatory-action disc

(B) Yellow-and-black radiation trefoil warning sign

(C) Green safe-condition sign

(D) Red prohibition circle only

Imaging Modalities and Contrast Media

Q4. In contrast-enhanced ultrasound, gas-filled microbubbles are injected intravenously. 'Harmonic imaging' improves the picture because the microbubbles:

(A) Resonate and emit strong signals at harmonic (multiple) frequencies of the transmitted beam

(B) Absorb the entire ultrasound beam and cast an acoustic shadow

(C) Convert ultrasound into ionising radiation for imaging

(D) Diffuse freely across cell membranes into the interstitium like iodinated contrast

Q5. On brain MRI, the **FLAIR** sequence is a heavily T2-weighted sequence with one key modification that makes periventricular lesions conspicuous. That modification is:

(A) It suppresses the signal from fat only

(B) It nulls (suppresses) the signal from free cerebrospinal fluid so it appears dark

(C) It is a plain T1-weighted sequence given after gadolinium

(D) It uses gradient-echo dephasing to detect blood products

Q6. A patient with suspected colonic perforation and possible toxic megacolon is referred for imaging. A **barium** enema in this setting is:

(A) The investigation of choice to outline the perforation

(B) Safe, because barium is inert in the peritoneum

(C) Preferred over water-soluble contrast in all acute abdomens

(D) Contraindicated, because barium leaking into the peritoneum causes severe chemical peritonitis

Chest and Cardiovascular Radiology

Q7. A chest radiograph in an occupational lung-disease clinic shows enlarged hilar lymph nodes with a thin rim of peripheral ('eggshell') calcification. This appearance is classically associated with:

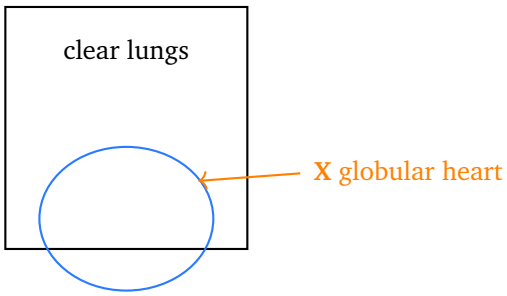
(A) Acute bacterial pneumonia

(B) Simple pulmonary oedema

(C) Lobar collapse

(D) Silicosis and sarcoidosis

Q8. The chest radiograph sketched below shows a symmetrically enlarged, globular 'water-bottle' cardiac silhouette (outline marked **X**) with clear lung fields. This is most suggestive of:



(A) Tension pneumothorax

(B) A large pericardial effusion

(C) Lobar pneumonia

(D) Miliary tuberculosis

Gastrointestinal and Genitourinary Radiology

Q9. A double-contrast barium enema in a patient with long-standing ulcerative colitis shows a smooth, tubular, featureless colon that has lost its normal haustral folds. This 'lead-pipe colon' appearance is due to:

(A) Multiple diverticula filling with barium

(B) An annular ('apple-core') carcinoma

(C) Chronic inflammation causing haustral loss and shortening of the colon

(D) Sigmoid volvulus

Q10. A woman with a positive pregnancy test and a raised serum beta-hCG has an empty uterus on transvaginal ultrasound, with an adnexal 'tubal ring' mass and free fluid in the pouch of Douglas. The single most likely diagnosis is:

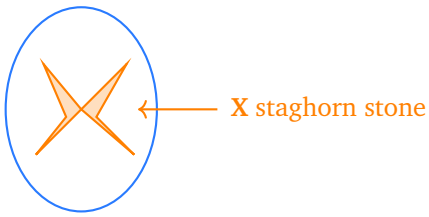
(A) Ectopic (tubal) pregnancy

(B) A normal early intrauterine pregnancy

(C) A complete hydatidiform mole

(D) A simple ovarian cyst

Q11. The plain radiograph below shows a large, branching calculus (marked **X**) filling the renal pelvis and calyces in a 'staghorn' configuration. Such staghorn calculi are most often composed of:



(A) Pure uric acid

(B) Cystine

(C) Calcium oxalate only

(D) Struvite (magnesium ammonium phosphate), linked to urease-producing infection

Musculoskeletal and Neuroradiology

Q12. A man with known carcinoma of the prostate has a bone scan and radiographs showing multiple dense, *sclerotic* (osteoblastic) deposits in the pelvis and spine. Among common primaries, which classically produces **sclerotic** (rather than lytic) bone metastases?

(A) Prostate carcinoma

(B) Renal cell carcinoma

(C) Multiple myeloma

(D) Bronchogenic (lung) carcinoma

Q13. A patient with sciatica and a foot drop has an MRI of the lumbar spine. Which finding best explains nerve-root compression from a prolapsed intervertebral disc?

