MC /20	
Long /110	
Total /130	
%	

Nat 5 W&R Prelim Revision

1. Microwaves are reflected from a metal barrier. If 'i' is the angle of incidence and 'r' is the angle of reflection then

   A i is greater than r

   B i is equal to r

   C i is less than r

   D i is directly proportional to 1/r

   E i and r are not related

2. When a note of frequency 8.0×10^{3} Hz is emitted in a certain gas, waves are produced of wavelength 4.0×10^{-2}m.

   What is the speed of sound in this gas, in m/s

   A 2.0×10^{5}

   B 3.2×10^{4}

   C 3.2×10^{2}

   D 2.0×10^{1}

   E 5.0×10^{-6}

3. When a **longitudinal** wave travels through a material, the particles in the material

   A move to and fro and travel along with the wave

   B move up and down across the direction of travel of the wave

   C move to and fro along the direction of travel of the wave

   D move up and down and travel along with the wave

   E move along with the wave only.

4. Which electromagnetic radiation has a frequency greater than visible light and less than X-rays?

A γ-rays

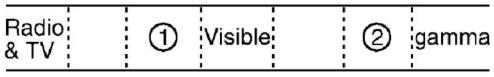
B ultra violet

C infra red

D microwaves

E radiowaves

5. The diagram shows the main regions of the electromagnetic spectrum. Not all of the regions have been identified. What are the regions 1 and 2?



	1	2
A	microwaves	ultra violet
B	infra red	X rays
C	ultra violet	infra red
D	X rays	infra red
E	ultra violet	microwaves

6. Every 60 seconds five waves pass a boat on a loch, the average distance between wave crests being 18 m. What is the average speed of the waves?

A 216.0 m/s

B 90.0 m/s

C 16.7 m/s

D 3.6 m/s

E 1.5 m/s

7. Which of the following phrases describes the frequency of a water wave?

A the maximum distance a particle of the water is displaced from its mean position

B the number of troughs passing any point in 1 second

C the time taken for 1 cycle of the wave to pass any point

D the distance travelled by a crest in 1 second

E the time taken for the source to make 1 complete vibration

8. Which of the following describes the *period* of a wave?

A the number of complete vibrations per second

B the time required for a complete vibration

C the maximum distance the wave is displaces from its rest position

D the distance travelled by a trough every second

E the distance from crest to trough

9. A trawler using an echo sounder detects a shoal of fish. If the note from the echo sounder is received 0.2 s after it was sent, how deep is the shoal of fish? (The speed of sound in the water is 1400 m/s).

A 140 m

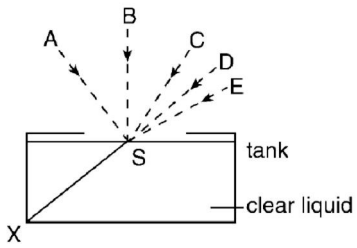
B 280 m

C 560 m

D 7 000 m

E 14 000 m

10. A tank contains a clear liquid. An engineer wishes to inspect the bottom of the tank at point X by shining a spotlight on it.



In which direction should she point her spotlight?

A AS

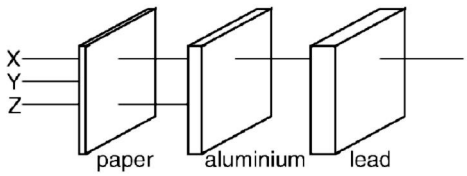
B BS

C CS

D DS

E ES

11. A physics book illustrates the passage through matter of the radiations from a radioactive source by means of a diagram as shown. During printing of the book the labelling of the radiation X, Y and Z is omitted.



Which of the following correctly identifies the radiations?

	RADIATION X	RADIATION Y	RADIATION Z
A	alpha	beta	gamma
B	gamma	alpha	beta
C	beta	gamma	alpha
D	gamma	beta	alpha
E	alpha	gamma	beta

12. A radioactive substance has a half life of 2 hours. If it were possible to watch one particular nucleus, and the time until it decayed, what would be observed?

