lass:	Index No:	Name: **partnerinlearning**

TAMPINES SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

Physics **5059/01**

Paper 1 Multiple Choice **30th August 2016**
60 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write in soft pencil.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Marks	
Multiple Choice (40 marks)	
Total (40 marks)	

Parent's Signature: _____

This document consists of 17 printed pages (including this cover page).

Setter: Mr Ng Weilun

[Turn over]

1 Which pair of physical quantities has the same base units?

A force and moment of a force
B moment of a force and work done
C work done and energy
D energy and current

2 Which of the following describes the weight of an object?

A the amount of substance it has
B the gravitational pull on it
C the pressure it exerts on the ground
D the product of its density and volume

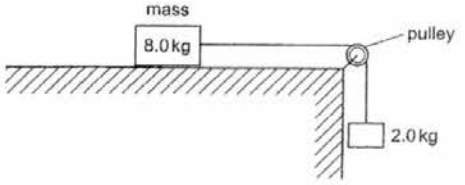
3 A motorist, on a straight road, accelerates from rest at 2.0 m/s^2 until he reaches and maintains a constant velocity of 40 m/s.
How much time will pass before the motorist covers a displacement of 1.0 km from his starting point?

A 20 s **B** 25 s **C** 35 s **D** 50 s

4 According to Newton's third law, when two bodies X and Y interact, two forces act.
Which statement about the forces is not correct?

A They are equal in magnitude.
B They act in opposite direction.
C They act on different bodies.
D They exist only when the two bodies are in contact.

5 A mass of 8.0 kg, resting on a horizontal surface, is connected to a hanging mass of 2.0 kg. There is a frictional force of 5.0 N acting between 8.0 kg mass and the surface.



What is the acceleration of the 8.0 kg mass?

A 1.5 m/s^2 **B** 1.9 m/s^2 **C** 2.0 m/s^2 **D** 2.5 m/s^2

6 A large bucket, lifted by a rope attached to a crane, is used on a building site to raise heavy loads.

The bucket, of total mass m when fully loaded, rises at a uniform velocity v before decelerating uniformly to rest in time t. The gravitational field strength is g.

What is the difference between the tensions in the rope supporting bucket when the bucket is travelling at uniform velocity and when the bucket is decelerating?

A $\frac{-mg}{t}$ **B** $\frac{-mv}{t}$ **C** $m\left(g-\frac{v}{t}\right)$ **D** $m\left(\frac{v}{t}-g\right)$

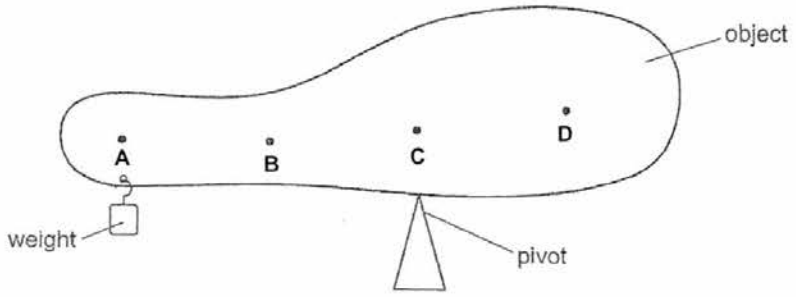
7 A person of weight 600 N at the bottom of a mountain climbs to the top. The gravitational field strength changes from 9.81 N/kg at the bottom to 9.79 N/kg at the top. His mass is unchanged as he climbs.

What are his mass and his weight at the top of the mountain?

	mass at top of mountain / kg	weight at top of mountain / N
A	61.2	599
B	61.2	600
C	61.3	599
D	61.3	600

8 A student balances a non-uniform object on a pivot. To do this, a weight is suspended near the left-end of the object.

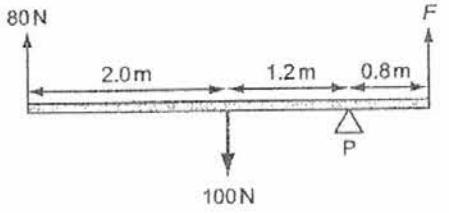
What is the centre of gravity of the object?



9 What makes an object the most stable?

	position of centre of gravity	area of base
A	high	small
B	high	large
C	low	small
D	low	large

10 A uniform rod of weight 100 N is pivoted at a point P. An 80 N upward force acts at one end and a force F acts at the other end to keep the rod in equilibrium.

