Physics
Course Questions
Intermediate 2

5963

Autumn 1999

HIGHER STILL

Physics

Course Questions
Intermediate 2

Support Materials

The Higher Still Development Programme gratefully acknowledges permission granted by the Scottish Qualifications Authority for use of questions from past examination papers.

Every attempt has been made to trace copyright owners. The Higher Still Development Programme apologises for any omission which, if notified, it will be pleased to rectify at the earliest opportunity.

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from the reproduction and that, if reproduced in part, the source is acknowledged.

First published 1999

Higher Still Development Unit
PO Box 12754
Ladywell House
Ladywell Road
Edinburgh
EH12 7YH

INTERMEDIATE 2 PHYSICS

Introduction

Course assessment will require candidates to respond to questions which integrate the work studied across the component units as well as to questions which are less structured and set in less familiar and more complex contexts (Intermediate 2 Physics, National Course Specification).

A unit assessment in Intermediate 2 Physics contains questions designed to assess achievement of the performance criteria associated with that unit and is not intended to grade or rank the candidates. The course assessment *is* designed to grade, hence certain questions, or parts of questions, are designed to assess the attainment of the candidate against the Grade Descriptions for the award at 'A'.

Generating evidence for estimates of performance and for appeals

The unit assessments cannot be used on their own to provide an estimate of performance or as evidence for appeals. Course type questions are required for these purposes. These questions must emulate the demands of the external course assessment. This pack provides examples of this type of question. Past paper questions and the questions provided in the specimen question paper are other sources.

A prelim paper attempted after the completion of two units can provide useful evidence for appeals. Such a paper might reflect the format and duration of the final examination paper and provide useful practice of examination technique. For this paper to be a suitable basis on which to submit an appeal, it must be able to persuade the Principal Assessor that it:

- has not been seen by the candidate
- offers a suitable level of demand
- allows for a demonstration of the criteria associated with the Grade descriptions for the "C" and "A" awards.

Although the paper can contain questions which are in the public domain, it should also include questions from other sources. It is not intended that all staff across Scotland should construct new questions when there are valid past paper questions available from previous years. However the use of a complete paper e.g. that of the previous year or so, is unlikely to prove acceptable to SQA in that there is a high probability that the candidate *has seen* these questions.

A prelim paper consisting of a variety of questions of suitable demand from a range of sources should be set. The paper should include questions which require candidates to integrate across at least two units. Such a prelim would to be supplemented by evidence of attainment in the remaining unit, e.g. by a short test of course type questions on that unit.

Although the prelim is a preferred method in many centres, this is not a requirement of SQA and a number of appropriate shorter tests of suitable demand is a possible alternative.

The questions

The questions in this pack allow opportunity to demonstrate attainment of the criteria associated with the A award. The time allocation for a test can be estimated by allowing for 25 marks per half hour. Some objective questions have been included.

Solutions and marking scheme

Brief solutions to all questions have been provided at the end of this pack. These solutions are designed to be of assistance to staff in marking the students scripts.

The general instructions for markers issued by SQA in 1999 should be used as a basis of awarding marks. Comments have been made to assist marking and highlight specific points.

For questions involving calculations where two marks are allocated, the following general rule for the award of partial marks should be applied:

{½} for the formula, **{½}** for substitution,

{½}for value of the answer and **{½}** for the unit, given with the correct value.

For example, in question 1 (a)

the candidate would be awarded full marks for an answer of 240 N

the candidate would be awarded partial marks of:

½ for a statement of the formula F = ma

½ for the substitution F = 60 x 4

and 1 for the answer 240 N [½ deducted if the unit is incorrect]

In some cases alternative methods of responding to the question have been identified. Where a question involving a calculation has more than two marks allocated, comment is provided to assist in awarding marks.

For questions calling for a description or an explanation, a brief solution has been provided. Professional judgement should be applied in giving credit for alternative correct answers.

Credit should be given for correct physics. Wrong physics is always penalised.

1. In a 100m sprint, a sprinter accelerates from rest at 4 m/s^2. The sprinter has a mass of 60 kg. The sprinter reaches maximum speed after 2.5 seconds and keeps running at this speed for the rest of the 100 m sprint.

(a) Calculate the force required to produce the acceleration. 2

(b) What is the maximum speed of the sprinter? 2

(c) Show that the sprinter travels 12.5 m *while accelerating*. 2

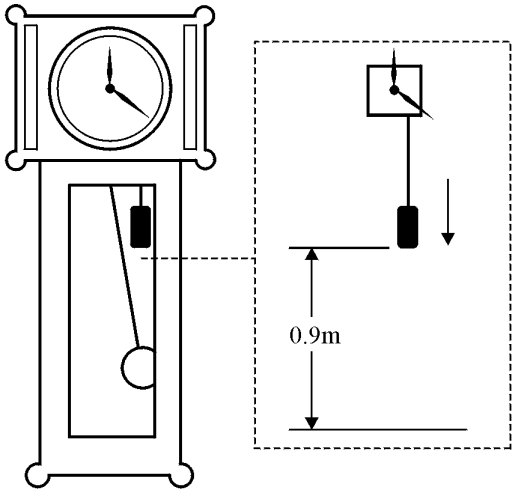
(d) How long will it take a sprinter to cover the 100 m ? 3

(e) Draw a graph, with numerical values on both axes, showing how the sprinter's speed varies with time for the 100 m sprint. 2

(f) The other sprinters in the race each start in a different lane. The sprinters nearest to the starting gun have a slight advantage in that they hear the starting gun a fraction of a second before the other sprinters. Describe one method which could be used to make sure that every sprinter hears the starting gun at the same time. 1

(12)

2. In a grandfather clock as shown below, the gravitational potential energy that has been supplied to a 14 kg mass provides the energy for the clock mechanism.
   The mass can travel downwards a maximum distance of 0.9 m.

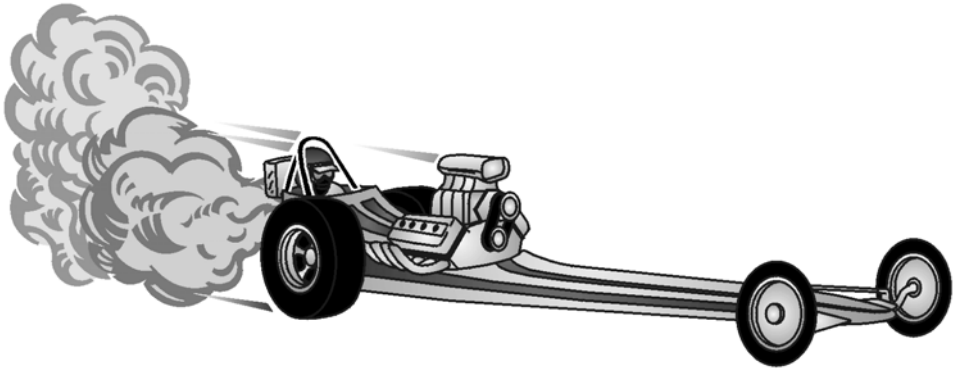


(a) Show that the initial gravitational potential energy supplied to the mass when it is at its highest position is 126 J. 2

(b) Only 48 J of the gravitational potential energy supplied to the mass is transferred to the clock mechanism. Calculate the efficiency of the grandfather clock. 2

(c) 48 J of energy is sufficient to keep the clock mechanism working for 4 days.
Calculate the power required by the clock mechanism. 3
(7)

3. A dragster racing car of mass 800 kg travels in a straight line and accelerates uniformly from rest to 90 m/s in 5 s. Then it comes to a halt in a further 5 s by using its brakes and a parachute. During the first 5 s when it is accelerating it uses 90 kg of fuel.



(a) Draw a graph, with numerical values on both axes, showing how the speed of the dragster varies with time for the entire journey. 2

(b) Calculate :

(i) The total distance travelled by the dragster.

(ii) The acceleration during the first 5 seconds.

(iii) The unbalanced force produced by the parachute and brakes. 7

(c) In practice, the acceleration is unlikely to be constant during the first 5 seconds. State what is likely to happen to the acceleration. Give a reason for your answer. 1

(10)

4. An astronaut on a planet drops an object. The object falls freely and reaches a speed of 3.5 m/s after 0.5 s.

   (a) Calculate the gravitational field strength of the planet. 2

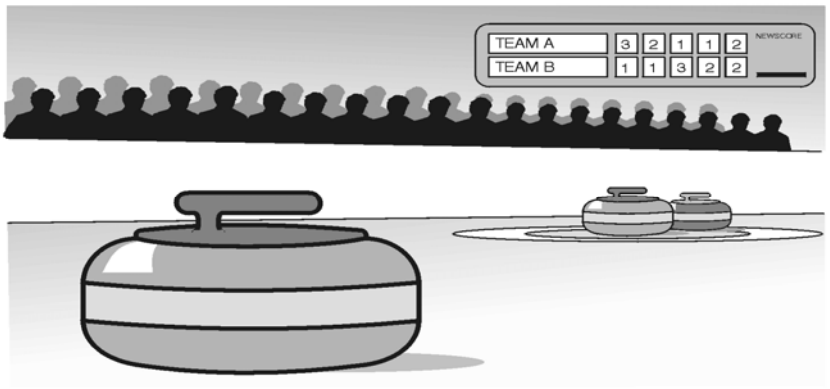
   (b) The mass of the object is 250 g. What is the weight of the object? 2

   (c) What is the weight of the object when falling freely? 1

   (d) During the return journey to Earth, the gravitational field strength becomes zero. Describe what happens when the astronaut lets go of an object he is holding. 1

(6)

5. At an ice-rink, a curling stone of mass 19.3 kg is released with a velocity of 1.2 m/s. The stone slides a distance of 29 m before colliding with another identical curling stone.



(a) A frictional force of 0.2 N acts on the curling stone as it slides down the ice. How much kinetic energy does the curling stone lose in travelling the 29 m? 3

(b) Calculate the speed of the curling stone just before it strikes the other stone. 3

(c) An electronic scoreboard in the ice-rink is made up of 400 LEDs. Each LED is rated at 2 V d.c. with a current of 65 mA.

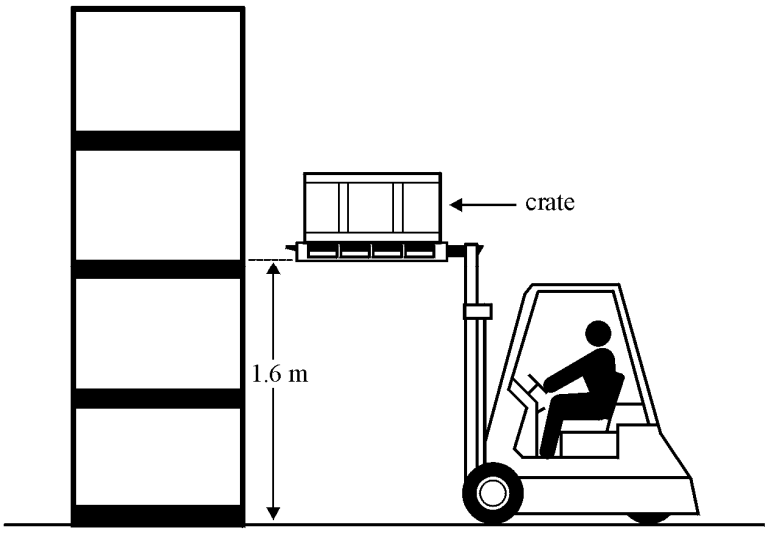
(i) Sketch a suitable circuit diagram for *one* LED which shows how a resistor and the LED would be connected so that the LED operates at its rated voltage and current when connected to a 12 V d.c. supply.

(ii) Calculate the resistance of the resistor used in the circuit diagram for part (i).

(iii) Calculate the total current drawn from the 12 V d.c. supply when every LED on the scoreboard is lit, and hence calculate the *total power* of the scoreboard. 6

(12)

6. A fork lift truck moves a crate of mass 150 kg in a warehouse. The crate is lifted vertically a distance of 1.6 m at a constant speed.



(a)	Calculate the gain in potential energy of the crate after it has been raised.	2
(b)	During the lifting of the crate, the power of the motor in the fork lift truck is 400 W. The efficiency of the fork lift truck during this operation is 60%. How long does this lifting operation take?	3
(c)	A 65 V battery is used to drive the 400 W motor. What is the current in the motor?	2
		(7)

7. A railway engine has a mass of 120 000 kg. The engine accelerates from rest to a speed of 30 m/s in a time of 5 minutes.