(A) A bright (high-signal) T2 cord with no disc abnormality

(B) A posterolateral disc protrusion indenting the thecal sac and displacing the traversing nerve root

(C) Uniform disc height with normal disc signal at every level

(D) An anterior vertebral body wedge fracture only

Interventional, Nuclear and Emergency Radiology

Q14. An inferior vena cava (IVC) filter is placed by interventional radiology. Its principal indication is:

(A) To dissolve an established pulmonary embolus

(B) To treat superficial varicose veins of the leg

(C) Venous thromboembolism (proven DVT or PE) when anticoagulation is contraindicated or has failed

(D) Routine prophylaxis in every patient with a calf DVT

Q15. On a technetium-99m thyroid uptake scan, a solitary nodule that takes up *no* tracer (a 'cold' nodule) against a normally functioning gland is significant because, compared with a 'hot' (hyperfunctioning) nodule, it:

(A) Is always a benign colloid nodule needing no further work-up

(B) Confirms Graves' disease

(C) Carries a higher risk of malignancy and warrants fine-needle aspiration

(D) Indicates the nodule is producing excess thyroid hormone

Detailed Solutions

Q1.

Solution

Concept – photoelectric effect versus Compton scatter: Two interactions dominate diagnostic imaging, and they behave differently with tissue.

Step 1 – describe the photoelectric effect: The incident photon is **completely absorbed** by an inner-shell electron (marked **X**), which is then ejected; no scattered photon of significance remains.

Step 2 – its dependence on atomic number: Its probability rises steeply with the **cube of the atomic number** (Z^3) of the absorber, so calcium-rich bone absorbs far more than soft tissue, and this difference is what creates useful **bone–soft-tissue contrast**.

Why the other options are wrong:

- B, scattered radiation: it is *Compton* scatter, not the photoelectric effect, that produces the scatter which fogs the image.
- C, independent of Z: the photoelectric effect is strongly Z-dependent, which is exactly why it gives contrast.
- D, megavoltage only: the photoelectric effect dominates at *low* diagnostic energies; Compton takes over at higher energies.

Final Answer: Rises with atomic number and gives bone–soft-tissue contrast $\Rightarrow$ A

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – kVp, mAs and image quality: Two exposure factors are controlled at the console, each with a distinct effect.

Step 1 – what kVp changes: Raising the **kVp** increases the **energy (penetration)** of the beam. The photons are more penetrating, so fewer are absorbed selectively.

Step 2 – the effect on contrast: Because more photons pass through both bone and soft tissue, the difference between them narrows, giving a **lower-contrast, longer grey-scale** image. (In contrast, mAs controls the *number* of photons and hence brightness/density and dose.)

Why the other options are wrong:

- A, raises contrast: higher kVp lowers, not raises, subject contrast, and it does affect dose.
- B, no effect: kVp clearly alters both penetration and image contrast.
- D, reduces penetration: higher kVp increases penetrating power.

Final Answer: Lowers contrast and increases penetration $\Rightarrow$ C

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – controlled area signage: Areas where staff may receive significant dose are marked and monitored.

Step 1 – define the controlled area: The X-ray room is a **controlled area**: entry is restricted, staff wear dosimeters, and warning lights show when the beam is on.

Step 2 – name the sign: The mandatory symbol at the entrance is the **yellow-and-black radiation trefoil** (three-bladed) warning sign, often with a supplementary text warning.

Why the other options are wrong:

- A, blue disc: blue discs are mandatory-action (for example 'wear protection'), not the radiation hazard sign.
- C, green sign: green signs indicate safe conditions or emergency exits, not a radiation hazard.
- D, red prohibition circle: prohibition signs alone do not convey the radiation warning; the trefoil is the recognised symbol.

Final Answer: Yellow-and-black radiation trefoil $\Rightarrow$ B

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – microbubbles and harmonic imaging: Contrast-enhanced ultrasound uses gas-filled microbubbles as a blood-pool agent.

Step 1 – how microbubbles behave: When insonated, the bubbles **oscillate (res-**

onate) and, because their response is non-linear, they emit signals at **harmonic frequencies** that are multiples of the transmitted frequency.

Step 2 – why harmonic imaging helps: The scanner listens selectively at these harmonics, where tissue returns little signal, so the bubble (vascular) signal stands out with a high contrast-to-tissue ratio.

Why the other options are wrong:

- B, cast a shadow: microbubbles enhance backscatter; they do not absorb the whole beam.
- C, ionising radiation: ultrasound is non-ionising and microbubbles do not create radiation.
- D, diffuse into interstitium: microbubbles are a pure *blood-pool* agent and stay intravascular, unlike iodinated contrast.

Final Answer: They resonate and emit harmonic signals ⇒ A

Answer: (A) Go Back to Q4

Q5.

Solution

Concept – FLAIR and gradient-echo sequences: Different MRI sequences suppress or highlight particular signals.