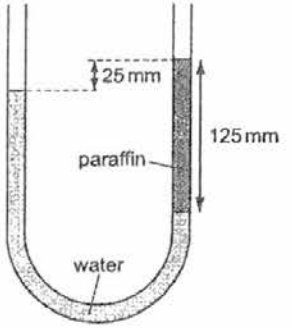


What is the value of F?

A 20 N **B** 45 N **C** 170 N **D** 470 N

11 Paraffin floats on water. Some paraffin is poured into one arm of a U-tube containing water.

The diagram below shows a difference of 25 mm in the surface level of the water and paraffin in the two arms. The length of the paraffin column in the tube is 125 mm.

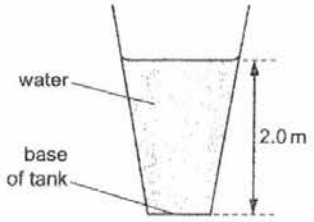


A small volume of paraffin is added to the right-hand arm increasing the length of the paraffin column in the tube to 150 mm.

What is the new difference between the surface levels of the water and paraffin in the two arms?

A 25 mm **B** 30 mm **C** 38 mm **D** 50 mm

12 A tank with sloping sides contains water to a depth of 2.0 m. The



The gravitational field strength g is 10 N/kg.

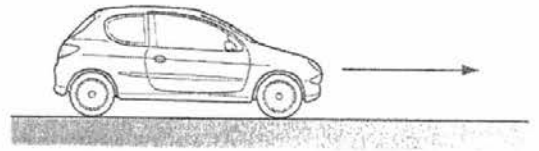
The density of water is 1000 kg/m^3.

The base of the tank has an area of 2.0 m^2.

What is the force caused by the water on the base of the tank?

A 400 N **B** 2500 N **C** 20 000 N **D** 40 000 N

13 A car is driven along a level road. The total energy input from the petrol is 100 kJ and the car wastes 40 kJ of energy.



What is the efficiency of the car?

A 20% **B** 40% **C** 60% **D** 80%

14 Which statement about a fixed mass of gas is correct?

A As pressure increases at constant temperature, the volume decreases.

B As pressure increases at constant temperature, the volume increases.

C As temperature increases at constant pressure, the volume decreases.

D As temperature increases at constant volume, the pressure decreases.

15 What describes the volume and shape of a gas or liquid at constant temperature?

A The volume of a gas is fixed but its shape is not fixed.

B The volume of a gas is not fixed and its shape is not fixed.

C The volume of a liquid is fixed and its shape is fixed.

D The volume of a liquid is not fixed but its shape is fixed.

16 Air in a closed container contains smoke, illuminated by bright light. When viewed through microscope, bright specks of light are seen moving at random.

Which statement is correct?

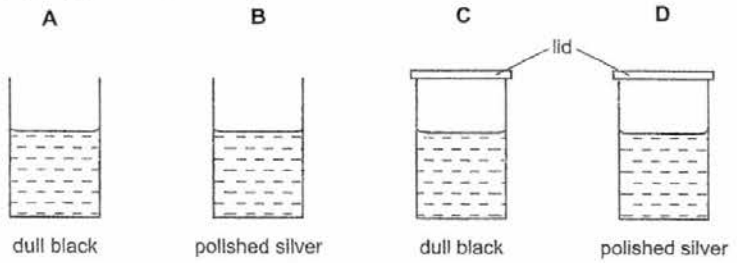
A The random motion of the specks is faster in a vacuum.

B The specks move faster when the air is at a higher temperature.

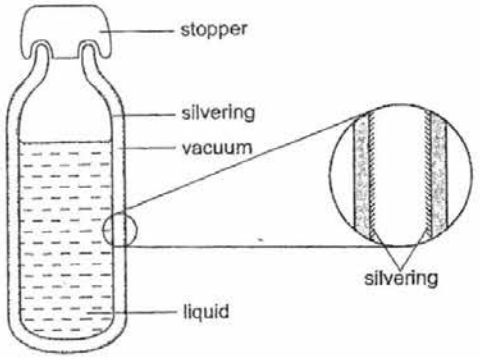
C The specks seen are molecules of air in rapid random motion.

D When the light is turned off, the specks slow down and stop moving.

17 The diagram shows four identical cans with their outside surfaces painted either dull black or polished silver. Each can contains the same volume of water, initially at 80 °C. After five minutes in a cool room, which can contains the hottest water?