A it would decay at the end of 1 hour

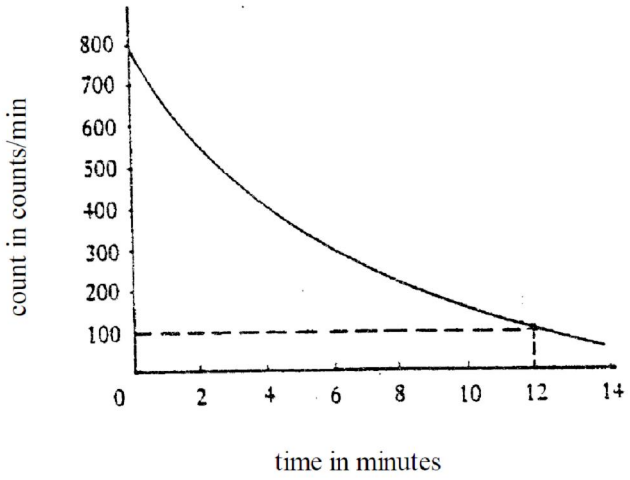
B it would decay at the end of 2 hours

C it would decay at the end of 4 hours

D it would decay sometime during the first 4 hours

E we could never predict when it would decay.

13. The graph below shows the variation of count rate with time for a sample of radioactive material, after correction for background radiation.



The half life of the radioactive material is

A 3 minutes

B 4 minutes

C 6 minutes

D 10 minutes

E 12 minutes

14. . A radioactive source is placed near a detector, and a large count rate is recorded. A thin sheet of paper is placed between the source and the detector, and the count rate is seen to fall to about half its original value. The sheet of paper is now replaced by a sheet of aluminium which is 1 cm thick, and no appreciable change in the count-rate is noted. The radiation coming from source is most likely to be

A a mixture of α, β and γ

B α and β only

C α and γ only

D β and γ only

E β only

15. A student made the following statements about a chain reaction.

I. A chain reaction can occur in nuclear fission

II. In a chain reaction one neutron is absorbed and three neutrons can be produced

III. In a chain reaction the energy used is greater than the energy produced.

Which of the following statements is/are true?

A I only

B II only

C I and II only

D I and III only

E I, II and III

16. In an experiment to measure the half life of a radioactive isotope in a place where the background count rate was 20 counts per minute the following results were recorded:

Time from start in minutes	0	2	4	6	8	10	12
Total count rate in counts per minute	116	96	80	69	58	50	44

The half life is approximately

A 4 minutes

B 6 minutes

C 8 minutes

D 10 minutes

E 12 minutes

17. A radioactive substance has a half life of 1 minute. How long does it take for the activity of a sample of this substance to fall to one-sixteenth of its original value?