(a) Calculate the acceleration of the engine. 2

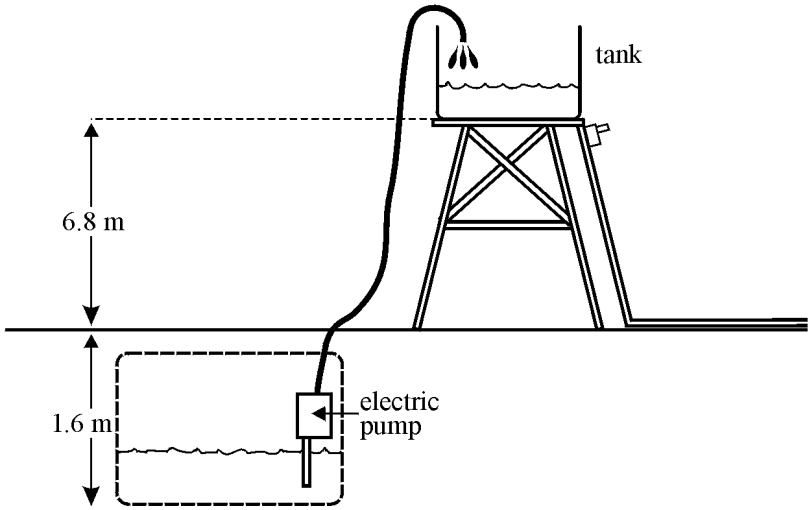
(b) Calculate the kinetic energy of the engine travelling at 30 m/s. 2

(c) On a dry day, the engine travelling at 30 m/s brakes to a halt in a distance of 500 m. Calculate the braking force. 2

(d) During another journey the rails are wet. Describe what effect this might have on the braking distance of the engine when it is travelling at 30 m/s. 1

(7)

8. A crop irrigation scheme has an electric pump which pumps water from an underground spring up to a water tank mounted on stilts, as shown in the diagram.



When the water tank is full, the water is released and flows down a pipe to the field beside it.

(a) Which is the correct ending to the following statement?
In moving from the underground spring to the field, the gravitational potential energy of the water *increases/decreases/stays the same*? 1

(b) Using the measurements shown on the diagram, calculate the potential energy gained by120 kg of water as it is pumped up to the tank. 2

(c) The electric pump takes 6 minutes to pump the 120 kg of water when connected across a 12 V d.c. supply. A current of 7.5 A is drawn from the supply.
Calculate the energy used by the motor in the 6 minutes. 3

(d) Calculate the efficiency of pump. 2

(e) Explain why the efficiency of the pump is less than 100%. 1
(9)

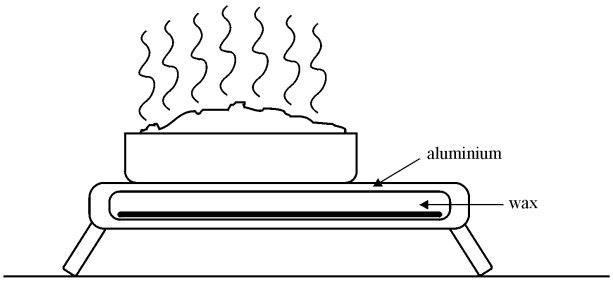
9. A cyclist pedals the 'training bicycle' in a fitness room at a steady speed of 2.4 m/s against a constant frictional force of 80 N provided by brake pads.

(a) A digital readout indicates the distance the training bicycle would travel if it could move. Calculate the reading on this digital readout after 4 minutes of cycling. 2

(b) Calculate the energy used by the cyclist in 4 minutes. 2

(c) The temperature of the brake pads rises from 20 °C to 42 °C during this time.
The total mass of the brake pads is 2 kg.
Calculate the specific heat capacity of the brake pad material. 3
(7)

10. The food on a table in a restaurant is kept hot by placing the dishes on a hot metal tray. Before the tray is brought to the table by the waiter, it is pre-heated. The pre-heating is carried out using an electrical heater rated at
200 W that is built in to the tray. The tray is hollow and contains 0.9 kg of solid wax as shown below.



The metal part of the tray is aluminium and has a mass of 0.8 kg.

(a) The temperature of the solid wax and the aluminium metal is raised from 18 °C to 42 °C by the heater. Show that the heat energy absorbed by the tray is 45 360 J. 3

(b) Assuming that no heat is lost to the surroundings during the pre-heating process, how long does it take the heater to raise the temperature of the tray from 18 °C to 42 °C? 2

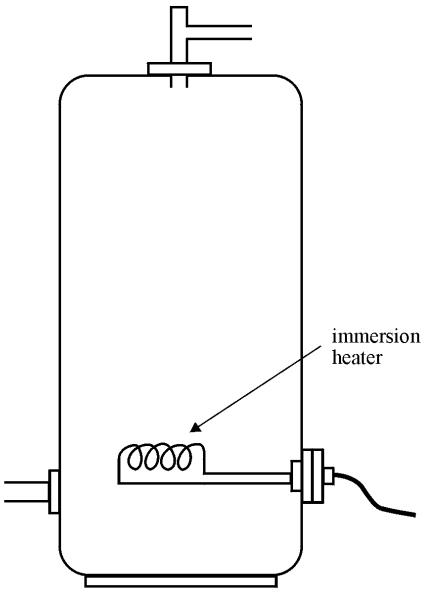
(c) The solid wax in the hollow part of the tray starts to melt at 42 °C. How long will it take the heater to melt all the wax? 2

(d) Draw a graph of temperature against time for the heating of the wax. Your graph should cover the period when the wax is at a temperature of 18 °C until the time when all the wax has melted. 2

(e) Suggest a reason why melted wax is used in the tray. 1
(10)

Specific heat capacity of aluminium = 900 J/kg °C Specific heat capacity of wax = 1300 J/kg °C Specific latent heat of fusion of wax = J/kg °C

11. A hot water system consists of a tank containing 5000 kg of water which is heated by an immersion heater.



(a) How much energy must the immersion heater supply to heat the water from 12 °C to 34 °C? (You may neglect heat losses to the surroundings.) 2

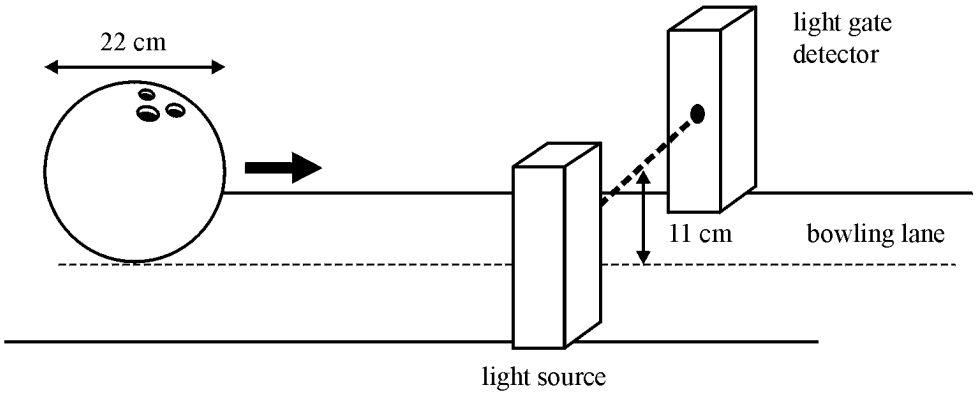
(b) The power of the immersion heater is 8000 W. How long will it take supply to heat the water from 12 °C to 34 °C? 2

(c) Which is the correct ending to the following statement?
The immersion heater is connected to a 230 V a.c. supply and should be protected by a fuse rated at *10 A/ 20 A/ 40 A*? 2

(d) Describe one method of reducing heat losses from the tank to the surroundings. 1
(7)

Specific heat capacity of water = 4200 J/kg °C

12. A light gate is used to measure the instantaneous speed of a bowling ball at the end of a ten-pin bowling lane. The diameter of the bowling ball is 22 cm. The ball passes through a light beam that is positioned 11 cm above the bowling lane.

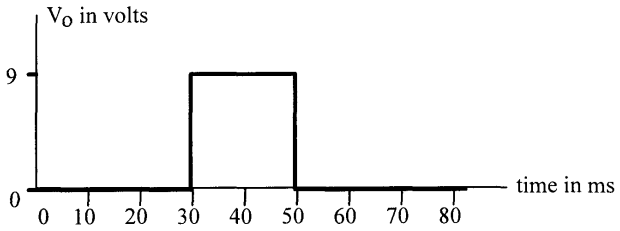


The circuit for the light gate detector is given below. When the light source is shining on the L.D.R in the detector circuit, the resistance of the L.D.R. is 140 Ω. .

(a) Calculate the output voltage, V_o, of the detector circuit when the light source is shining on the L.D.R. 2

(b) What will happen to the output voltage, V_o, when the ball passes through the light beam? Explain your answer. 3

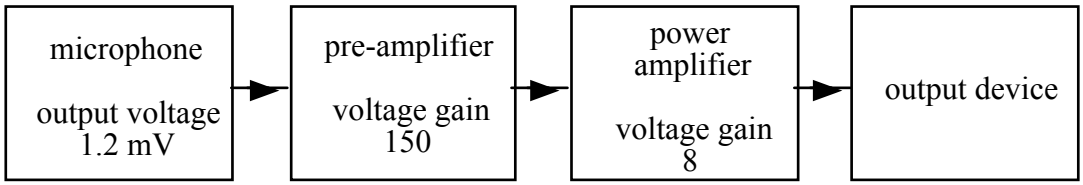
(c) The output voltage from the light gate circuit is plotted as a graph of voltage against time using a computer. The graph obtained is shown below.



Calculate the instantaneous speed of the ball as it passes the light gate. 3

(8)

13. A medical physicist designs an electronic stethoscope which uses a pre-amplifier and a power amplifier as shown in the block diagram below.



The pre-amplifier has a voltage gain of 150 and the power amplifier has a voltage gain of 8. The microphone has an output voltage of 1.2 mV

(a) What energy change takes place in the microphone? 1

(b) Name a suitable output device for the stethoscope system. 1

(c) The power amplifier uses an n-channel enhancement MOSFET. Draw the circuit diagram symbol for an n-channel enhancement MOSFET. 1

(d) The output voltage of the microphone is 1.2 mV. Calculate the output voltage of the power amplifier. 3

(e) (i) The microphone detects a sound of frequency of 230 Hz. What frequency will be heard by the person using the stethoscope?

(ii) What is the wavelength of this sound in air? 3

(9)

Speed of sound in air = 340 m/s

14. A small kettle is designed to operate from a 12 V car battery. The kettle draws a current of 20 A when it is operating normally. The kettle takes 3 minutes to heat a cupful of water from 20 °C to 100 °C.

(a) (i) The kettle has an on/off switch and is connected to a socket in the car. The kettle can only be switched on when the car's ignition switch is on.

Draw a labelled circuit diagram showing the car battery, ignition switch, kettle switch and kettle heater element.
The circuit diagram symbol for a heater element is shown below.

(ii) Calculate the power rating of the kettle.

(iii) Show that the energy supplied by the kettle in the 3 minutes is 43200 J.

(iv) Calculate the mass of water heated by the kettle.
State any assumption you make. 9

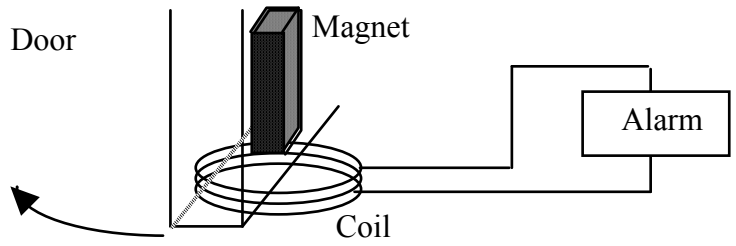
(b) A second identical kettle is connected so that it is in parallel with the first.

What total current would now be drawn from the battery? 1

(10)

Specific heat capacity of water = 4200 J/kg °C

15. A DIY enthusiast designs a burglar alarm system. A magnet is hidden in the edge of a door. A coil of wire is hidden under the floor so that it lies below the magnet when the door is closed. When a large enough voltage is induced in the coil the burglar alarm is activated.



(a) Under which of the following conditions will a voltage be induced?

(i) door left closed

(ii) door being opened

(iii) door left open

(iv) door being closed. 2

(b) Without tampering with the magnet or the coil, how could the door be opened with very little voltage being induced in the coil? 1

(c) The DIY enthusiast notices that the alarm is activated whenever the cooker is switched on or off. The cause is traced to a cable supplying the cooker, under the floor near the coil.

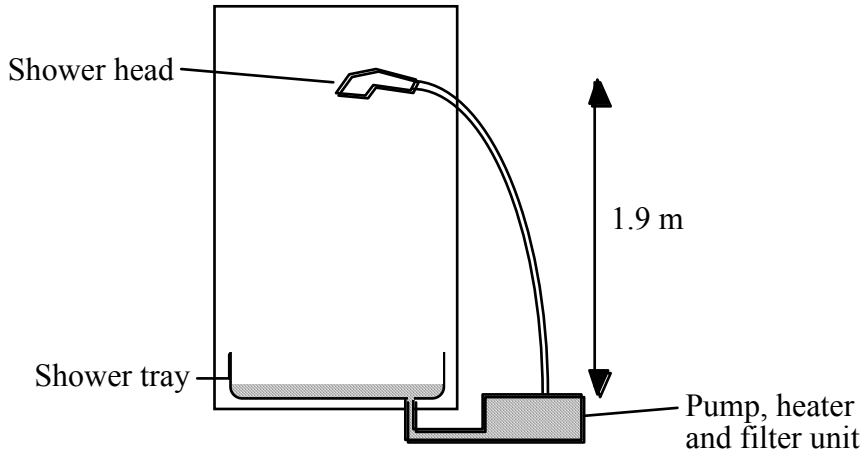
(i) Explain why the cooker cable could induce voltages in the detector

(ii) An optical fibre telephone line is close to the coil but does not cause any false alarms. Explain why the telephone line does not cause the alarm to be activated. 4

(d) When the alarm is activated a current of 53 μA is produced in the coil for 470 ms. Calculate the charge transferred in the alarm system. 2

(9)

16. A shower unit as shown below is designed for use where water is in short supply. The shower water is recycled in the pump and filter unit.