18 The diagram shows a vacuum flask and an enlarged view of a section through the flask wall.



The main reason for the silvering is to reduce heat transfer by

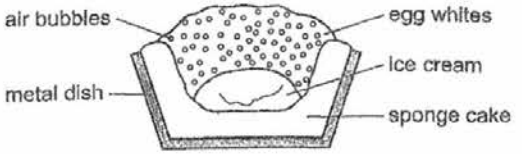
A conduction only.

B conduction and convection.

C radiation only.

D radiation and convection.

19 A cook makes the pudding 'baked Alaska'.



The pudding is placed in a very hot oven until the top of the egg white turns brown. It is then removed from the oven.

Why does the ice cream stay cold?

A Air is a good conductor of heat and conducts the heat away from the ice cream.

B Air is a poor conductor of heat and slows the heat from reaching the ice cream.

C The metal dish is a good conductor of heat and conducts the heat away from the ice cream.

D The metal dish is a poor conductor of heat and slows the heat from reaching the ice cream.

20 The bulb of a thermometer is wrapped in a tube of cotton fabric. The fabric is dipped into a cup containing water at room temperature and left for some time. The thermometer wrapped in wet fabric is then removed from the cup and evaporation takes place.

What happens to the thermometer reading?

A It falls.

B It remains unchanged.

C It rises.

D It rises and then falls.

21 The thermal properties of various materials have some useful applications.

Which device makes use of thermal expansion of a liquid?

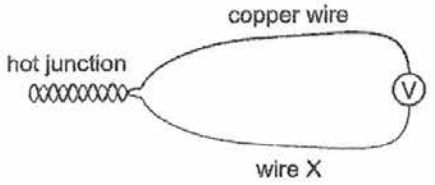
A barometer

B liquid-in-glass thermometer

C manometer

D thermistor

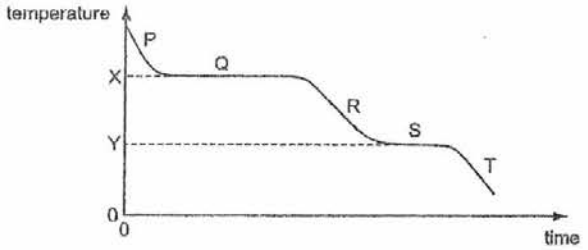
A thermocouple thermometer is made from two wires connected to a voltmeter.



Which combination gives a reading on the voltmeter?

	temperature of voltmeter	wire X
A	colder than hot junction	copper
B	colder than hot junction	iron
C	same as hot junction	copper
D	same as hot junction	iron

23 A gas in a container is at high temperature and loses thermal energy to its surroundings.
The graph shows how its temperature varies with time.



Which feature of the graph indicates that the specific latent of vaporisation of the substance is greater than its specific latent heat of fusion?

A The gradient of the graph at P is greater than the gradient of the gradient at R.

B The gradient of the graph at T is greater than the gradient of the gradient at R.

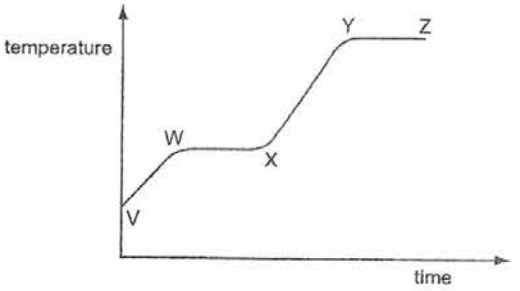
C The length of the line Q is greater than the length of the line S.

D The value of X is greater than the value of Y.

24 An electric kettle contains 500 g of water at 15 °C. The heating element of the kettle is rated at 2.2 kW and the specific heat capacity of water is 4200 J/kg °C.
Assuming there is no heat loss, calculate the minimum time it takes to raise the temperature of the water to 100 °C.

A 22 s **B** 81 s **C** 95 s **D** 81 000 s

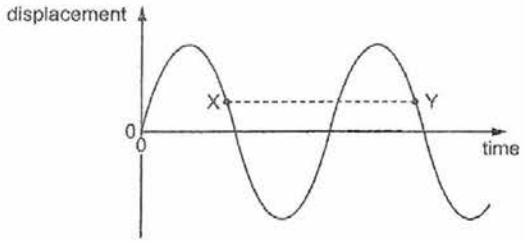
25 A beaker of ice is taken from a freezer and heated.
The graph shows the temperature of the beaker and its content during the experiment.



Between which two points on the graph does the beaker contain a mixture of liquid and solid?

