3. Waves

3.3 Electromagnetic spectrum

Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 Which regions of the electromagnetic spectrum are used for satellite television and for security marking?

	satellite television	security marking
A	microwaves	infrared
B	microwaves	ultraviolet
C	X-rays	infrared
D	X-rays	ultraviolet

2 The early Universe was filled with gamma radiation. Since then, the radiation has shifted to the microwave region of the electromagnetic spectrum.

How has this change affected the wavelength and speed of the radiation?

	wavelength	speed
A	decreased	decreased
B	decreased	stayed the same
C	increased	decreased
D	increased	stayed the same

3 Infrared is a useful type of electromagnetic radiation. However, excessive exposure to infrared can cause harmful effects.

Which row gives a use and a harmful effect for infrared?

	use	harmful effect
A	detection of cancer	mutations
B	intruder alarms	skin burns
C	detection of fake bank notes	cell damage
D	thermal imaging	internal heating of body cells

4 Excessive exposure to some regions of the electromagnetic spectrum can cause harmful effects to people.

Which regions cause mutation of cells in the body, skin burns and internal heating of body cells?

	mutation of cells	skin burns	internal heating of body cells
A	radio waves	infrared	visible light
B	radio waves	ultraviolet	microwaves
C	X-rays	infrared	microwaves
D	X-rays	ultraviolet	visible light

5 Where do all types of electromagnetic waves travel at the same speed?

A air

B a vacuum

C glass

D water

6 The table shows different types of wave in the electromagnetic spectrum.

radio waves	microwaves	infrared waves	visible light	ultraviolet waves	X-rays	gamma rays

Where do all the waves travel at the same speed?

A in a vacuum

B in diamond

C in glass

D in water

7 Which statement is correct?

A A remote controller emits microwave radiation.

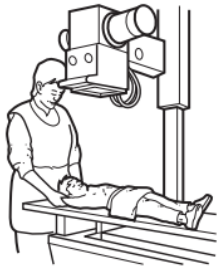
B A remote controller emits infrared radiation.

C A remote controller emits ultrasound.

D A remote controller emits ultraviolet radiation.

8 The two devices shown use different types of electromagnetic waves.

medical scanning



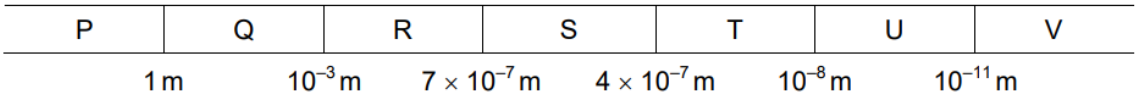
remote controller

Which types of waves are used in these devices?

	medical scanning	remote controller
A	ultraviolet	infrared
B	ultraviolet	microwaves
C	X-rays	infrared
D	X-rays	microwaves

9 The diagram shows the electromagnetic spectrum. The numbers indicate the approximate wavelength at the boundaries between the various regions of the spectrum.

For a device to be able to make use of electromagnetic radiation, it needs an aerial of approximately the same size as the wavelength of the radiation it is designed to work with.



Which statement is correct?

A A mobile phone uses radiation from region P.

B A television satellite dish uses radiation from region Q.

C The receptor cells in an eye use radiation from region R.

D The remote controller for a television uses radiation from region U.

10 Microwaves and X-rays are regions of the electromagnetic spectrum.

Which statement about microwaves and X-rays is correct?

A Microwaves and X-rays have the same frequency.

B Microwaves and X-rays travel at the same speed in a vacuum.

C Microwaves have a shorter wavelength than X-rays.

D Microwaves travel at a lower speed than X-rays in a vacuum.

11 Visible light has a frequency of approximately 5.0×10^{14} Hz.

M and N are two other types of electromagnetic radiation.

The frequency of M is 5.0×10^{6} Hz.

The frequency of N is 5.0×10^{15} Hz.

Which types of radiation are M and N?

	M	N
A	radio waves	infrared
B	radio waves	ultraviolet
C	ultraviolet	X-rays
D	X-rays	infrared

12 Two students are describing different types of electromagnetic radiation.

student 1 This radiation is used in communications.

student 2 This radiation is used in remote controllers.

Which row shows the possible type of radiation that each student is describing?

	student 1	student 2
A	microwave	infrared
B	radio	ultraviolet
C	sound waves	visible light
D	X-rays	gamma rays

13 Which part of the electromagnetic spectrum is used by a remote controller for a television?

A infrared waves

B microwaves

C radio waves

D visible light

14 Which statement correctly compares radio waves and X-rays?

A Radio waves have a longer wavelength and a greater speed in a vacuum.

B Radio waves have a longer wavelength and the same speed in a vacuum.

C Radio waves have a shorter wavelength and a greater speed in a vacuum.

D Radio waves have a shorter wavelength and the same speed in a vacuum.

15 Microwaves, green light and infrared are three types of electromagnetic radiation.

What is their order when listed by wavelength from the shortest wavelength to the longest?