The water is filtered and pumped up to the shower head by an electrical pump. The shower water is heated by a heating element in the unit.

(a) Water is pumped up 1.9 m to the shower head by the pump motor which has an efficiency of 3%. The water in the tray has a temperature of 25 °C and must be heated to 35 °C by the heating element. The shower recycles 20 g of water every second. Calculate:

(i) the gravitational potential energy gained by the water each second,

(ii) the electrical energy used by the pump each second,

(iii) the heat energy supplied by the heater each second,

(iv) the total power supplied to the shower unit,

(v) the current used by the unit when connected to a 230 V supply. 10

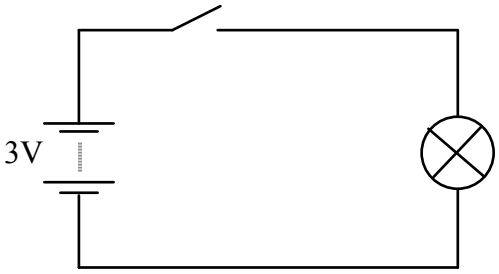
(b) The pump develops a fault and only pumps 15 g of water per but the heater continues to work as before. What effect does this have on the temperature of the water coming out of the shower head. You must explain your answer. 2

(12)

Specific heat capacity of water = 4200 J/kg °C Gravitational field strength = 9.8 N/kg

17. A new cycle lamp design is proposed to replace an existing design.

(a) The existing design has a lamp of power rating 2.4 W supplied by a 3 V battery.

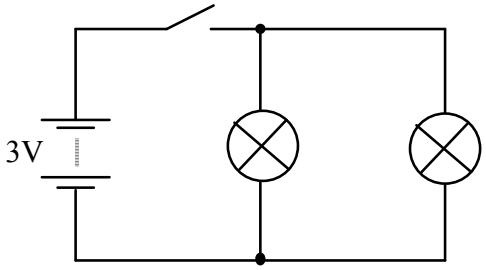


Circuit diagram of existing design

(i) Calculate the current drawn from the battery by the lamp. 2

(ii) Calculate the energy used by the lamp in 35 minutes. 2

(b) The new design has two lamps, each with an output power of 2.4 W connected in parallel across a similar 3 V battery. The battery can supply a charge of 4.1×10^4 C.



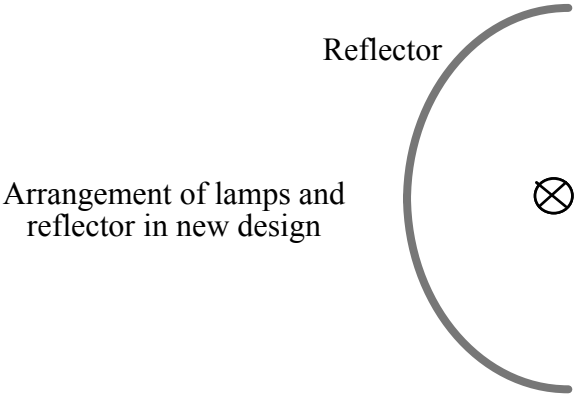
Circuit diagram of new design

(i) Calculate the current drawn from the battery by the lamps in the new design. 1

(ii) For how long will the new design operate before the battery is discharged? 2

(iii) Explain fully one advantage of using two lamps in the new design compared to the single lamp in the existing design. 2

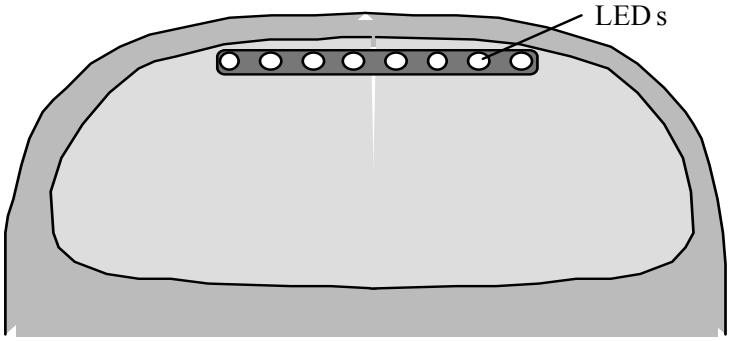
(c) Each lamp is placed at the focus of a curved reflector.



Carefully draw four rays reflecting from the curved reflector to show how the light would be produced by one lamp in the new design. 2

(11)

18. A new brake lamp system is designed for the rear window of a car. The system uses red LED s in the middle of the rear window.



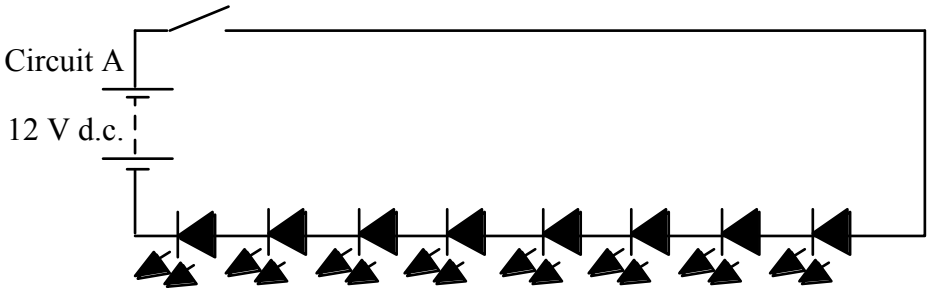
Two circuits, A and B, as shown below are proposed for the system. The switch in each circuit is closed when the brakes are applied.

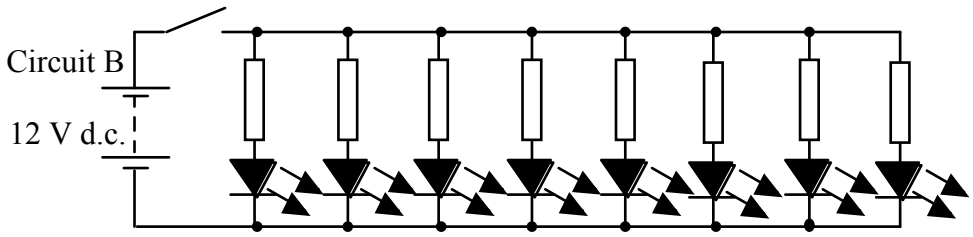
In each circuit the LEDs operate at their correct rating of 1.5 V and 30 mA.

(a) State one advantage of circuit B compared to circuit A. 1

(b) Why does circuit B provide a resistor in series with each LED? 1

(c) Calculate the current drawn from the battery in
(i) circuit A





(ii) circuit B. 2

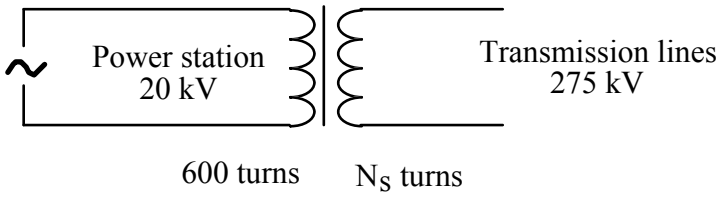
(d) Calculate the power consumed by one LED in circuit A. 2

(e) Calculate the resistance of one of the resistors in circuit B. 2

(f) Calculate the total power produced by the resistors of circuit B. 2

(10)

19. A hydroelectric power station generates power of 280 MW at a voltage of 20 kV. The output voltage is stepped up to 275 kV for power transmission across the national grid using a transformer with 600 turns on the primary coil. There are no power losses in the transformer.



(a) (i) Calculate the current produced by the power station in the 600 turn coil.

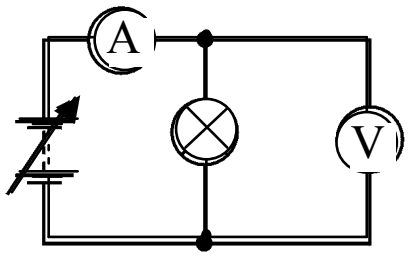
(ii) Calculate the number of turns in the secondary coil, N_S.

(iii) Show that the current in the secondary coil of the transformer is approximately 1018 A. 6

(b) The national grid uses aluminium cables for transmission lines. A 1 km length of aluminium cable has a resistance of 2 mΩ.
Calculate the power loss when there is a current of 1018 A in 34 km of cable. 3

(c) Describe the movement of electrons in the transmission lines. 1
(10)

20. A stage lighting engineer tests the operation of a lamp at different applied voltages. She measures the potential difference and current using the circuit below. The results obtained are shown in the table.



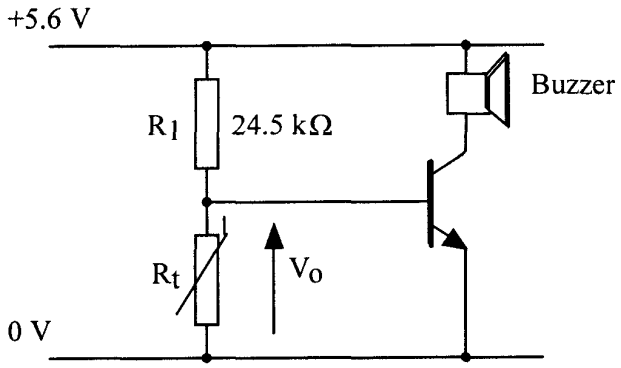
Potential difference (V)	Current (A)	Resistance (Ω)
10	2.30	
15	2.50	
20	2.85	
25	3.25	
30	3.75	

(a) Using squared paper draw a line graph showing how the *resistance* of the lamp varies with potential difference over the range 10 V to 30 V. 6

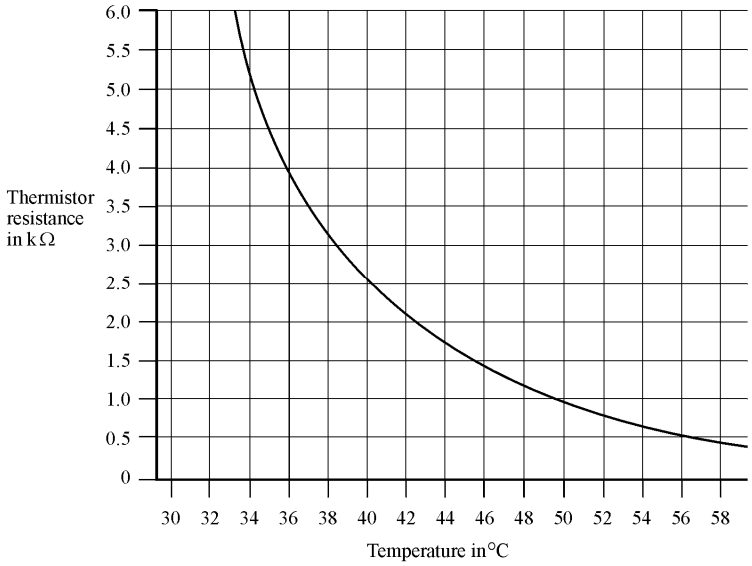
(b) The lamp is designed to run from a power supply of voltage 23 V. Using information from your graph show that the power of the lamp at 23 V is approximately 72 W 3

(9)

21. A circuit is designed to monitor the temperature of water in a tank. A warning buzzer switches on if the water temperature falls below 37 °C.



The transistor switches on if the voltage Vo is greater than + 0.7 V. The circuit uses a thermistor R_t with characteristics plotted below.



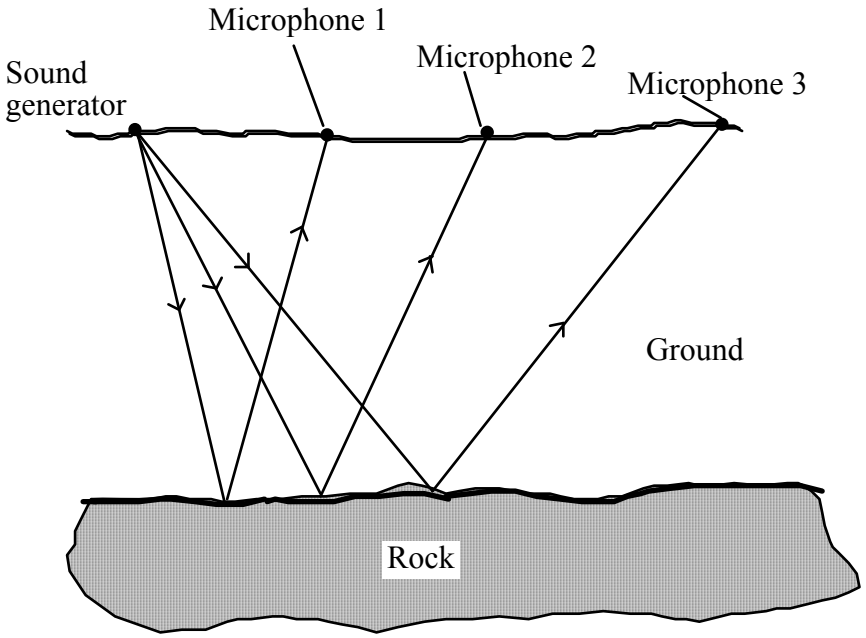
(a) Calculate the voltage across the thermistor V_o at 37 °C. 3

(b) Explain whether the buzzer will sound or not if the temperature rises above 37 °C. 2

(c) The same thermistor is used in a circuit with an n-channel enhancement MOSFET instead of the NPN transistor. The MOSFET switches on when V_o is 2.4 V or greater.
In order that the buzzer will still switch on at 37 °C, R_1 is adjusted from 24.5 kΩ to a new value. Calculate the new value of R_1. 3

(d) Draw a circuit diagram of this new circuit. 1
(9)

22. 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.