A V and W **B** W and X **C** X and Y **D** Y and Z

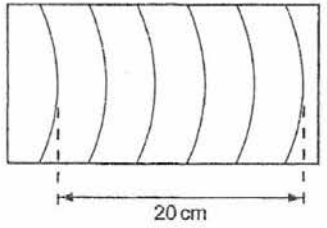
26 The diagram shows a graph of wave motion.



The separation XY on the graph represents .....1..... of the wave.
X and Y have equal .....2..... .
Which words correctly complete 1 and 2?

	1	2
A	period	wavefronts
B	period	displacements
C	wavelength	wavefronts
D	wavelength	displacements

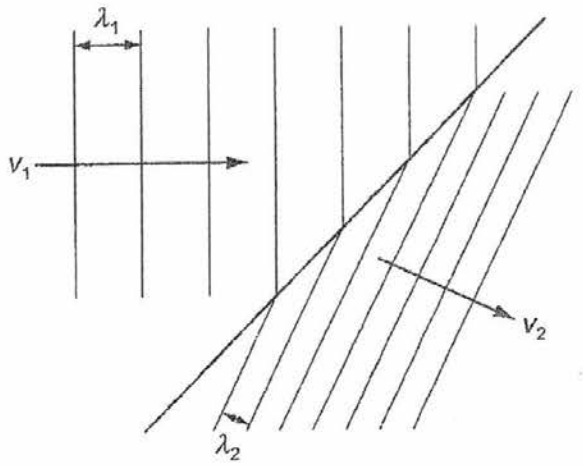
27 A dipper in a ripple tank vibrates at a frequency of 4.0 Hz and the resulting wave pattern is photographed.
The distance between the two crests shown is 20 cm.



What is the speed of the wave?

A 4 cm/s **B** 5 cm/s **C** 16 cm/s **D** 20 cm/s

28 A plane wave in a ripple tank undergoes refraction.
Initially, the wave has wavelength λ_1 = 3.0 cm and speed V_1 = 0.20 m/s.
After refraction, the wave has wavelength λ_2 = 1.5 cm.



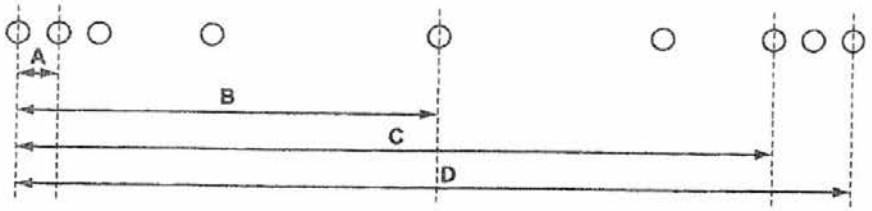
What is the speed V_2 of the wave after refraction?

A 0.10 m/s
B 0.30 m/s
C 0.40 m/s
D 0.60 m/s

29 A ray of light in a glass block is incident on a boundary with air at an angle of incidence of 40°. The critical angle at this boundary is 43°.
What happens to the ray of light at the boundary?

A It is partly reflected back into the glass and partly refracted along the boundary.
B It is partly reflected back into the glass and partly refracted into the air.
C It is totally reflected back into the glass.
D It is totally refracted into the air.

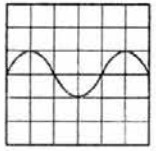
A sound wave passes through air. The diagram represents the arrangement of air molecules at one instant.
Which distance is the wavelength of the sound wave?



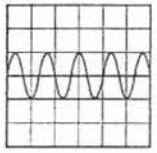
31 Which waves consist of compressions and rarefactions?

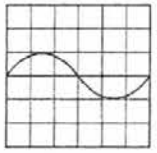
A gamma rays
B infra-red waves
C radio waves
D ultrasound waves

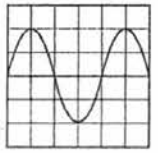
32 The diagram shows the trace on a cathode-ray oscilloscope when a microphone which is connected to it picks up a sound.

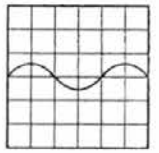


Which trace is obtained when the sound wave is changed to one of higher pitch but the same loudness?

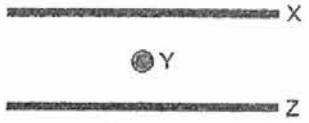
A


B


C


D


33 The diagram shows two charged horizontal plates X and Y viewed from the side.
A charged sphere Y of mass *m* is suspended stationary in the uniform electric field between the two plates.