A green light → infrared → microwaves

B green light → microwaves → infrared

C infrared → green light → microwaves

D microwaves → infrared → green light

16 Radiation from which part of the electromagnetic spectrum is used in the remote controller for a television?

A infrared waves

B microwaves

C radio waves

D ultraviolet waves

17 Two rays of light are different colours.

Which row is correct?

	speed of the two colours in a vacuum	wavelengths of the two colours in a vacuum
A	different	different
B	different	the same
C	the same	different
D	the same	the same

18 Visible light, X-rays and microwaves are all components of the electromagnetic spectrum.

Which statement about the waves is correct?

A In a vacuum, microwaves travel faster than visible light and have a shorter wavelength.

B In a vacuum, microwaves travel at the same speed as visible light and have a shorter wavelength.

C In a vacuum, X-rays travel faster than visible light and have a shorter wavelength.

D In a vacuum, X-rays travel at the same speed as visible light and have a shorter wavelength.

19 Which radiation has a higher frequency than red light?

A ultraviolet

B radio waves

C microwaves

D infrared

20 A student is asked to give two uses of four different types of electromagnetic radiation.

In which row are both the uses correct?

	radiation	use 1	use 2
A	radio	sterilising medical equipment	mobile phone masts
B	microwaves	mobile phones	sterilising medical equipment
C	infrared	remote controllers	intruder alarms
D	X-rays	security in airports	intruder alarms

HM The diagram shows the electromagnetic spectrum.

γ-rays	E	ultraviolet	F	infrared	microwaves	G

Which types of wave are E, F and G?

	E	F	G
A	radio	visible light	X-rays
B	radio	X-rays	ultrasound
C	X-rays	radio	ultrasound
D	X-rays	visible light	radio

HH Which type of radiation does a remote controller use to send its instructions to a TV set?

A γ-rays

B infrared radiation

C ultraviolet radiation

D X-rays

HO An intruder alarm sensor detects that a person is warmer than his surroundings.

Which type of electromagnetic wave does the sensor detect?

A infrared

B radio

C ultraviolet

D visible light

НП The diagram shows the electromagnetic spectrum.

γ-rays	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves

increasing .....→

A word is missing from the label below the spectrum.

Which word is missing?

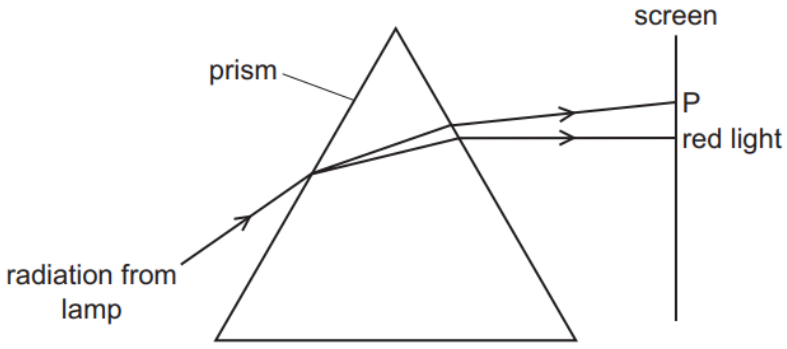
A amplitude

B frequency

C speed

D wavelength

НР The diagram shows radiation from a lamp passing through a prism.



Which type of radiation is found at P?

A γ-rays

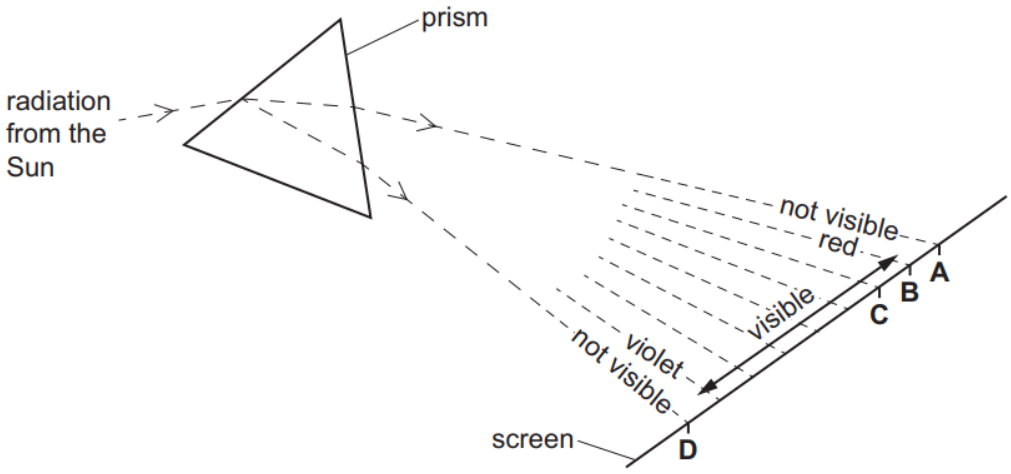
B infrared

C ultraviolet

D X-rays

26 Some of the Sun's radiation passes through a prism. The diagram shows the spectrum of the radiation.

Which point on the screen does the infra-red radiation reach?