A 2 minutes

B 3 minutes

C 4 minutes

D 8 minutes

E 16 minutes

18. Which of the following is the unit of dose equivalent?

A becquerel

B sievert

C gray

D watt

E joule

19. What is the frequency of a wave, if 20 crests pass a point in two seconds?

A 0·1 hertz

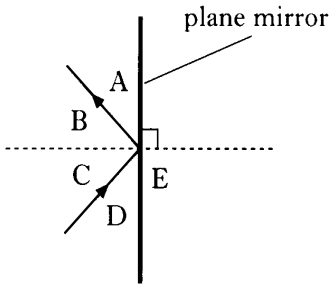
B 2 hertz

C 10 hertz

D 20 hertz

E 40 hertz

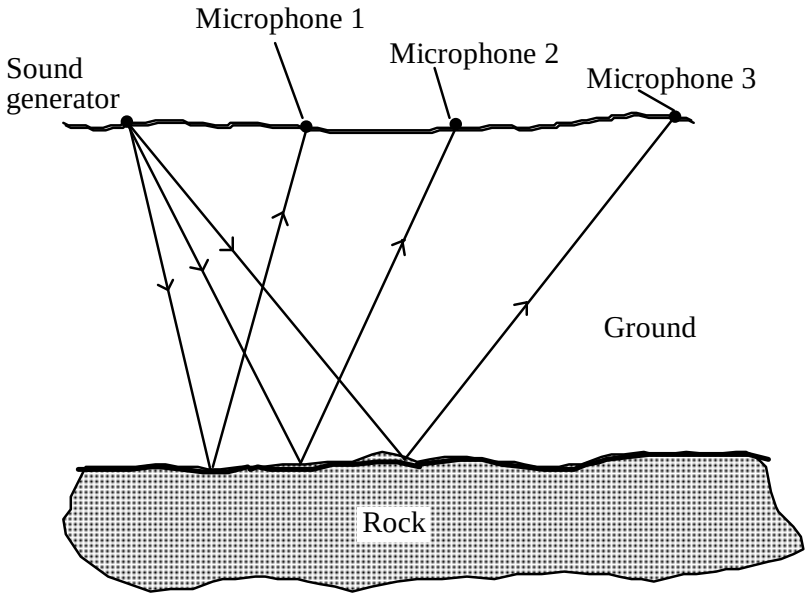
20. The diagram shows a ray of light reflected from a plane mirror.



Which of the labelled angles is the angle of reflection?

21. Geologists use sound waves to help them to find out where oil is trapped under the ground. Pulses of sound waves from a generator are directed into the ground and are reflected from the layers of rock below. Microphones on the surface then detect the reflected sound.

22



The speed of the sound pulses through the ground is 1800 m/s.

a) Which microphone will detect the reflected sound first? Explain your answer 2

b) Microphone 1 detects the reflected sound after 0.45 seconds.
What distance did the sound pulse have to travel through the ground? 3

c) The sound pulses will also travel through the air directly to the microphones at a speed of 340 m/s. Microphone 3 detects both the sound that travelled through the air and the reflected sound 0.8 seconds after the sound pulse was generated. What additional distance did the sound have to travel through the ground compared to through the air? 4

(9)

22. A crop scientist wishes to measure how effectively a new variety of wheat extracts minerals from fertiliser. To do this she adds a small amount of radioactive mineral to the fertiliser. She then measures the level of radioactivity from the wheat over a period of two weeks.

27

Three different types of radioactive material were available for use by the scientist.

Radioactive Mineral	Radiation	Half-life
A	α	5 days
B	β	?
C	γ	6 days

a) The scientist chose material C. Explain why this was the most suitable to choose from those that were available. 2

b) State two precautions the scientist should take when handling the radioactive material in the laboratory. 2

c) The initial activity of radioactive material C was 2400 kBq.
What was the level of activity after 24 days? 2

d) Material B started with an activity of 6000 kBq. After one day, the activity is measured at 750 kBq. What is the half-life of Material B? 4

(10)

23. Three types of radiation are α-particles, β-particles and γ-radiation. Each type of radiation has a different range in air, different ionisation properties and uses.

28

a) List the three types of radiation in order of their range in air from the radiation with the longest range to the radiation with the shortest range. 1

b) What is an α-particle? 1

c) Describe what is meant by *ionisation*. 2

d) Which types of radiation are not suitable for use as a tracer in the human body. Explain your answer. 2

e) Apart from being used as a tracer, describe one other use of radiation in medicine. 2

(8)

24. Radiation is used in hospitals for the treatment of cancer. During the treatment care is taken to ensure that healthy tissue is not exposed to too much radiation. Too much exposure could be harmful. The risk of harm to tissue depends on the absorbed dose.

29

a) What is meant by absorbed dose and in what unit is it measured? 2

b) State one other factor which affects the risk of harm from radiation. 1

c) A patient receives a dose equivalent of 500 µSv. The radiation weighting factor of the radiation is 6. What is the absorbed dose? 3

d) Hospital staff who work with radiation take precautions to ensure that they are not exposed to too much radiation.

(i) State two precautions that could be taken to limit the amount of exposure to radiation. 2

(ii) Staff wear film badges to monitor the level of radiation to which they have been exposed. Explain how the badges allow this monitoring to be carried out. 2

(10)

25. a) The table below gives some information on the quantities and units associated with radiation.
31

Quantity	Unit
Absorbed Dose	
	sievert (Sv)

Complete the table 2

b) A technician is working with two radioactive sources, A and B.
Source A has a half-life of 2 hours and source B has a half-life of 2.5 hours.