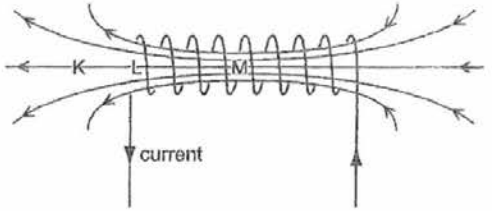
What row shows the possible signs of the charges on the three components?

	plate X	sphere Y	plate Z
A	negative	positive	negative
B	negative	positive	positive
C	positive	positive	negative
D	positive	negative	positive

34 A student tries to magnetise a short steel rod.
Which of these tests shows that he has been successful?

A both ends of a permanent magnet attract the rod
B one end of a permanent magnet repels the rod
C the rod picks up a small piece of paper
D when free suspended, the rod points in any direction

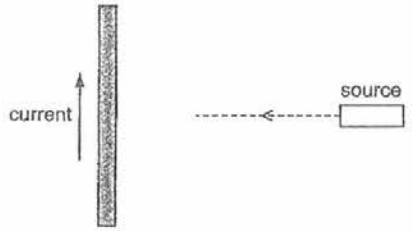
35 The diagram shows the magnetic field pattern due to a current in a solenoid.



Which statement is correct?

A The strength of the field is greater at K than it is at L.
B The strength of the field is greater at M than it is at L.
C The strength of the field is the same at K as it is at M.
D The strength of the field is the same at L as it is at M.

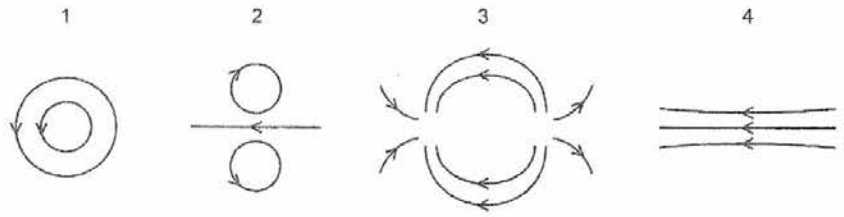
36 The diagram shows a long vertical wire carrying current. A source fires a horizontal beam of positive charges towards the wire.



As the charges approach the wire, they experience a force due to the field of the current. What is the direction of this force?

A down
B left
C right
D up

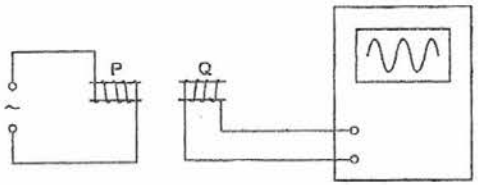
37 Four magnetic fields are shown.



What is the correct order for objects to match these fields?

	1	2	3	4
A	flat circular coil	bar magnet	solenoid	long straight wire
B	flat circular coil	solenoid	bar magnet	long straight wire
C	long straight wire	flat circular coil	bar magnet	solenoid
D	long straight wire	solenoid	bar magnet	flat circular coil

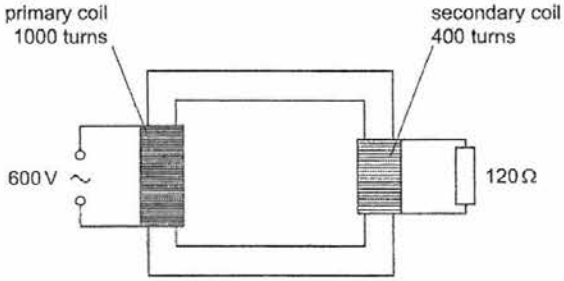
38 A coil P is connected to a 50 Hz alternating supply. Coil P lies close to a separate coil Q which is connected to a cathode-ray oscilloscope. A waveform appears on the screen of the oscilloscope.



If the coils are now linked by a soft iron core, what would be the effect on the waveform?

	height of waveform	number of cycles on screen
A	increases	increases
B	increases	stays the same
C	stays the same	increases
D	stays the same	stays the same

39 An ideal transformer has a primary coil of 1000 turns and a secondary coil of 400 turns. The primary voltage is 600 V and the secondary coil is attached to a resistor of resistance 120 Ω.