Step 1 – what FLAIR does: FLAIR (Fluid-Attenuated Inversion Recovery) is a T2-weighted sequence in which an inversion pulse **nulls the signal of free CSF** so it appears dark.

Step 2 – why it is useful: With bright CSF removed, T2-hyperintense lesions next to the ventricles (for example multiple-sclerosis plaques or oedema) become far more conspicuous. (Gradient-echo, by contrast, is used to detect blood products through susceptibility.)

Why the other options are wrong:

- A, suppresses fat only: fat suppression (STIR/fat-sat) is a different technique; FLAIR nulls fluid.
- C, plain T1 post-gadolinium: FLAIR is T2-based, not a post-contrast T1 sequence.
- D, gradient-echo dephasing: that describes the *gradient-echo/susceptibility* sequence, not FLAIR.

Final Answer: It nulls free CSF so it appears dark ⇒ B

Answer: (B) Go Back to Q5

Q6.

Solution

Concept – barium and suspected perforation: The choice of enteric contrast changes when perforation is possible.

Step 1 – the hazard of barium: If the bowel is perforated, **barium leaking into the peritoneum** is inert to resorption but incites a severe **chemical (and later granulomatous) peritonitis** with a high mortality.

Step 2 – the safe alternative: Where perforation or toxic megacolon is suspected, barium is **contraindicated**; a *water-soluble* agent (for example gastrografin) is used because any leak is resorbed harmlessly.

Why the other options are wrong:

- A, investigation of choice: an enema is avoided in toxic megacolon because of the perforation risk.
- B, barium is inert: barium is inert to the body's clearance but is *not* harmless in the peritoneum; it causes peritonitis.
- C, preferred over water-soluble: the reverse is true when perforation is possible.

Final Answer: Contraindicated – barium causes chemical peritonitis $\Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – eggshell nodal calcification: A thin rim of calcium around hilar nodes is a specific radiographic sign.

Step 1 – recognise the pattern: Eggshell calcification is a peripheral, shell-like ring of calcium in enlarged hilar or mediastinal lymph nodes.

Step 2 – the classic causes: It is classically seen in **silicosis** (and coal-worker's pneumoconiosis) and in **sarcoidosis**, both of which fit an occupational or granulomatous clinic setting.

Why the other options are wrong:

- A, bacterial pneumonia: causes air-space opacity, not calcified nodes.

- B, pulmonary oedema: gives interstitial/alveolar shadowing, not eggshell nodes.
- C, lobar collapse: shows volume loss, unrelated to eggshell calcification.

Final Answer: Silicosis and sarcoidosis ⇒ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – the water-bottle heart of pericardial effusion: Fluid in the pericardial sac enlarges the cardiac silhouette in a typical way.

Step 1 – read the film: A symmetrically enlarged, **globular 'water-bottle'** cardiac shadow (outline marked **X**) with **clear lung fields** suggests a large pericardial effusion rather than heart failure.

Step 2 – the confirmation: Echocardiography is the investigation of choice: it shows the pericardial fluid and any tamponade physiology (diastolic collapse of the right chambers).

Why the other options are wrong:

- A, tension pneumothorax: shows a lucent hemithorax with mediastinal shift, not a globular heart.
- C, lobar pneumonia: gives lung opacity with air bronchograms, not an enlarged clear-lung silhouette.
- D, miliary tuberculosis: shows diffuse tiny nodules, not a water-bottle heart.

Final Answer: A large pericardial effusion ⇒ B

Answer: (B) Go Back to Q8

Q9.

Solution

Concept – the lead-pipe colon of chronic ulcerative colitis: Long-standing mucosal inflammation remodels the colon.

Step 1 – read the study: A smooth, tubular, **featureless colon with loss of haustra** (the 'lead-pipe' colon) is characteristic of chronic ulcerative colitis.

Step 2 – the mechanism: Repeated inflammation causes **haustral loss, mucosal atrophy and shortening** of the colon, so it becomes narrowed and rigid like a

pipe.

Why the other options are wrong:

- A, diverticula: produce outpouchings filling with barium, not a smooth tube.
- B, apple-core carcinoma: gives a short, irregular annular narrowing, not a diffusely featureless colon.
- D, sigmoid volvulus: gives a dilated pelvic loop, not a lead-pipe colon.

Final Answer: Chronic inflammation with haustral loss $\Rightarrow$ C

Answer: (C) Go Back to Q9

Q10.

Solution

Concept – ultrasound of a suspected ectopic pregnancy: A positive test with an empty uterus is a red flag.

Step 1 – interpret the findings: A raised beta-hCG with an **empty uterus**, an **adnexal 'tubal ring' mass** and free fluid in the pouch of Douglas points strongly to an **ectopic (tubal) pregnancy**.

