



**National 5  
Physics**

**Solutions to  
Waves & Radiation  
exam questions**

1 (a) (i)  $3 \times 10^8 \text{ m s}^{-1}$  [number **and** unit must be correct]  
OR  $3\ 00\ 000\ 000 \text{ m s}^{-1}$

(ii)  $d = v t$  (1)  
 $= (3 \times 10^8) \times 0.68$  (1)  
 $= 20\ 400\ 000 \text{ m}$  (1) [number **and** unit must be correct]

(b)  $v = f \lambda$  (1)

$$3.0 \times 10^8 = 2100 \times 10^6 \times \lambda \quad (1)$$

$$\lambda = \frac{3.0 \times 10^8}{2100 \times 10^6}$$

$$= 0.14 \text{ m} \quad (1) \text{ [number **and** unit must be correct]}$$

- 2 (a) (i) Diagram 2 (represents ionized atom) (1)  
An electron has been removed (from the atom) (1)
- (ii) Alpha (accept symbol  $\alpha$ ) (1)
- (b) Use forceps/don't point at eyes/wear gloves etc. (1)
- (c) (i) Instrument sterilisation/treatment of cancer (1)
- (ii) Beta radiation (accept symbol  $\beta$ ) (1)

3. B

4. E

5. C

6. C

7. D

8. A

- 9 (a)  $3 \times 10^8 \text{ m s}^{-1}$  [number **and** unit must be correct] (1)  
OR  
 $300\,000\,000 \text{ m s}^{-1}$
- (b)  $v = f \lambda$  (1)  
 $3 \times 10^8 = 12 \times 10^9 \times \lambda$  (1)  
 $\lambda = 0.025 \text{ m}$  (1)
- [number **and** unit must be correct]

10. FM waveband has short(er) wavelength (1)  
These radio waves do not diffract around hills (1)

11. photodiode/phototransistor/CCD (sensor from digital camera) (1)

**Note: IR detectors such as thermometer/thermopile/ thermogram are not suitable for the given context.**

**Not infra red camera OR infra red detector**

12 (a) 1500 m s<sup>-1</sup> [number **and** unit must be correct] (1)

(b)

$$v = \frac{d}{t} \quad (1)$$

$$1500 = \frac{25}{t} \quad (1)$$

$$t = 0.0167 \text{ (s)} \quad (1) \quad \text{unit not required here}$$

unless this time is left  
as the final answer

$$\text{total time} = 2 \times 0.0167 = 0.0334 \text{ s} \quad (1)$$

sig. fig. range (if no intermediate rounding) :

0.03, 0.033, 0.0333.

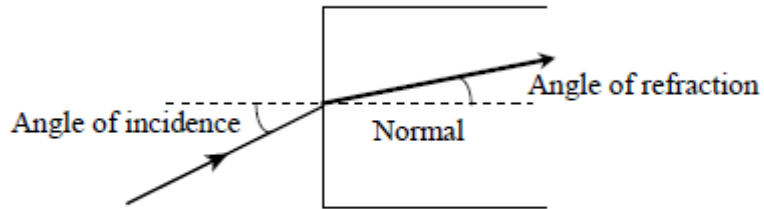
(c) (i) Time interval is unchanged 1

(ii) Speed (of sound in water) is same/unchanged. 1  
Frequency has no effect (on the time taken for the wave to  
travel the 50m)



13. (a) The radiation detector would detect a higher level of radiation (1)  
OR  
count rate would be higher where there was a crack in the aircraft
- (b) (i) Time taken for the (radio) activity (of a radioactive source) to (1)  
reduce by half.
- (ii) Source Y (1)  
gamma can penetrate through the metal aircraft (1)  
Long half life (1)
- (c) Point away from face / people (1)  
OR  
use tongs/ forceps  
OR  
Use lead (lined) aprons/gloves etc.
- (d)  $48/12 = 4$  ( half lives) (1)  
  
 $128 \rightarrow 64 \rightarrow 32 \rightarrow 16 \rightarrow 8$  (MBq)  
  
(1) for halving  
(1) for final answer [number **and** unit must be correct]

14. (a) Greater (1)
- (b) Correct drawing and change of direction (1)



All 3 labels correctly shown (1)

- 15 (a) Selection of any two correct count rate values from the graph, where second value = half of the first value. (1)  
Half-life = 2 hours (1) [number **and** unit must be correct]
- (b) Any two valid answers – 1 mark each. (2)  
e.g. two from; atmosphere, radon gas, cosmic rays, underlying geology (rocks), nuclear weapons tests
- (c) A type of electromagnetic radiation / wave/ ray. (1)

16. (a) (i)  $D = \frac{E}{m}$  (1)

$$D = \frac{6.0 \times 10^{-6}}{0.5} \quad (1)$$

$D = 12 \mu\text{Gy}$  [number **and** unit must be correct] (1)  
(or  $12 \times 10^{-6} \text{ Gy}$ )

(ii)  $H = DW_R$  (1)

$$H = (12 \times 10^{-6}) \times 20 \quad (1)$$

$H = 240 \mu\text{Sv}$  [number **and** unit must be correct] (1)  
(or  $2.4 \times 10^{-4} \text{ Sv}$ )

(iii)  $A = \frac{N}{t}$  (1)

$$= \frac{24,000}{(5 \times 60)} \quad (1)$$

$= 80 \text{ Bq}$  [number **and** unit must be correct] (1)

(b) Fission (1)

17. C

18. E

19. E

		Marks	
20	(a)	gamma radiation can penetrate the body OR beta radiation cannot penetrate the body	(1)
	(b)	12 → 6 → 3 → 1.5 (MBq) 3 half-lives (can be implied) 3 × 13 = 39 (hours) 5pm on May 1st (or 17:00 on 1st May)	(1) (1) (1)
	(c)	(i) All windows shaded	(1)
		(ii) The blacker/darker/foggier the film, the more radiation they have been exposed to.	(1)

		Marks
21	(a) Radioastron has a higher orbit OR Hubble has a lower orbit	(1)
	(b) P = X-rays Q = Ultra violet/UV <b>both</b> must be correct	(1)
	(c) Any one of the following; (Black bulb) thermometer, photodiode, phototransistor, thermofilm, thermistor, thermopile, thermocouple, thermographic film, heat sensitive paper, IR film, CCD	(1)

		Marks
22.	(a)	$D = \frac{E}{m}$
		(1)
		$1.5 \times 10^{-3} = \frac{E}{1.4}$
		(1)
		$E = 2.1 \times 10^{-3} \text{ J}$ [number <b>and</b> unit must be correct] (= 2.1 mJ)
		(1)
	(b)	$18 \div 6 = 3$ half-lives
		(1)
		$320 \rightarrow 160 \rightarrow 80 \rightarrow 40 \text{ MBq}$
		for halving
		(1)
		for final answer [number <b>and</b> unit must be correct]
		(1)



			Marks
23.	(a)	Fission (induced fission accepted but NOT chain reaction)	(1)
	(b)	P (slow) neutron Q (fissionable) nucleus R (fast) neutron S fission fragment/daughter product	(2)

24. B

25. C

26. E

27. A

28. C