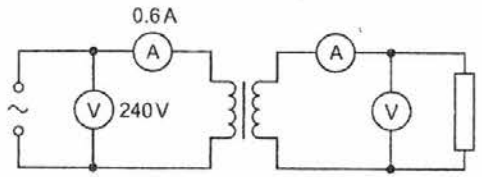


What is the power dissipated in the resistor?

A 120 W **B** 244 W **C** 480 W **D** 3000 W

17

The diagram shows an ideal transformer connected to a resistor.



Which row shows possible readings for the voltmeter and the ammeter in the output circuit?

	voltmeter reading	ammeter reading
A	40 V	360 mA
B	120 V	300 mA
C	360 V	0.4 A
D	400 V	1 A

Answers

ıPER 1 [40 marks] (DURATION: 1 HOUR)

1	C	21	B
2	B	22	B
3	C	23	C
4	D	24	B
5	B	25	B
6	B	26	B
7	A	27	C
8	D	28	A
9	D	29	B
10	C	30	C
11	B	31	D
12	D	32	A
13	C	33	B
14	A	34	B
15	B	35	B
16	B	36	A
17	D	37	C
18	C	38	B
19	B	39	C
20	A	40	C

ass:	Index No:	Name:

TAMPINES SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

Physics
Paper 2 Theory

5059/02
30th August 2016
1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A (50 marks)
Answer **all** questions.

Section B (30 marks)
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

INFORMATION FOR CANDIDATES
Use of calculator is allowed.

Parent's Signature: _____

Marks	
Section A (50 marks)	
Section B (30 marks)	
Total (80 marks)	

This document consists of 22 printed pages (including this cover page).

Setter: Mr Ng Weilun

Section A (50 marks)

Answer **all** the questions in this section.

1 Fig. 1.1 shows a set of traffic lights supported by two cables, **A** and **B**, which hang from a pole. The set of traffic lights is in equilibrium.

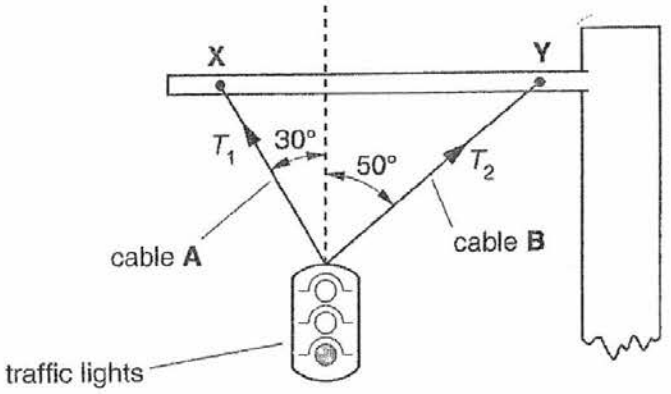


Fig. 1.1

The weight of the set of traffic lights is 350 N. The weight of the cables and pole is negligible. The tensions in the cables **A** and **B** are T_1 and T_2 respectively.

In the space below, draw a labelled vector diagram to show the resultant of the two tensions. State the scale used.

Hence, determine the magnitudes of T_1 and T_2.

scale = ...

T_1 = ...

T_2 = ...

A stone falls from the top of a cliff into the sea, as shown in Fig. 2.1.
The velocity-time graph for the stone is shown in Fig. 2.2.

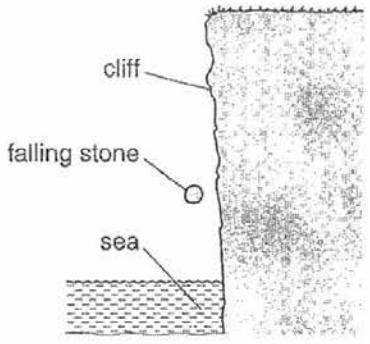


Fig. 2.1

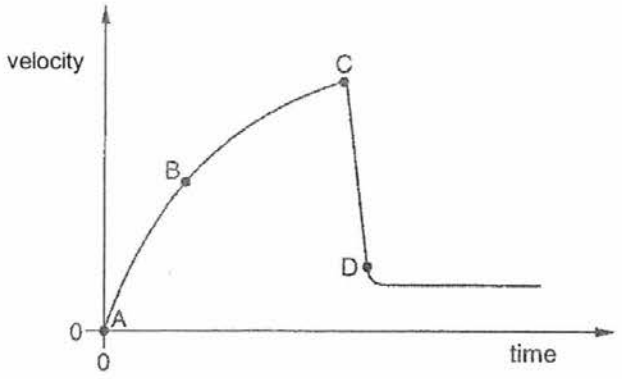


Fig. 2.2

(a) State how acceleration is found from a velocity-time graph.