Step 2 – the contrast with a normal IUP: A normal intrauterine pregnancy would show an *intrauterine* gestational sac with a yolk sac (and later a fetal pole) at the expected hCG level; its absence with an adnexal mass is the key discriminator.

Why the other options are wrong:

- B, normal IUP: a normal pregnancy would show the sac *inside* the uterus, not an empty uterus with an adnexal mass.
- C, molar pregnancy: shows a 'snowstorm'/vesicular intrauterine mass, not an empty uterus with a tubal ring.
- D, simple cyst: is anechoic without a tubal ring and does not explain the empty uterus with positive hCG.

Final Answer: Ectopic (tubal) pregnancy $\Rightarrow$ A

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – staghorn calculi and their composition: A branching stone filling the collecting system has a typical chemistry.

Step 1 – read the film: A large branching calculus (marked **X**) that fills the renal pelvis and calyces in a 'staghorn' shape is the classic appearance.

Step 2 – name the stone: Staghorn calculi are most often **struvite (magnesium ammonium phosphate)** stones, which form in alkaline urine produced by **urease-splitting** organisms such as *Proteus* (so-called infection stones).

Why the other options are wrong:

- A, uric acid: uric-acid stones are typically radiolucent and rarely form a staghorn.
- B, cystine: cystine stones can be large but are far less common and only in cystinuria.
- C, calcium oxalate only: oxalate stones are usually small and dense, not the typical struvite staghorn.

Final Answer: Struvite, linked to urease-producing infection $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – lytic versus sclerotic bone metastases: Different primaries produce different reactions in bone.

Step 1 – state the rule: Most metastases are **lytic** (bone-destroying), but a few are **sclerotic** (bone-forming). The classic sclerotic primary is **prostate carcinoma** (and, in women, some breast cancers).

Step 2 – apply it: The dense osteoblastic deposits in this man match prostate cancer, which stimulates new bone formation rather than pure destruction.

Why the other options are wrong:

- B, renal cell carcinoma: gives characteristically *lytic*, often expansile, deposits.
- C, multiple myeloma: produces punched-out *lytic* lesions with no sclerotic rim.
- D, lung carcinoma: metastases are usually *lytic*.

Final Answer: Prostate carcinoma (sclerotic) ⇒ A

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – MRI of a prolapsed intervertebral disc: MRI shows the disc, the thecal sac and the nerve roots directly.

Step 1 – identify the compressive lesion: A **posterolateral disc protrusion** that indents the thecal sac and **displaces or compresses the traversing nerve root** is the finding that explains radicular pain and a foot drop.

Step 2 – correlate: The level and side of the protrusion match the dermatome and myotome affected (for example an L4–L5 disc compressing the L5 root causes foot drop).

Why the other options are wrong:

- A, bright cord, no disc: intrinsic cord signal without a disc lesion does not explain root compression.
- C, normal discs: normal disc height and signal at every level means no compressive disc.
- D, wedge fracture only: an anterior wedge fracture is a bony injury, not disc-root compression.

Final Answer: Posterolateral protrusion displacing the nerve root ⇒ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – indications for an IVC filter: The filter mechanically catches emboli travelling from the legs.

Step 1 – state the main indication: An IVC filter is placed for **venous thromboembolism** (proven DVT or PE) when **anticoagulation is contraindicated** (for example active bleeding) or has **failed** despite adequate therapy.

Step 2 – the principle: It prevents further clot from reaching the lungs but does not treat existing clot; anticoagulation is resumed and the filter removed when it is safe.

Why the other options are wrong:

- A, dissolve an embolus: a filter traps clot; it does not lyse an established PE.
- B, varicose veins: superficial varicosities are unrelated to an IVC filter.
- D, routine prophylaxis: filters are not used for every calf DVT; they carry their own risks.

Final Answer: VTE when anticoagulation is contraindicated or has failed $\Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept – hot versus cold thyroid nodules: A radionuclide uptake scan grades how a nodule handles tracer.

Step 1 – define the cold nodule: A **cold** nodule takes up *no* tracer against a normal gland, meaning it is non-functioning.

Step 2 – why it matters: Cold nodules carry a **higher risk of malignancy** than hot nodules, so they warrant **fine-needle aspiration cytology**. A *hot* (hyperfunctioning) nodule overproduces hormone and is very rarely malignant.

Why the other options are wrong:

- A, always benign: a cold nodule is exactly the one that needs cytology because it may be malignant.
- B, Graves' disease: Graves' shows *diffuse* increased uptake, not a single cold nodule.
- D, excess hormone: a cold nodule is non-functioning; it is the hot nodule that produces excess hormone.

Final Answer: Higher malignancy risk, warrants FNAC $\Rightarrow$ C

Answer: (C) Go Back to Q15

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	B	4	A	5	B
6	D	7	D	8	B	9	C	10	A
11	D	12	A	13	B	14	C	15	C