The diagram shows the path of some of the sound waves.

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

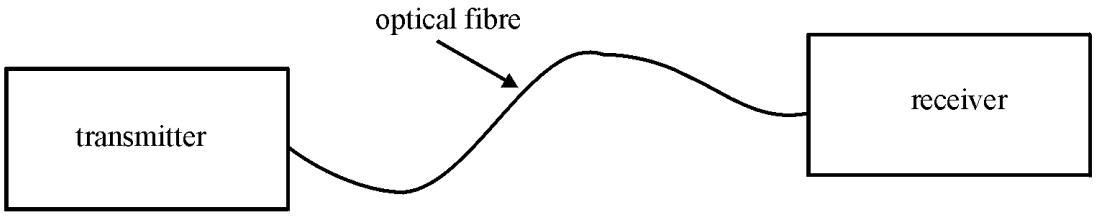
(a) Which microphone will detect the reflected sound first? Explain your answer. 2

(b) Microphone 1 detects the reflected sound after 0.45 seconds. What distance did the sound pulse have to travel through the ground? 2

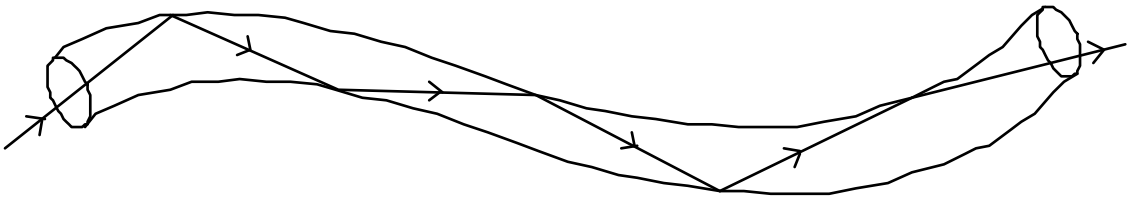
(c) The sound pulses will also travel through the air directly to the microphones at a speed of 340 m/s. Microphone 3 detects both the sound that travelled through the air and the reflected sound 0.8 seconds after the sound pulse was generated. What additional distance did the sound have to travel through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

(7)

23. In a telecommunication system, pulses of light are sent from a transmitter to a receiver using an optical fibre as shown.



An enlarged part of the optical fibre is shown in the diagram below. The path followed by light travelling down the optical fibre is shown in the diagram.



Light pulses travel along the optical fibre at a speed of 2×10^8 m/s.

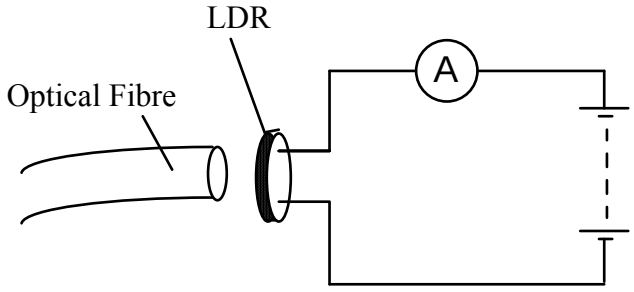
(a) Explain why light in the optical fibre follows the path shown. 1

(b) The distance travelled by light in the optical fibre is 20 km.

(i) Calculate the time taken for the light to travel this distance. 2

(ii) Some of the light energy produced by the transmitter is lost as the light travels through the fibre. For every kilometre travelled by the light, 0.5% of the energy from the transmitter is lost. If the energy of the light signal drops by 6%, a repeater has to be inserted into the fibre to amplify the signal. Explain why this length of optical fibre will require only one repeater. 2

(c) In the receiver, a light dependent resistor (LDR) is placed at the end of the optical fibre. A simplified version of the receiver circuit is shown below.

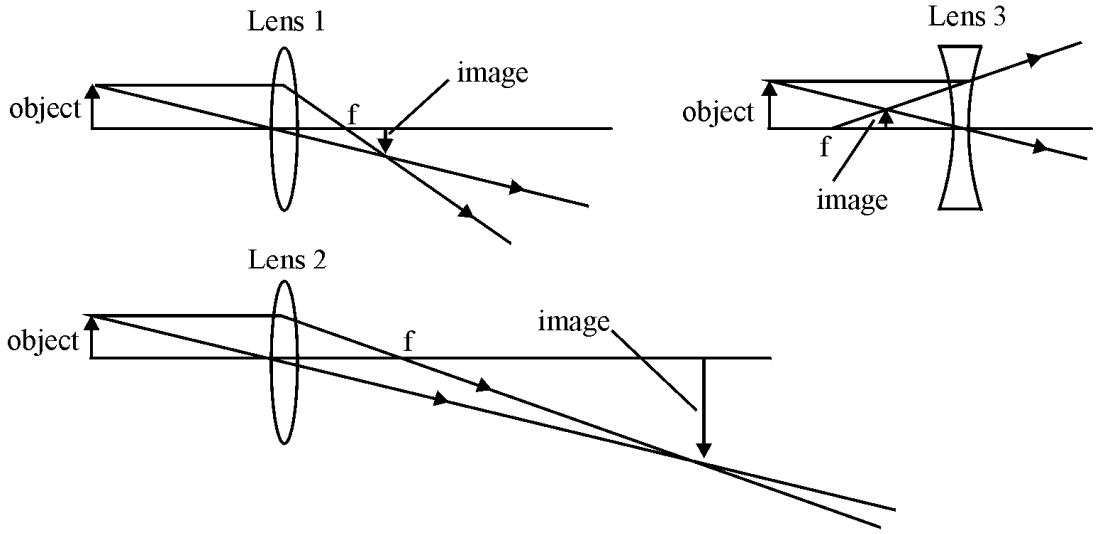


The pulses of light produce pulses of current in the circuit. Explain how this happens. 2

(7)

24. (a) A student carried out experiments on the properties of three lenses, lens 1, lens 2 and lens 3. His results included ray diagrams and a list of the power of the lenses used.

The student's ray diagrams are as follows.



The powers listed by the student were +2D, +5D and –4D.

Match lenses 1, 2 and 3 to their correct power. You must explain how you came to your conclusions. 4

(b) An optician makes a pair of spectacle lenses to correct the sight of a person with short sight.

(i) What is meant by short sight?

(ii) Copy and complete the diagram below to show the type of spectacle lens that would be used to correct for short sight. Show the effect of this spectacle lens on the rays of light. Show also the paths of the rays in the eye.

Rays of light eye 4

(8)

25. Astronomers use radio telescopes to study parts of the universe which do not emit visible light. Radio telescopes are constructed with a large dish as shown below.

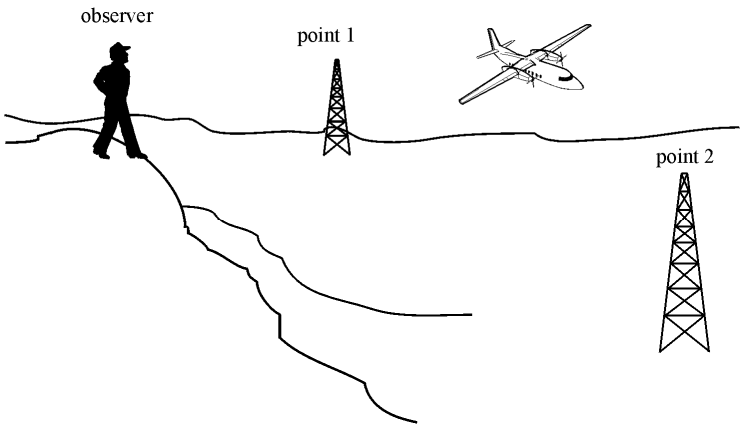
(a) With the aid of a diagram explain why a dish is used in a radio telescope 2

(b) A radio telescope detects radiation which has a frequency of 6.0×10^9 Hz. What is the wavelength of this radiation? 2

(c) Radiation is received by the telescope from a source that is 15 light years away. A light year is the distance that light travels in one year. How far away in metres is the source of radiation? 3

(7)

26. An aircraft is flying between two fixed points that are 1000 m apart. The aircraft is being observed from a distant hill. The observer can both see and hear the aircraft.



(a) Describe two differences between the sound waves and the light waves that travel from the aircraft to the observer. 2

(b) The aircraft takes 4 seconds to travel between the two points. Explain using a calculation if the aircraft is travelling at a speed faster or slower than the speed of sound. 3

(c) The pilot of the aircraft transmits a radio signal to the observer. The radio signal has a frequency 110 MHz. What is the wavelength of the radio signal? 2

(7)

Speed of sound in air = 340 m/s Speed of light = 3×10^8 m/s

27. 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.

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

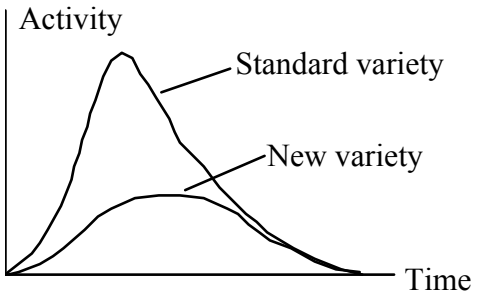
Radioactive Mineral	Radiation	Half-life
A	α	5 days
B	β	2 hours
C	γ	6 days

(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? 3

(d) The scientist used a standard variety of wheat and the new variety of wheat in her test. She added the same mass of treated fertiliser to both samples of wheat.
The graph below shows how the level of activity from both wheat samples varied with time.



Explain which variety of wheat took up the minerals in the shortest time. 2

(9)

28. 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.

(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)

29. 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.

(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 quality factor of the radiation is 6. What is the absorbed dose? 2

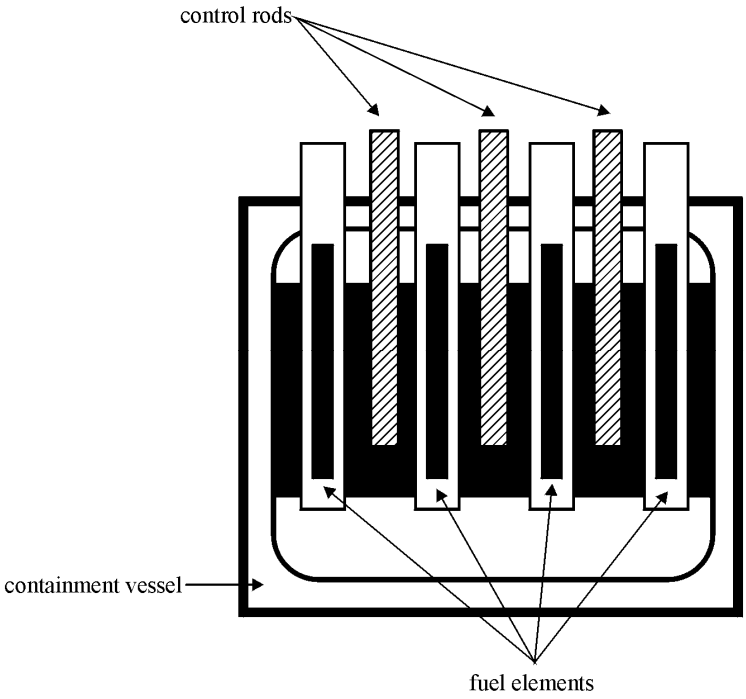
(d) Hospital staff who work with radiation take precautions to ensure that they are not exposed to too much radiation.

(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

(9)

30. Moving the control rods in and out of the core of a nuclear reactor varies the rate of the fission reaction. A diagram of the structure of the core of a reactor is shown below.



(a) Explain, in terms of nuclear fission, what will happen if the control rods are drawn slightly out of the reactor 2

(b) Energy from the fission reaction is converted into heat energy. Describe how this heat energy is converted into useful electrical energy. 3

(c) A thick containment vessel surrounds a reactor. What is the purpose of this vessel and what materials are suitable for its construction? 1

(6)

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

Quantity	Unit
Absorbed Dose	
	sievert (Sv)

Copy and complete the table 1

(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*?

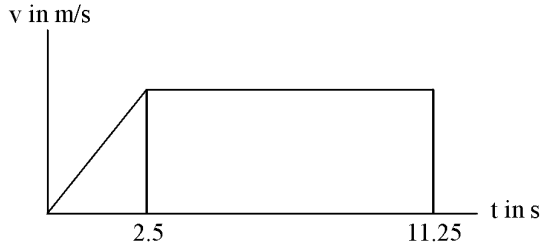
(ii) At a certain time each source has an activity of 800 kBq. What is the total activity of the two sources 10 hours later?