(i) What is the meaning of the term half-life? 1

(ii) At a certain time each source has an activity of 800 kBq.
What is the total activity of the two sources 10 hours later? 5

(iii) State two procedures the technician should use to reduce his exposure to the radiation from the sources while he is working with them. 2

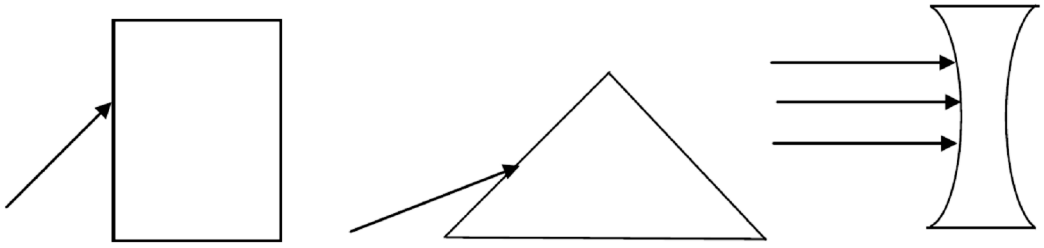
(10)

26. Materials X and Y are radioactive and their respective half-lives are 20 minutes and 30 minutes. At the start of an experiment the activity of material X is 8 000 Bq while the activity of Y is 2 000 Bq.
U
c5 How much time will elapse, from the start of the experiment, before the activities of materials X and Y are equal? What is the value of the activity at this time? 6

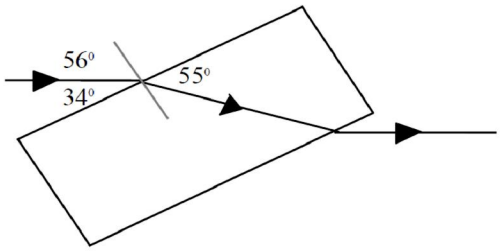
27. Four pupils were asked to find out as much as they could about the refraction of light and the use of lenses.

U

c2 a) Jane shone rays of light through different perspex shapes.
Complete the diagrams below to show her results. 3



b) Robert shone a ray of light through a rectangular glass block. He sketched the path of the ray through the block and measured three angles. The diagram below shows the measurements he made.



i What is the line drawn at right angles to the surface of the glass block called? 1

ii What size is the angle of incidence? 1

iii What size is the angle of refraction? 1

(6)

28. Read the passage below and use it to answer the questions that follow.

U

c3 The sun is a star 150 x 10^6 km from Earth which produces enormous amounts of energy in the form of electromagnetic waves. We can detect the visible light from the sun with our eyes but we cannot detect the invisible ultraviolet light which also reaches Earth. Exposure to the ultraviolet light from the sun can produce a change in the colouring of the skin which we call a sun tan.

There are three types of ultraviolet radiation. We are constantly exposed to UVA and we need this for healthy growth and to make vitamin D in our bodies. UVA light has wavelengths in the range 315 to 400 nm. UVB light has wavelengths in the range 280 to 315 nm. Most of the UVB light from the sun is removed by the layer of ozone in the atmosphere around the Earth. Scientists have found that there is a hole in the ozone layer which is allowing more UVB to reach us on the surface of the earth. UVB can cause a skin cancer called melanoma. The third type of UV light, with wavelengths in the range 200 to 280 nm, is called UVC.

a) Calculate how long it takes for ultraviolet light to travel from the sun to Earth. 3

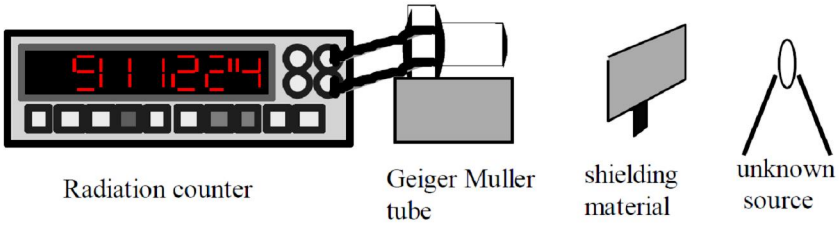
b) Calculate the frequency of the shortest wavelength UVC light. 3

c) What type of UV light has a frequency of 7•5 x 10^{14} Hz? 4

(10)

29. A medical physicist carries out a shielding experiment to find out what kind of radiation is being emitted by unknown sources X and Y.
He sets up the following apparatus and record the results shown below.