27 Different parts of the electromagnetic spectrum are used for different purposes. Below are four statements about parts of the spectrum.

statement 1: Infra-red waves are used in television remote controllers.

statement 2: Radio waves are used to transmit television pictures from satellites to Earth.

statement 3: Ultraviolet waves are used for intruder alarms.

statement 4: X-rays are used for security checks.

Which statements are correct?

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

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

28 Radio waves are electromagnetic waves. **(extended only)**

What is the wavelength of a radio wave of frequency 2.0×10^5 Hz?

A 0.00067 m **B** 0.0015 m **C** 670 m **D** 1500 m

29 What is the speed of electromagnetic waves in a vacuum? **(extended only)**

A 300 m / s

B 300 km / s

C 300 000 km / s

D 300 000 000 km / s

30 Which region of the electromagnetic spectrum is used for detecting fake bank notes?

A radio

B microwaves

C ultraviolet

D X-rays

31 Which waves are used in the medical scanning of soft tissue?

A gamma rays

B infrared

C microwaves

D ultrasound

32 Thermal radiation is part of the electromagnetic spectrum.

What is the name of this region of the spectrum?

A gamma rays

B infrared

C ultraviolet

D visible light

33 A radio transmitter broadcasts at a frequency of 200 kHz. **(extended only)**

What is the wavelength of these radio waves?

A 6.7×10^{-4} m **B** 1.5 m **C** 1.5×10^{3} m **D** 1.5×10^{6} m

34 The frequency of the microwaves used in a microwave oven is 2400 MHz. **(extended only)**

What is the wavelength of these microwaves?

A 0.125 m **B** 8.00 m **C** 125 m **D** 7200 m

35 Visible light has wavelengths in the range 4.0×10^{-7} m to 7.0×10^{-7} m.

What is the range of the frequencies of visible light?

A 0.12 Hz to 0.21 Hz

B 120 Hz to 210 Hz

C 4.3×10^{11} Hz to 7.5×10^{11} Hz

D 4.3×10^{14} Hz to 7.5×10^{14} Hz

36 A radio station broadcasts a signal with a frequency of 89 MHz. **(extended only)**

What is the wavelength of this signal?

A 3.7 μm **B** 3.4 m **C** 3.7 km **D** 3.4 Mm

37 The Sun emits infrared radiation and light.

Light from the Sun reaches the Earth in 8 minutes.

Which row gives correct information about the infrared radiation?

	wavelength of infrared radiation	time taken for infrared radiation to reach the Earth
A	longer than wavelength of light	8 minutes
B	longer than wavelength of light	much less than 8 minutes
C	shorter than wavelength of light	8 minutes
D	shorter than wavelength of light	much more than 8 minutes

38 Which list shows regions of the electromagnetic spectrum in order of increasing frequency?

A X-ray → ultraviolet → visible light → infrared

B X-ray → infrared → visible light → ultraviolet

C infrared → visible light → ultraviolet → X-ray

D ultraviolet → visible light → infrared → X-ray

39 Which statement about electromagnetic waves is **not** correct? **(extended only)**

A They travel at 3×10^8 m/s in a vacuum.

B They transfer energy.

C They travel at 340 m/s in air.

D They are transverse waves.

40 What is the speed of microwaves in air? **(extended only)**

A 3×10^8 μm/s

B 3×10^8 cm/s

C 3×10^8 m/s

D 3×10^8 km/s

41 An eclipse of the Sun happens when the Moon comes between the Earth and the Sun.

Which statement is correct?

A Infra-red radiation from the Sun disappears before visible light and ultra-violet radiation.

B Ultra-violet radiation from the Sun disappears before visible light and infra-red radiation.

C Visible light from the Sun disappears before ultra-violet radiation and infra-red radiation.

D Infra-red radiation, ultra-violet radiation and visible light from the Sun all disappear at the same moment.

42 A remote-controlled vehicle is travelling on the surface of a planet. The vehicle senses an obstacle ahead. It sends a radio message to the control room from where it is being controlled. The control room is 2.4×10^6 km away from the vehicle. The control room sends a message back to the vehicle telling it to stop. **(extended only)**

What is the minimum time that elapses between the vehicle sensing the obstacle and receiving the message back from the control room?

A 8.0 ms **B** 16 ms **C** 8.0 s **D** 16 s

43 Which statement is **not** correct? **(extended only)**

A The speed of long-wavelength infra-red radiation in a vacuum is greater than that of short-wavelength ultraviolet light.

B The speed of microwaves in air is approximately 3.0×10^8 m/s.

C The speed of γ-rays emitted from a sample of cobalt-60 is 3.0×10^5 km/s.

D The X-rays emitted in a supernova explosion reach the Earth at the same time as the visible light emitted.