(iii) State two procedures the technician should use to reduce his exposure to the radiation from the sources while he is working with them. 7

(8)

INTERMEDIATE 2 - COURSE QUESTION ANSWERS

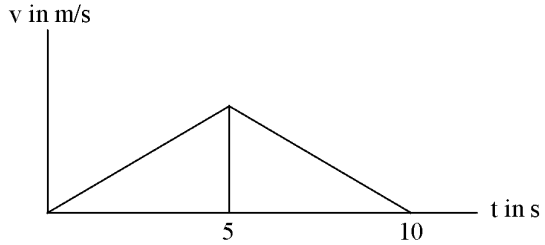
1. (a) 240 N **{2}** [Standard marking]
   (b) 10 m/s **{2}}** [Standard marking]
   (c) area of triangle = distance travelled = 12.5 m Q.E.D. **{2}**
   (d) 100 - 12.5 = 87.5 m at speed of 10 m/s = 8.75 s,
   + 2.5 s when accelerating = 11.25 s **{3}**
   (e) Graph **{2}**



(f) e.g. loudspeakers in starting blocks **{1}**

2. (a) 126 J **{2}** [Standard marking]
   (b) 38□ **{2}** [Standard marking]
   (c) t = 345600 s **{1}**
   power = 1.39 x 10^{-4} W **{2}**

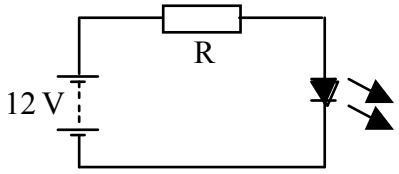
3. (a) graph **{2}**



(b) (i) 90 m **{2} }**[Standard marking]
   (ii) 18 m/s^2 **{2} }**[Standard marking]
   (iii) mass = 710kg **{1}** 12780 N **{2}**
   (c) Either – increases (mass getting less)
   or - decreases (air resistance increasing) **{1}**

4. (a) 7 N/kg **{2}** [Standard marking]
   (b) 1.75 N **{2}**
   (c) 1.75 N **{1}**
   (d) object floats about **{1}**

5. (a) E_k lost = work done against friction = 5.8 J **{3}**
   (b) Initial E_k = 13.9 J => Final E_k = 13.9 - 5.8 = 8.1 J **{1}**
   Final speed = 0.92 m/s **{2}** [Standard marking]
   (c) (i) Diagram **{1}**



   (ii) 153.8 Ω **{2}** [Standard marking]
   (iii) current = 26 A **{1}**; power = 312 W **{2}**

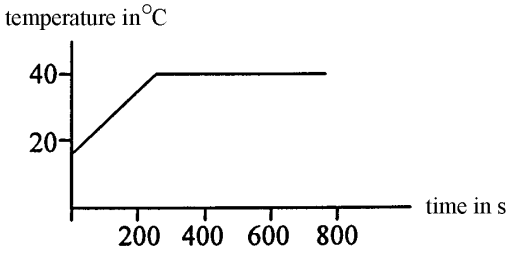
6. (a) 2400 J **{2}** [Standard marking]
   (b) energy in = 4000 (J) **{1.5}** 320 J time = 10 s **{1.5}**
   (c) 6.15 A **{2}** [Standard marking]

7. (a) 0.1 m/s^2 **{2}** [Standard marking]
   (b) 5.4 x 10^7 J **{2}** [Standard marking]
   (c) 108 000 N **{2}}** [Standard marking]
   (d) Braking distance might increase. **{1}**

8. (a) Increases **{1}**
   (b) 10080 J **{2}** [Standard marking]
   (c) 32400 J **{3}**
   (d) 31.1 % **{2}** [Standard marking]
   (e) e.g. energy lost in pump, as heat and sound.**{2}**

9. (a) 576 m **{2}** [Standard marking]
   (b) 46080 J **{2}** [Standard marking]
   (c) 1047 J/kg^{o}C **{3}**

10. (a) Aluminium – 17280 J **{1}**
    Wax – 28080 J **{1}** Total = 45360 J **{1}**
    (b) 227 s **{2}** [Standard marking]
    (c) 540 s **{2}** [Standard marking]
    (d) graph **{2}**

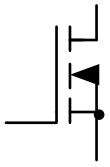


    (e) As wax cools/solidifies, heat transferred to food. **{1}**

11. (a) 4.62×10^8 J **{2}** [Standard marking]
    (b) 57750 s **{2}** [Standard marking]
    (c) 40 A **{2}** [Standard marking]
    (d) e.g. surround tank with insulating material. **{1}**

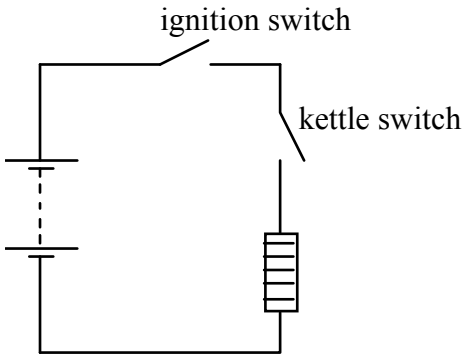
12. R_{LDR} = 140 Ω **{1}**, V_o = 0.40 V **{1}**
    (b) No light shines on LDR **{1}**, Resistance of LDR increases **{1}**, V_o increases **{1}**.
    (c) Time of ball passing 20 ms **{1}**
    Distance = diameter of ball = 0.22 m **{1}**
    Instantaneous speed = 11 m/s **{1}**

13. (a) Sound to electrical **{1}**
    (b) Loudspeaker/earphone or headphones **{1}**
    (c) **{1}**



    (d) Total gain = 1200 **{1}** V_{out} = 1.44 V **{2}** [or two separate gains calculations **1** $^1/_2$ each]
    (e) (i) 230 Hz **{1}**
    (ii) λ = 0.148 m **{2}** [Standard marking]

14. (a) (i)

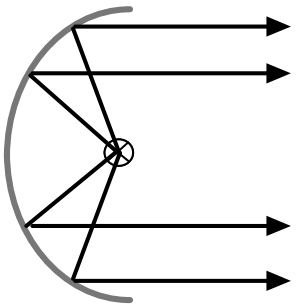


    or equivalent **series** circuit **{1}**
    [order of switches in circuit not essential]
    (ii) P = 240 W **{2}** [Standard marking]
    (iii) t = 180 s => E = 43200 J **{2}** [Standard marking] [Clear working must be shown to support answer.
    (iv) ΔT = 80 °C, m = 0.128 kg **{2}** [Standard marking]
    (b) (i) 40 A **{1}**

15. (a) (i) no voltage **{½}**
(ii) voltage induced **{½}**
(iii) no voltage **{½}**
(iv) voltage induced **{½}**
(b) Open door very slowly **{1}** [no need to relate to change of magnetic field]
(c) (i) As cooker switches on it can cause a change in magnetic field. **{1}**
This changing field induces voltage in detector **{1}**
(ii) Optical fibres transmit light **{1}**
Light does not cause an induced voltage. **{1}**
(d) 2.5×10^{-5} C **{2}** [Standard marking]

16. (a) (i) $E_p = 0.38$ J **{2}** [Standard marking]
(ii) E = 12.7 J**{2}** [Standard marking]
(iii) $E_H = 840$ J **{2}** [Standard marking]
(iv) Energy per second = 853 J **{1}** hence P = 853 W **{1}** [or E = Pt calc.]
(v) I = 3.7 A**{2}** [Standard marking]
(b) Temperature increases **{1}** less mass but same heat energy so from E = cmΔT, ΔT must increase.**{1}**

17. (a) (i) I = 0.8 A **{2}** [Standard marking]
(ii) E = 5040 J **{2}** [Standard marking]
(b) (i) I = 1.6 A **{1}**
(ii) 25600 s (or 7 hours, 7 minutes and 5 seconds) **{2}** [Standard marking]
(iii) Brighter light/ unit will still function even if one lamp blows [any one] **{2}**
(c)



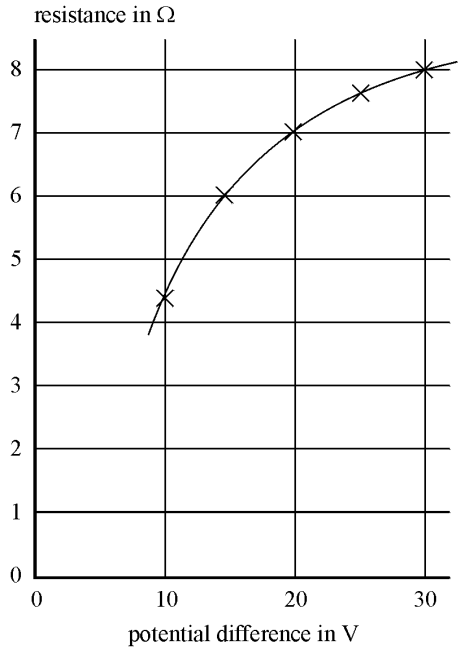
Rays reflected from dish **{1}**
Parallel rays **{1}**

18. (a) If one LED fails the others will still light **{1}**
(b) To reduce current through LED/ apply correct voltage to LED / prevent damage to LED **{1}**
(c) (i) 30 mA **{1}**
(ii) 240 mA **{1}**
(d) P = 45 mW **{2}** [Standard marking]
(e) R = 350 Ω **{1}**
(f) 2.52 W **{2}** [Standard marking]

19. (a) (i) 14000 A **{2}** [Standard marking]
(ii) 8250 turns **{2}** [Standard marking]
(iii) Use P = IV in secondary or similiar to show clearly Is = 1018 A **{2}**
(b) R = 0.68 Ω **{1}** 70.5 kW **{2}**
(c) Electrons move backwards and forwards **{1}** [reference to frequency not required].

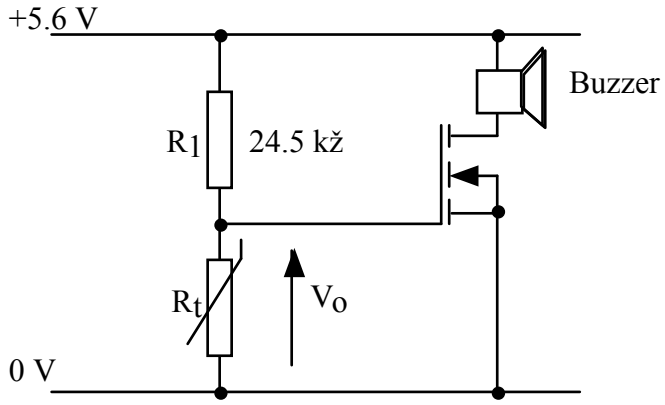
20. (a)

Resistance (Ω)
4.3
6.0
7.0
7.7
8.0



[table need not be copied and completed]
correct resistances **{3}**; all points correctly plotted**{1}**; correct axes **{1}**, units/labels on axes **{1}**
(b) From graph R = 7.3 to 7.4 Ω **{1}** Clear working to show P = 72 W **{2}**

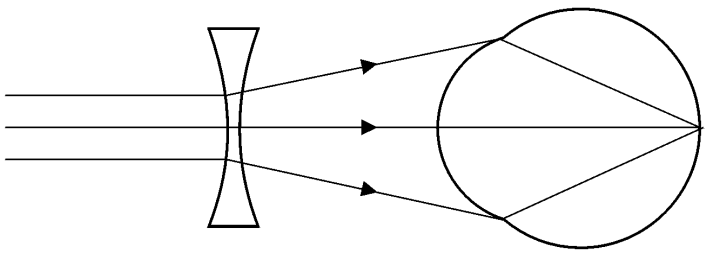
21. (a) From graph: $R_t = 3.5\ k\Omega$ {1}, $V_o = 0.7\,V$ {2}
    (b) As temperature rises the resistance of the thermistor decreases **{1}** so V_o decreases **{½}** and the buzzer switches off **{½}**.
    (c) $I = 0.68\,mA$ {1}, $R_1 = 4.67\ k\Omega$ {2}
    (d) Diagram must show MOSFET symbol and value for R_1. **{1}**



22. (a) Microphone 1 **{1}** , shortest distance **{1}**
    (b) 810 m **{2}** [Standard marking]
    (c) Distance by air = 272 m **{1}**
    Distance by ground = 1440 m **{1}**
    Extra distance = 1168 m **{1}**

23. (a) Total internal reflection **{1}**
    (b) (i) 0.1 ms **{2}** [Standard marking]
    (ii) 20 km ∏10% loss **{1}**; 6% requires one repeater, do not require second **{1}**
    (c) Light increases, R_{LDR} decreases **{1}** , R_{LDR} decreases, I increases **{1}**

24. (a) Lens 3 ∏ -4D **{½}** - concave **{½}** , -ve power **{½}**
    Lens 1 ∏ +5D **{½}** - convex **{½}**,large +ve power **{½}** so short focal length **{½}**
    Lens 2 ∏ +2D **{½}**
    [may be in different order]
    (b) (i) can only see close objects clearly/ cannot see distance objects clearly **{1}**
    (ii)



bending at lens **{1}** , bending at eye **{1}** , focus at retina **{1}**

25. (a)