U
c4



Source	Initial count	Paper shield count	Aluminium shield count	Thick Lead shield count
X	4 200	4 200	4 200	5
Y	3 800	5	5	5

a) What kind of radiation is each source emitting? Explain your answer. 4

b) What effect would sources X and Y have on photographic film? 1

The physicist thinks source X would be best to use as a radioactive tracer but has to ensure it has a suitably short half-life.

c) Why is source X better than source Y as a radioactive tracer? 1

d) Why is it important to ensure the source has a short half-life? 1

She carries out an experiment to determine the half-life of source X and finds that the count rate falls from 3 200 Bq to 200 Bq in 3 hours.

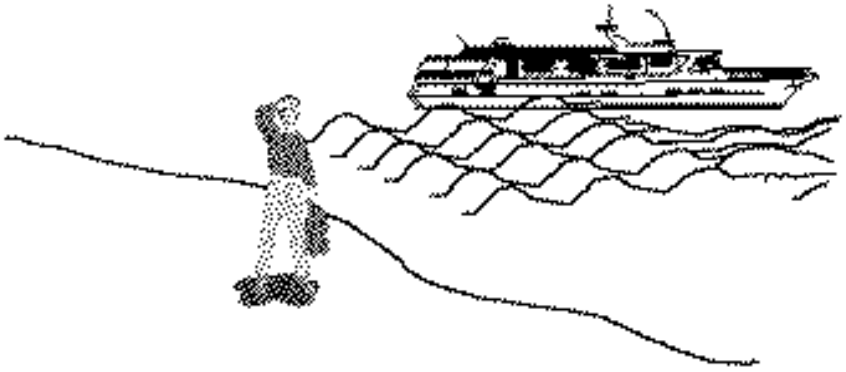
e) Calculate the half-life of the source. 3

f) What would the activity of the source be after 6 hours? 2

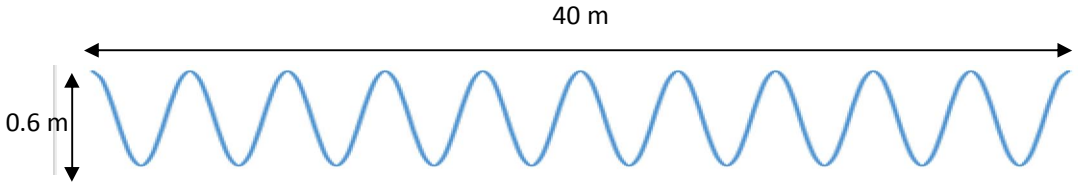
(12)

30. A schoolboy, who is studying waves in school, decides to put some theory into practice. He stands at the edge of a loch, near a harbour, and waits for a large car ferry to pass by on its way out of the loch. The boy has a stop clock and a metre stick for his investigation.

U
c2



As the car ferry passes by it creates large waves, which the boy draws as shown below. The waves take 20 seconds to create, and the first wave takes 10 seconds to reach the shore.



a) What is the amplitude of the waves? 1

b) What was the frequency of the waves produced by the car ferry? 3

c) What was the wavelength of the waves produced by the car ferry? 3

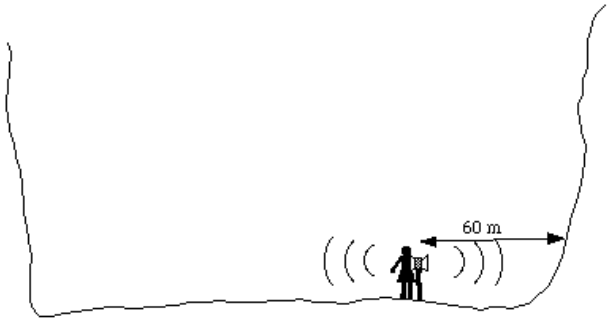
d) Calculate the speed of the waves. 3

(10)

31. A scientist is testing some sonar equipment in a valley.

u

c3



The equipment operates at 40 kHz, giving a wavelength in air of 0•83 cm, and consists of an ultrasound transmitter / receiver and a sensitive timing device. There are two horns on the transmitter which direct the ultrasound in two opposite directions, as shown above.