..... [1]

(b) Describe how the acceleration of the stone changes between point A and point D.

.....

.....

.....

..... [3]

(c) Explain, in terms of the forces acting, why the acceleration changes between point A and point B.

.....

.....

.....

..... [3]

(d) Explain how Fig. 2.2 shows that the stone does not reach terminal velocity in the air.

.....

..... [1]

Fig. 3.1 shows a metal pan containing water on a cooker. The hotplate heats the water.

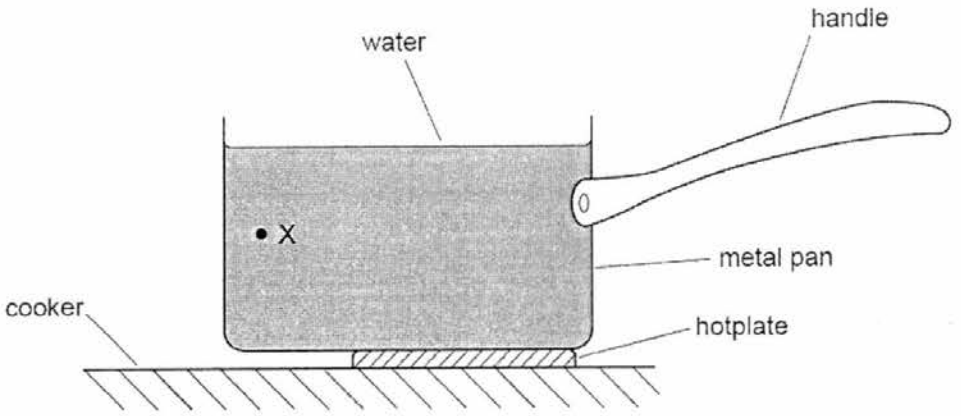


Fig. 3.1

(a) Describe how the particles transfer heat through the metal pan.

.....

.....

..... [1]

(b) **(i)** On Fig. 3.1, draw an arrow to show the direction of movement of the water at point X. [1]

(ii) Explain why the water moves in this direction.

.....

.....

.....

.....

..... [3]

4 **(a)** State the principle of moments.

.....

.....

..... [2]

(b) Fig. 4.1 shows a simplified diagram of the handbrake lever of a car. Distances are marked on Fig. 4.1.

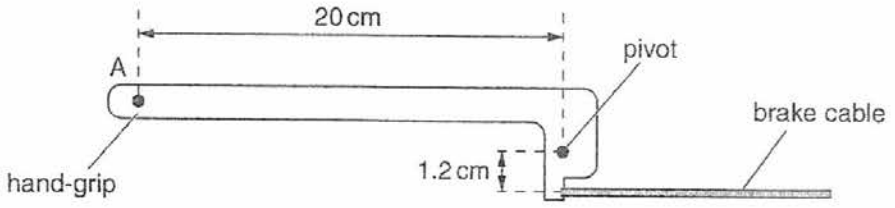


Fig. 4.1 (not to scale)

A force of 30 N is applied by the car driver at point A.

(i) Describe how, with a 30 N force at A, the driver can produce the largest moment about the pivot.

.....

..... [1]

(ii) Calculate the largest moment of this force about the pivot.

moment = ... [2]

(iii) Calculate the largest force in the cable brake.

force = ...

Fig. 5.1 shows part of a machine for making coffee. Water is heated and changes into steam. The steam is produced at 100 °C and is used to heat milk.

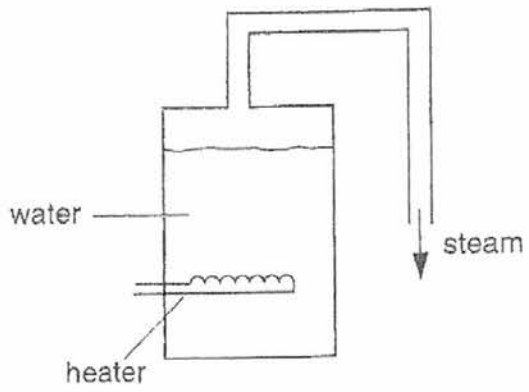


Fig. 5.1

The machine initially contains 500 g of boiling water.
The heater transfers 1.2 kJ of energy to the water every second.
The heater switches off when 100 g of water remains in the machine.
The specific latent heat of vaporisation of water is 2250 J/g.