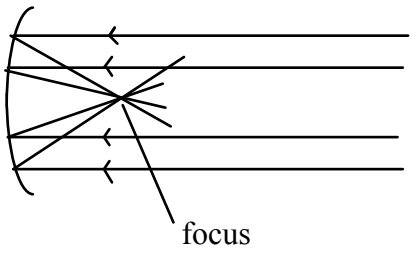


diagram **{1}**
dish collects parallel rays **{$^1/_2$}** ,brings them to focus **{$^1/_2$}**

(b) 0.05 m **{2}** [Standard marking]

(c) 1 year = 31536000 seconds **{1}**
distance = 1.42 x 10^{17} m **{2}** [Standard marking]

26. (a) speed of sound << speed of light **{1}**
sound is a longitudinal wave, light is a transverse wave **{1}**

(b) speed of aircraft = 250 m/s **{2}** [Standard marking]
this is less than 330m/s so plane is flying slower than speed of sound **{1}**

(c) 2.7 m **{2}** [Standard marking]

27. (a) γ penetrates wheat **{1}** , half-life long enough **{2}**

(b) Any two from shielding, distance, time reduction **2 x {1}**

(c) 150 kBq **{2}** [Standard marking]

(d) Standard variety **{1}** , higher peak in shorter time **{1}**

28. (a) γ-radiation, β-particles, α-particles **{1}**

(b) 2 protons + 2 neutrons *or* helium nucleus **{1}**

(c) Addition or removal **{1}** of electrons from an atom **{1}**

(d) α-particles produce too much ionisation *or* are absorbed by tissue **{1}**
β-particles are absorbed by tissue **{1}**

(e) Sterilisation of instruments **{1}** radiation kills cells **{1}** *or*
Destroy cancers **{1}** radiation kills cells **{1}** *or*
Investigation & diagnosis **{1}** using X-rays **{1}**

29. (a) Energy/ Unit mass (Energy/kg) **{1}** , gray **{1}**

(i) Type of radiation *or* organs exposed **{1}**

(ii) 83.3 μGy **{2}** [Standard marking]

(iii) (i) Any two from shielding, distance, time reduction **2 x {1}**

(c) Film fogs on exposure to radiation **{1}**
More fogging – more radiation **{1}**

30. (a) more neutrons pass/less absorbed **{1}** more fissions **{1}**
    (b) Heat energy boils water **{1}**
    Steam turns turbine **{1}**
    Turbine turns generator producing electricity **{1}**
    (c) To contain radiation in the core **{1}** concrete or steel **{1}**

31. (a)

Quantity	Unit
Absorbed Dose	gray (Gy)
Dose Equivalent	sievert (Sv)

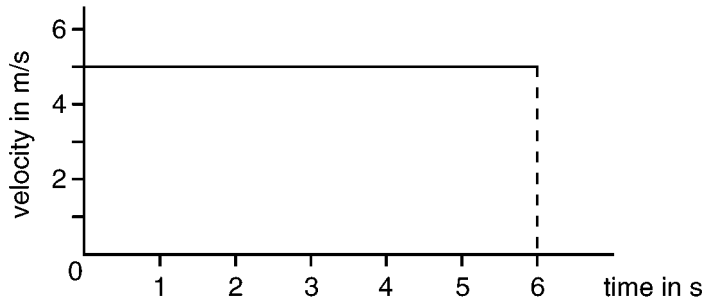
{$^1/_2$} mark for each box.

(b) (i) The time taken for activity to drop to half its value. **{1}**
(ii) Source A – 25 kBq **{$1^1/_2$}**; Source B – 50 kBq **{$1^1/_2$}**
Total activity = 75 kBq **{1}**
(iii) Any two from reduce time of exposure, insert shielding, increase separation between technician and source. **{1 each}**

INTERMEDIATE 2 PHYSICS

Objective Questions

1. The velocity of a vehicle during a 6-second period of its motion is given by the following graph.



The acceleration of the vehicle during the same 6 second period is

A $30\ m/s^2$

B $15\ m/s^2$

C $\frac{6}{5}\ m/s^2$

D $\frac{5}{6}\ m/s^2$

E $0\ m/s^2$

2. A car travelled form P to Q in 10s. The distance from P to Q is 240 m. The car had a speed of 20 m/s at P and 30 m/s at Q.

What was the average speed of the car as it travelled from P to Q?

A $\frac{240}{10}\ m/s^2$

B $\frac{240}{2}\ m/s^2$

C $\frac{30\ +\ 20}{10}\ m/s^2$

D $\frac{30\ +\ 20}{2}\ m/s^2$

E $\frac{30\ -\ 20}{2}\ m/s^2$

3. Which one of the following consists entirely of vector quantities?

   A force, mass, acceleration

   B displacement, velocity, acceleration

   C acceleration, displacement, energy

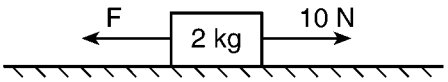
   D speed, distance, time

   E length, time, velocity

4. The acceleration due to gravity at the surface of Jupiter is 25 m/s. A robot has a mass of 80 kg on earth. Select the correct entry from the following table:

	Robot's Mass on Jupiter, kg	**Robot's weight on Jupiter, N**
A	80	2000
B	80	800
C	2000	20000
D	800	8000
E	3.2	32

5. A block of mass 2 kg is being pulled across a horizontal bench by a force of 10 N as shown.



   If the block accelerates at 3 m/s^2, the force of friction, F, between the block and the bench is

   A zero

   B 4 N

   C 6 N

   D 7 N

   E 10N

6. What is the gravitational field strength on a planet if 50 J of energy are required to raise a mass of 1kg to a height of 10 metres above its surface?

A 0.2 N/kg

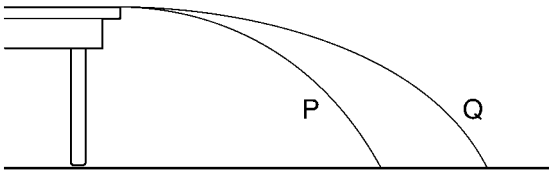
B 5 N/kg

C 10 N/kg

D 50 N/kg

E 500 N/kg

7. Two coins P and Q were projected simultaneously from the edge of a table and their subsequent paths are as shown.



The motions of P and Q differed in

A the time taken to fall to the floor

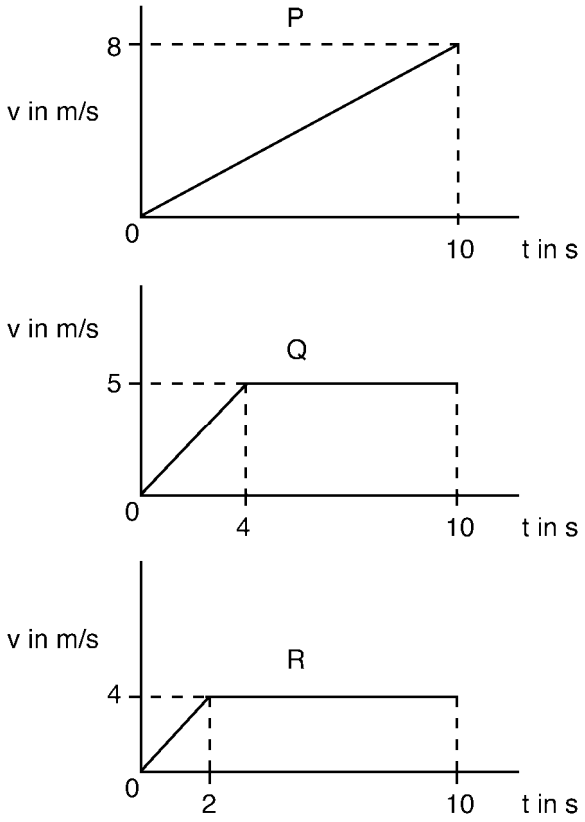
B the acceleration

C the final vertical velocity

D the final horizontal velocity

E the height fallen

8. Shown below are the velocity-time graphs for three boys P, Q and R involved in a race against each other.



After 10 seconds

A P leads Q and R

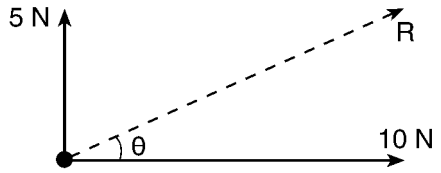
B Q leads P and R

C R leads P and Q

D P and Q share first place

E all 3 are together

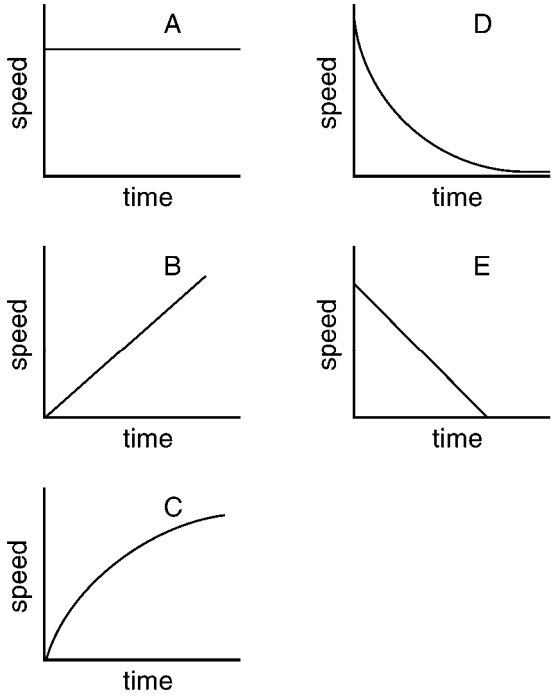
9. Two force of magnitude 5 N and 10 N are acting at right angles to each other on an object.



Which entry in the table describes the resultant force R on the object?

	Magnitude of R	Direction of R
A	more than 15 N	θ more than 45°
B	more than 5 N but less than 15 N	θ more than 45°
C	more than 5 N but less than 15 N	θ less than 45°
D	15 N	θ less than 45°
E	less than 5 N	θ more than 45°

10. Which of the following diagrams represents the correct speed-time graph for an object falling freely in a vacuum?



11. A trolley of mass 1 kg travelling at 2 m/s collides with, and remains attached to, a stationary trolley of mass 2 kg. The momentum of the combined trolley is

A $\frac{2}{3}$ kg m/s

B 1 kg m/s

C $\frac{4}{3}$ kg m/s

D $\frac{3}{2}$ kg m/s

E 2 kg m/s

12. Which of the following statements correctly describes what happens when two bodies collide?

A momentum may or may not be conserved, depending on the type of collision

B kinetic energy may or may not be conserved, depending on the type of collision

C there is always some loss in the total momentum

D there is always some loss in the kinetic energy

E kinetic energy is always conserved

13. During an elastic collision

A momentum but not kinetic energy is conserved

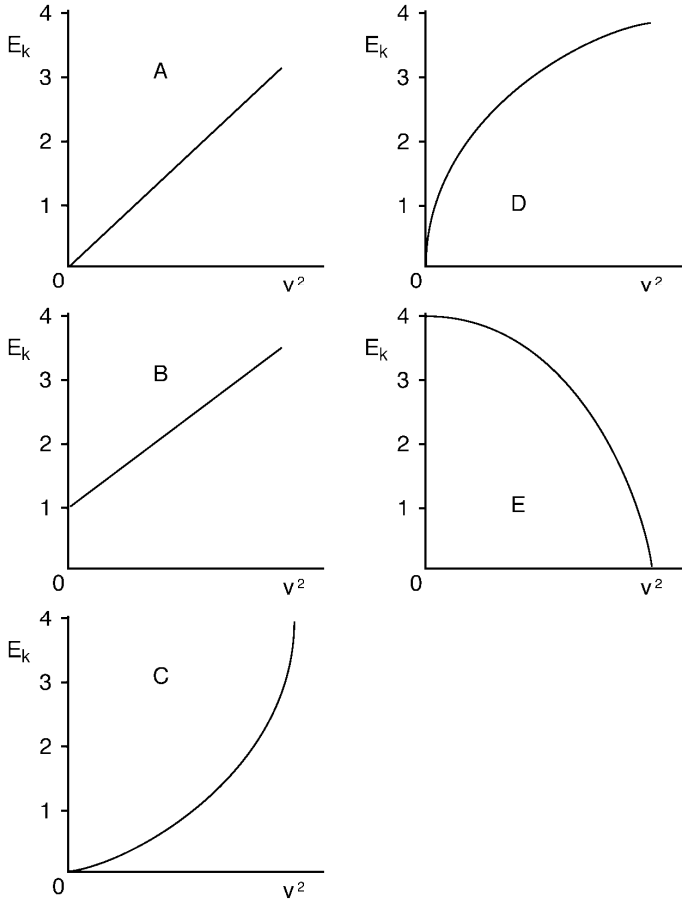
B kinetic energy but not momentum is conserved

C momentum and kinetic energy are conserved

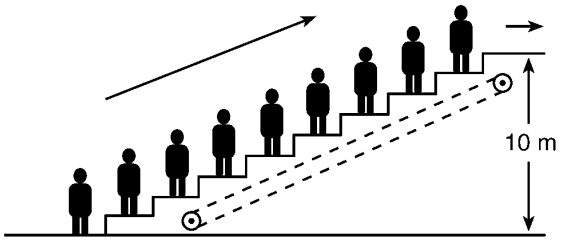
D neither momentum nor kinetic energy is conserved

E kinetic energy is converted to momentum

14. Which of the following graphs shows how the kinetic energy of an object depends on the square of its velocity?



15. During the rush hour, a moving staircase carries 120 commuters per minute up from an underground railway to street level. The railway is 10 m below street level and the average commuter weighs 500 N.