The scientist positions the equipment 60 m from the nearby valley wall and transmits a pulse of ultrasound. The time between transmission and detection of each pulse echo is then displayed on the timer.

a) Calculate the speed of sound in the valley. 3

b) What time elapsed, after transmission, before the first echo was detected? 4

c) The second echo was detected at a time of 0•6 seconds after transmission. What was the distance between the scientist and the faraway valley wall? 4

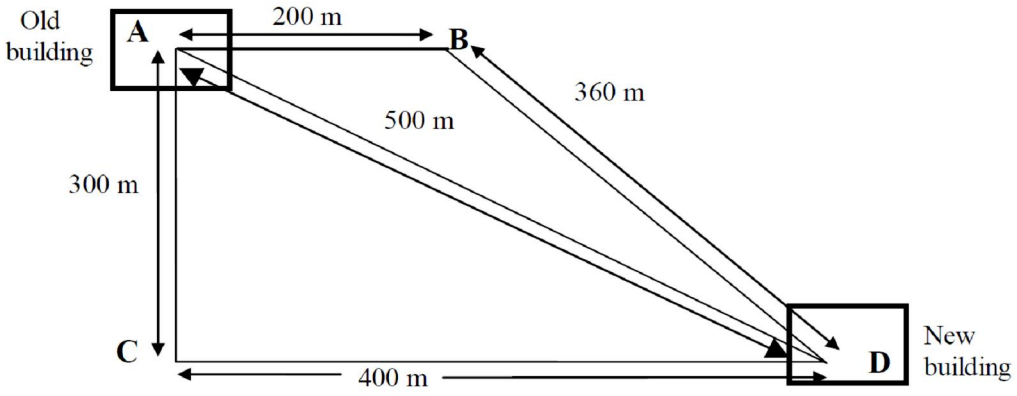
(11)

32. A high street bank decides to extend their premises and move into a second building near their main branch. In order to pass information from one building to the other they lay fibre optic cables to link them. The most cost effective way to do this is to lay the cables along existing pathways.

u

The map below shows the different ways the cable could be laid.

c4



a) Along which route should the cable be laid to ensure that data is passed as quickly as possible? Why?(Use the letters on the diagram) 2

b) If the speed of light along the cables is 2×10^8 m/s, calculate the time delay between sending and receiving the information along this route. 3

c) If the frequency of the light used is 5×10^{14} Hz, what is the period of the waves? 3

(8)

DATA SHEET

Speed of light in materials

Material	*Speed* in $m\,s^{-1}$
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in $N\,kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in $J\,kg^{-1}$
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
Water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in $J\,kg^{-1}$
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed* in $m\,s^{-1}$
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in $J\,kg^{-1}\,°C^{-1}$
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3

$$E_p = mgh$$

$$E_k = \tfrac{1}{2}mv^2$$

$$Q = It$$

$$V = IR$$

$$R_T = R_1 + R_2 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_s$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$P = \frac{E}{t}$$

$$P = IV$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$E_h = cm\Delta T$$

$$p = \frac{F}{A}$$

$$\frac{pV}{T} = \text{constant}$$

$$p_1V_1 = p_2V_2$$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$d = vt$$

$$v = f\lambda$$

$$T = \frac{1}{f}$$

$$A = \frac{N}{t}$$

$$D = \frac{E}{m}$$

$$H = Dw_R$$

$$\dot{H} = \frac{H}{t}$$

$$s = vt$$

$$d = \overline{v}t$$

$$s = \overline{v}t$$

$$a = \frac{v-u}{t}$$

$$W = mg$$

$$F = ma$$

$$E_w = Fd$$

$$E_h = ml$$