The average power output of the motor which drives the staircase must be at least

A 1 000 W

B 5 000 W

C 10 000 W

D 50 000 W

E 600 000 W

16. A trolley passes through the beam of a photoelectric timing device. A pupil makes only the following measurement

    - length of the trolley
    - mass of the trolley
    - time for the trolley to pass through the beam.

    Which of the following can be calculated from these measurements?

    A the velocity, acceleration and kinetic energy of the trolley

    B the velocity, momentum and kinetic energy of the trolley

    C the acceleration, momentum and kinetic energy of the trolley

    D the velocity, acceleration and momentum of the trolley

    E the acceleration, velocity and momentum of the trolley

17. 200 J of work are done by a force of 40 N in moving a 2 kg block along a frictionless horizontal surface.

    The distance moved by the block is

    A 0.2 m

    B 0.4 m

    C 2.5 m

    D 5.0 m

    E 10.0 m

18. A machine has an efficiency of 40%. For this machine to give an output of 800 J, the input energy is

    A $\frac{800 \times 40}{100}$ J

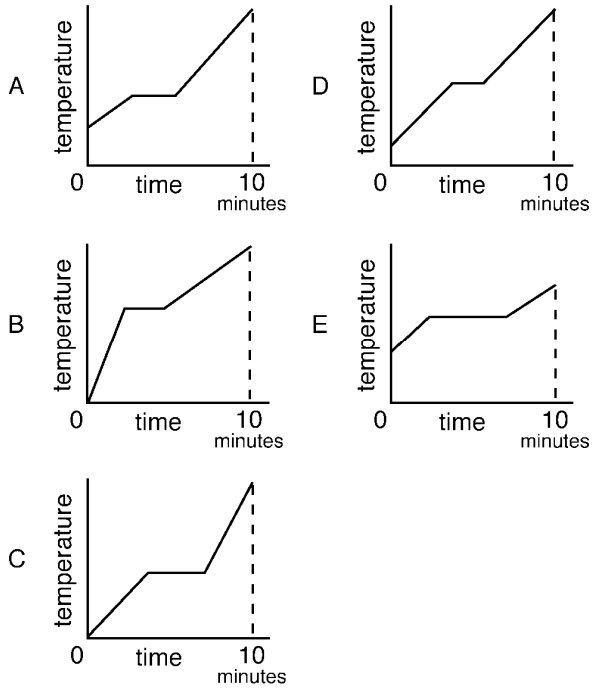
    B $\frac{800}{100 \times 40}$ J

    C $\frac{800 \times 100}{40}$ J

    D $\frac{800}{40}$ J

    E 40×800 J

19. Five different solids each of mass 1 kg were heated for the same time in insulated containers using identical immersion heaters. Which graph of temperature against time refers to the material with the greatest value of specific latent heat of fusion?



20. Specific heat capacity is the amount of heat

A which a body can absorb, divided by its mass

B which a body can absorb, multiplied by its mass

C which a body can absorb, multiplied by its mass and the change in temperature

D which a body can absorb, multiplied by its mass and divided by the change in temperature

E which a body can absorb, divided by its mass and the change in temperature.

21. Which property of water ensures that its temperature in a hot water bottle does not fall at too great a rate?

A low specific latent heat

B low specific heat capacity

C poor heat conductivity

D high specific latent heat

E high specific heat capacity

22. 5 kg of oil of specific heat capacity 1900 J/kg °C is heated from 10 °C to 50 °C. The heat energy gained by the oil is

A 9.5 J

B 237.5 J

C 17 200 J

D 380 000 J

E 475 000 J

23. The addition of 9000 J of heat to a 2 kg block of metal raises the temperature from 20 °C to 50 °C. The specific heat capacity of the metal is

A $2 \times 30 \times 9000$ J/kg °C

B $2 \times 50 \times 9000$ J/kg °C

C $\frac{9000}{2 \times 50}$ J / kg °C

D $\frac{9000}{2 \times 30}$ J / kg °C

E $\frac{2 \times 50}{9000}$ J / kg °C

24. A current of 2.0 A flows through the element of an electric fire. How much charge passes through the element if the fire is switched on for 3.0 minutes?

A $\frac{2}{3}$ C

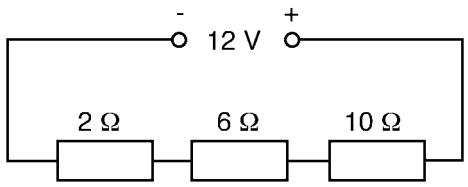
B $\frac{3}{2}$ C

C 6 C

D 90 C

E 360 C

25. The circuit shows a 12 V supply connected across three resistors in series.



The potential difference across the 6 Ω resistor is

A 2 V

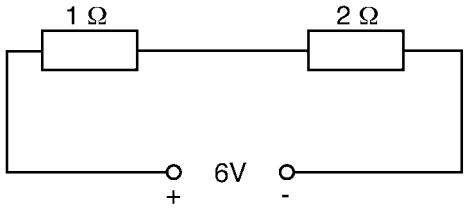
B 4 V

C 6 V

D 9 V

E 12 V

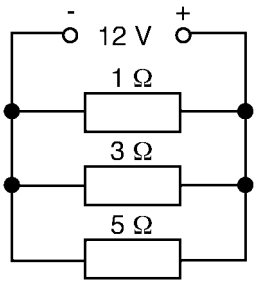
26. Two resistors are connected in series across a 6 V d.c. supply as shown.



The current through the 1 Ω resistor is 2 A. Which entry gives the current in the 2 Ω resistor, and the p.d. across it?

	Current	**P.D.**
A	1 A	2 V
B	1 A	6 V
C	2 A	4 V
D	2 A	6 V
E	4 A	8 V

27. The circuit shows a 12 V supply connected across three resistors in parallel.



The potential difference across the 1 ohm resistor is

A $1\frac{1}{3}$ V

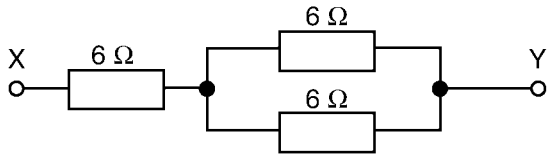
B 3 V

C 4 V

D 9 V

E 12 V

28. In the circuit below, what is the resistance between X and Y?



A 2 Ω

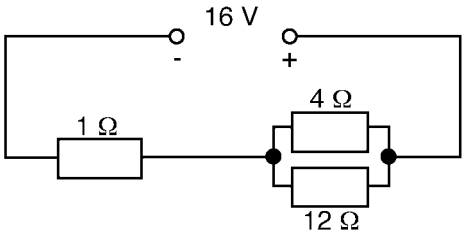
B 4 Ω

C 9 Ω

D 12 Ω

E 18 Ω

29. A circuit is set up as shown



What is the potential difference across the 1 Ω resistor

A 1 V

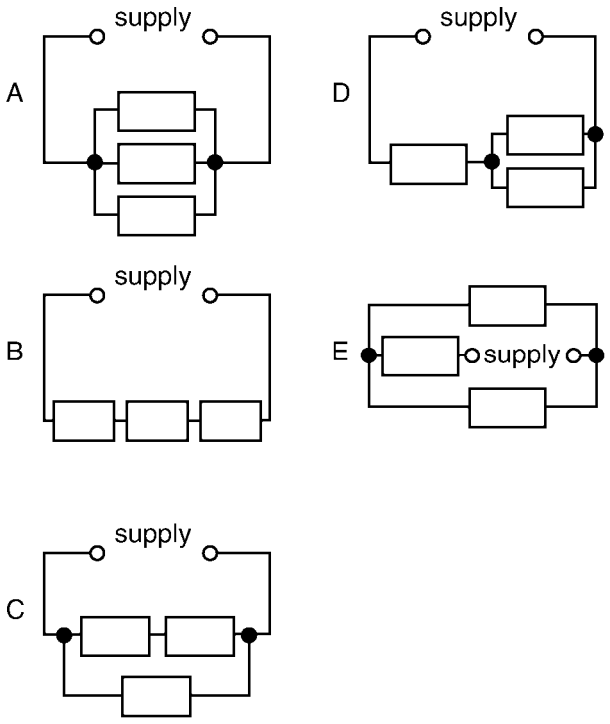
B 4 V

C 8 V

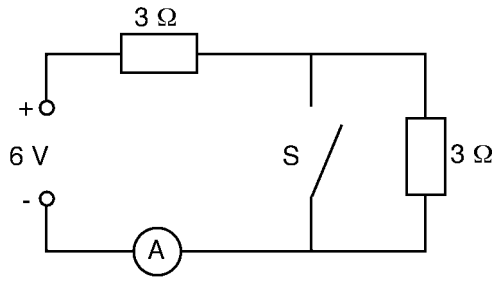
D 12 V

E 16 V

30. If all the resistors are identical which circuit has the least resistance?



31. In the circuit shown the switch S is open.



On closing the switch S the ammeter reading changes from

A ½ A to 1 A

B 1 A to ½ A

C 1 A to 2 A

D 1 A to 3 A

E 2 A to 1 A

32. The diagram shows the label attached to the base of an electric kettle.

Electric Kettle	
Operating Voltage	250 V
Power	3 kW
Fuse Rating	13 A

How much electrical energy is converted if this kettle is switched on for 4 minutes?

A $3 \times 250 \times 4$ J

B $3 \times 1000 \times 4 \times 60$ J

C $13 \times 250 \times 4 \times 60$ J

D $3 \times 1000 \times 250$ J

E $3 \times 1000 \times 250 \times 4$ J

33. An electric motor is running with a steady input of 250 V and 4 A while raising a load of 1000 N. Assuming the motor and transmission to be 100% efficient the time taken to life the load vertically through a distance of 10 m is

A 250 s

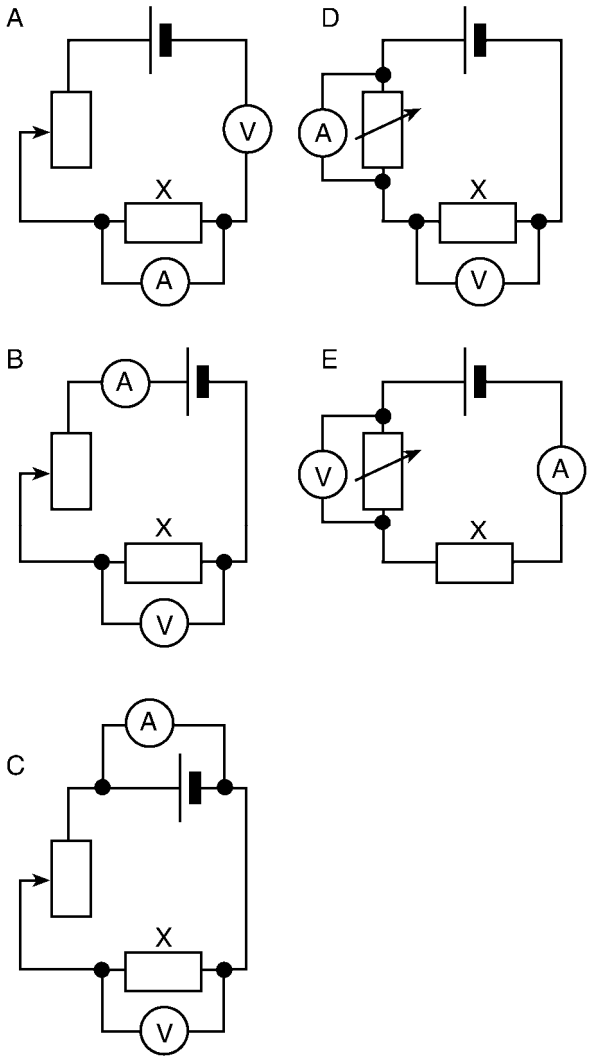
B 10 s

C 4.0 s

D 1.5 s

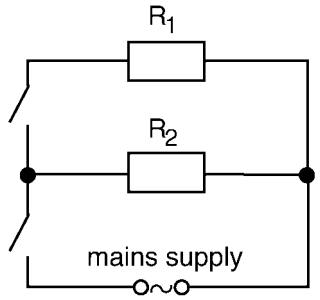
E 1.0 s

34. Which of the following circuits could be used to find the resistance of the resistor X?

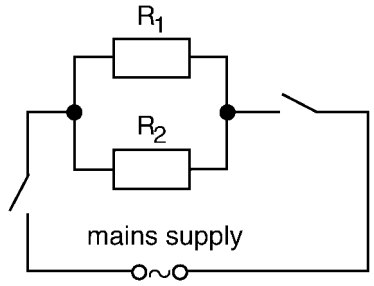


35. An electric fire has two elements R_1 and R_2. Which of the following circuits enables either element to be used on its own and both elements to be used together?

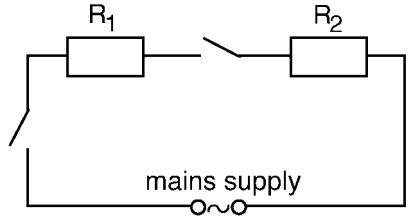
A



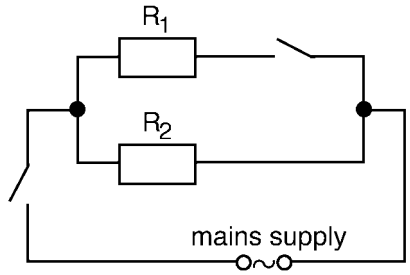
B



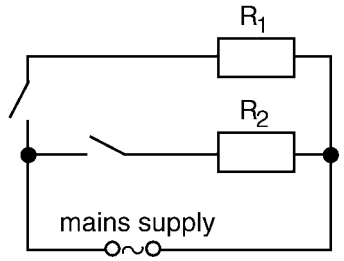
C



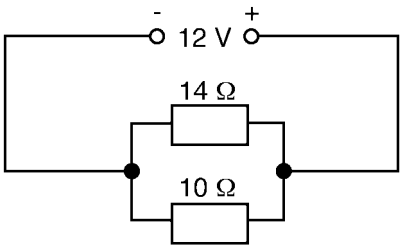
D



E



36. The circuit diagram shows two resistors connected in parallel across a 12 V d.c. supply.



The potential difference across the 14 Ω resistor is

A 5 V

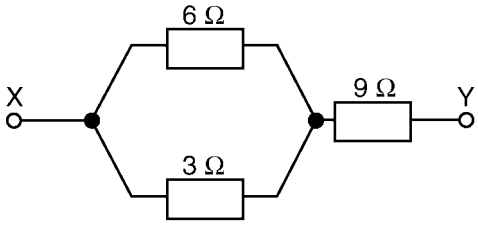
B 7 V

C 10 V

D 12 V

E 14 V

37. The diagram shows 3 resistors connected between the points X and Y.



What is the total resistance between X and Y?

A 1.6 ohms

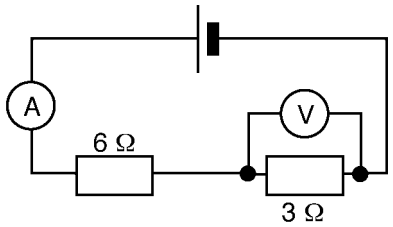
B 9.5 ohms

C 11.0 ohms

D 13.5 ohms

E 18.0 ohms

38. The diagram shows a battery driving current round a circuit containing two resistors. The ammeter reading is I and the voltmeter reading is V. The voltmeter has a high resistance.



When the resistors are interchanged, how will the readings alter if at all?

A V decreases and I does not change

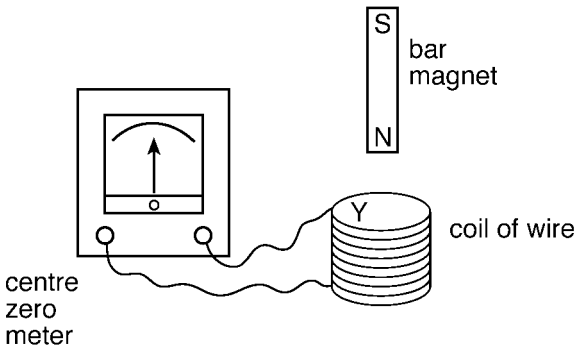
B V decreases and I decreases

C V decreases and I increases

D V increases and I decreases

E V increases and I does not change

39. A student sets up an experiment as shown below.



The magnet is moved into the coil.

The following statements are recorded by the student.

I. A steady deflection is obtained on the meter when the magnet is held steady inside the coil.

II. An increased deflection on the meter could be obtained by using a coil of more turns

III. An increased deflection on the meter could be obtained by using a magnet of stronger magnetic field strength.

Which of the above statements is/are correct?

A I only

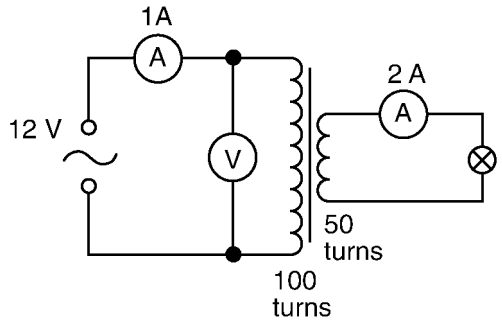
B III only

C I and III only

D II and III only

E I, II and III

40. The diagram below shows a transformer supplying power to a lamp.



Assuming the transformer to be 100% efficient, what is the resistance of the lamp?

A 2 ohms

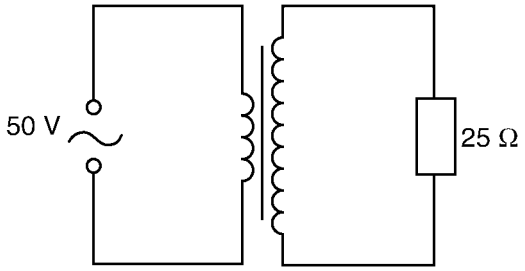
B 3 ohms

C 4 ohms

D 6 ohms

E 12 ohms

41. A transformer has 20 turns in the primary and 100 turns in the secondary. The secondary circuit is connected to a resistor of resistance of 25 ohms. The voltage applied to the primary is 50 V a.c.



Assuming no power losses in the transformer, what current flows in the secondary circuit?

A 0.1 A

B 0.4 A

C 2.0 A

D 5.0 A

E 10 A

42. The voltage gain of an amplifier may be calculated from the expression

A $\frac{\text{output voltage}}{\text{input voltage}}$

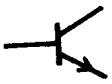
B $\frac{\text{input voltage}}{\text{output voltage}}$

C output voltage – input voltage

D $\frac{\text{output voltage - input voltage}}{\text{input voltage}}$

E $\frac{\text{input voltage}}{\text{output voltage - input voltage}}$

43. The following symbol is used in circuit diagrams.



The symbol represents a

A light emitting diode (LED)

B light dependent resistor (LDR)

C transistor

D variable resistor

E battery.

44. 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

45. 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}

46. 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.

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

A γ-rays

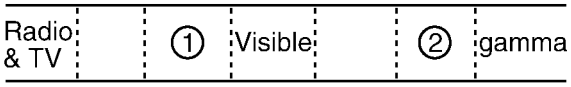
B ultra violet

C infra red

D microwaves

E radiowaves

48. 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

49. 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

50. 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

51. 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

52. 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

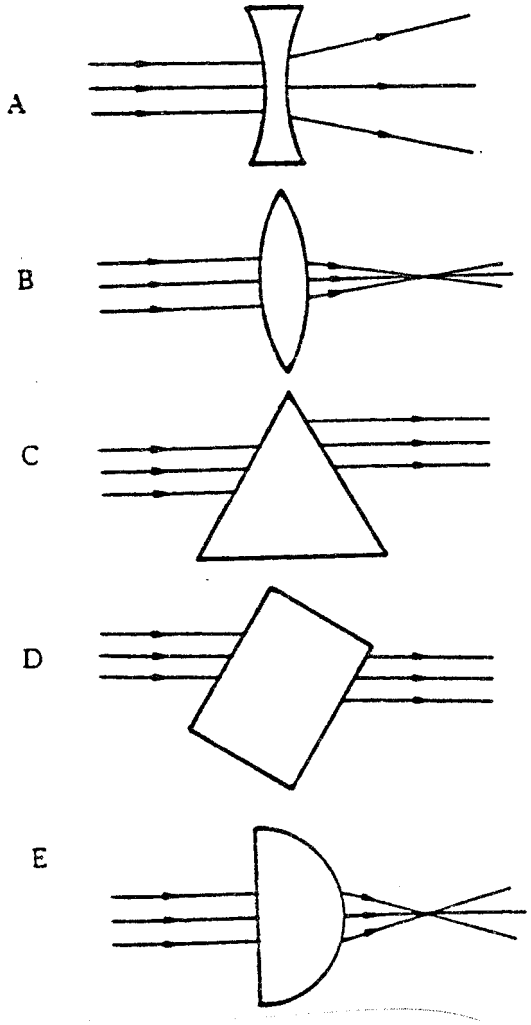
C 560 m

D 7 000 m

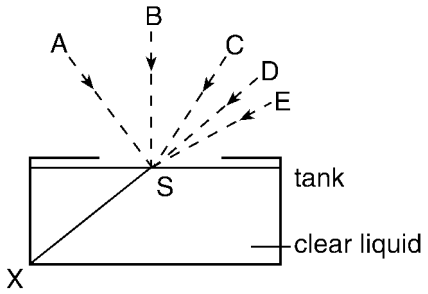
E 14 000 m

53. Three parallel rays of light from a ray box pass through a selection of perspex blocks as shown.

Which diagram must be **incorrect**?



54. 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

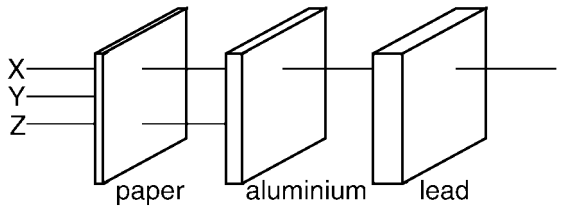
B BS

C CS

D DS

E ES

55. 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

56. 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

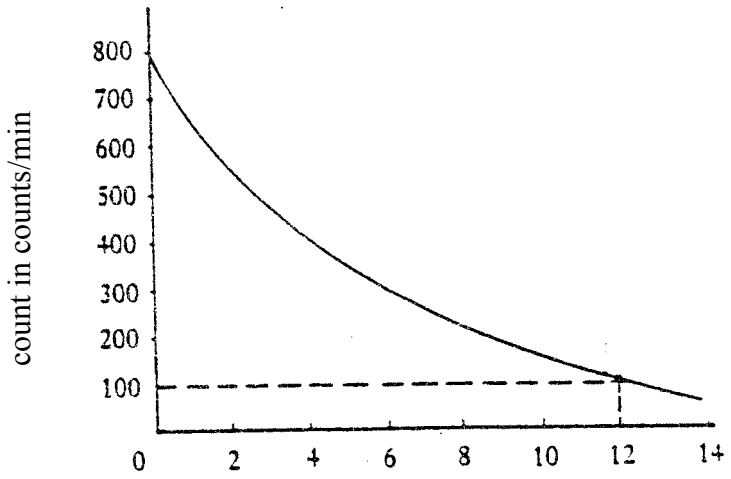
B it would decay at the end of 2 hours

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.

57. 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

58. 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

59. 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

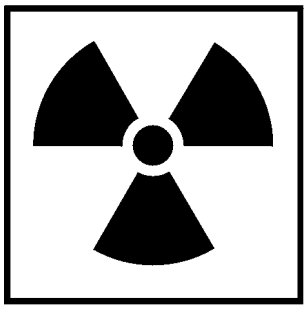
B II only

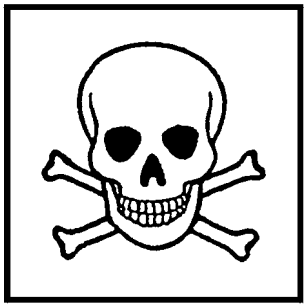
C I and II only

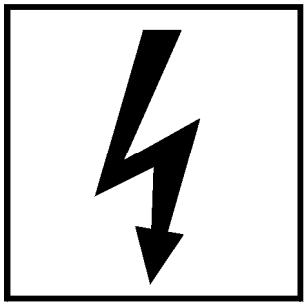
D I and III only

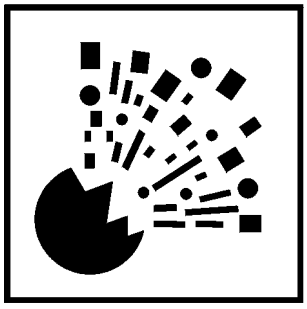
E I, II and III

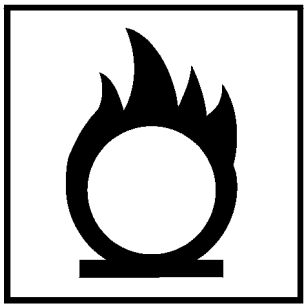
60. Which sign is used to indicate the presence of radioactivity?

A 

B 

C 

D 

E 

61. 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

62. 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

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

A becquerel

B sievert

C gray

D watt

E joule

INTERMEDIATE 2 PHYSICS

Answers: Objective questions

1.	E	**17.**	D	**33.**	B	**49.**	E
2.	A	**18.**	C	**34.**	B	**50.**	B
3.	B	**19.**	E	**35.**	E	**51.**	B
4.	A	**20.**	E	**36.**	D	**52.**	A
5.	B	**21.**	E	**37.**	C	**53.**	C
6.	B	**22.**	D	**38.**	E	**54.**	C
7.	D	**23.**	D	**39.**	D	**55.**	B
8.	B	**24.**	E	**40.**	B	**56.**	E
9.	C	**25.**	B	**41.**	E	**57.**	B
10.	B	**26.**	C	**42.**	A	**58.**	C
11.	E	**27.**	E	**43.**	C	**59.**	C
12.	B	**28.**	C	**44.**	B	**60.**	A
13.	C	**29.**	B	**45.**	C	**61.**	B
14.	A	**30.**	A	**46.**	C	**62.**	C
15.	C	**31.**	C	**47.**	B	**63.**	B
16.	B	**32.**	B	**48.**	B		