(a) Define *specific latent heat of vaporisation*.

.....

.....

..... [2]

(b) Calculate the time for which the machine produces steam.

time = ... [3]

Fig. 6.1 shows an air bubble in water. Three rays of light are incident on the air bubble.

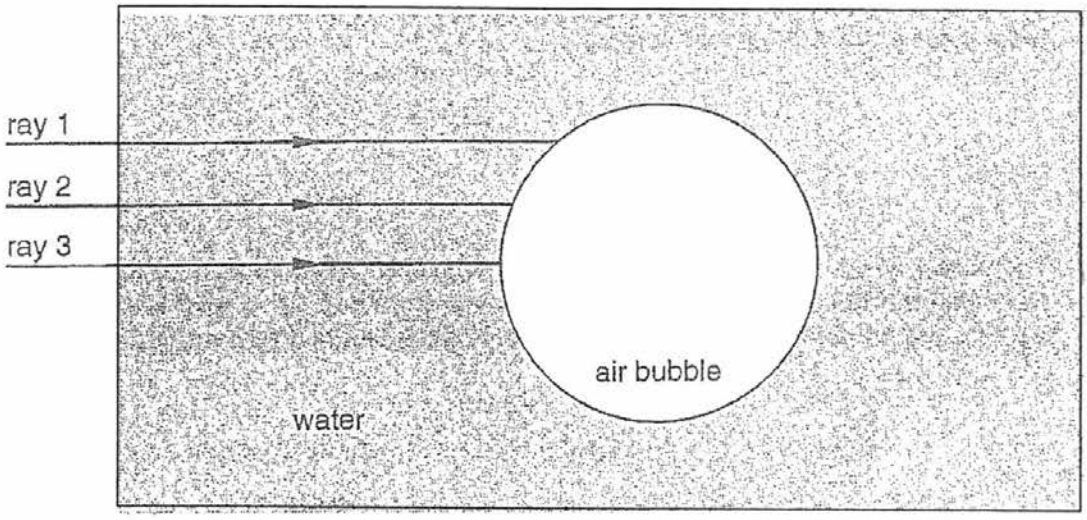


Fig. 6.1

The angle of incidence of ray 1 on the air bubble is greater than the critical angle.
The angle of incidence of ray 2 on the air bubble is less than the critical angle.
Ray 3 is perpendicular to the surface of the air bubble.

(a) On Fig. 6.1, at the point where ray 1 meets the air bubble, mark

(i) the normal to the surface.

(ii) the angle of incidence.

[2]

(b) Complete Fig. 6.1 to show how all three rays continue after they meet the air bubble.

[3]

Stars that are being formed emit infra-red radiation. Some of this radiation is received by a telescope that orbits the Earth. Microwave signals from the telescope are sent to the Earth's surface, as shown in Fig. 7.1.

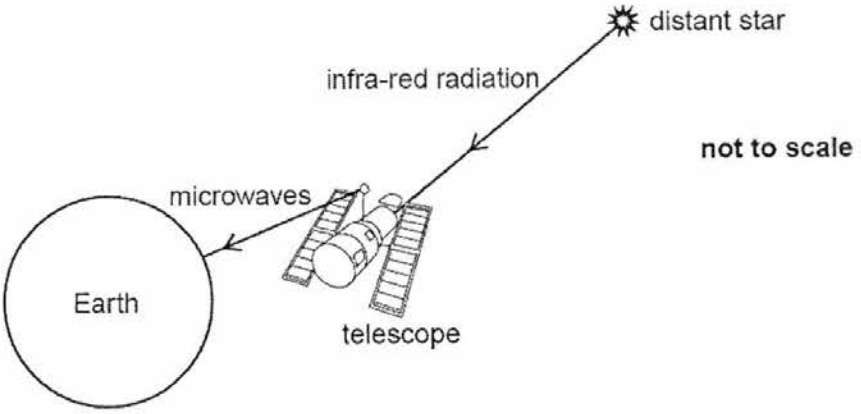


Fig. 7.1

Infra-red and microwave radiation are both part of the electromagnetic spectrum.
State **two** similarities and give **one** difference between infra-red and microwave radiation.

.....

.....

.....

..... [3]

8 **(a)** An insulated plate is rubbed with a cloth and becomes positively charged.
Explain, in terms of the movement of electrons, how the plate becomes positively charged.

.....

.....

..... [2]

(b) Two stages in the production of a photocopy are shown in Fig. 8.1.

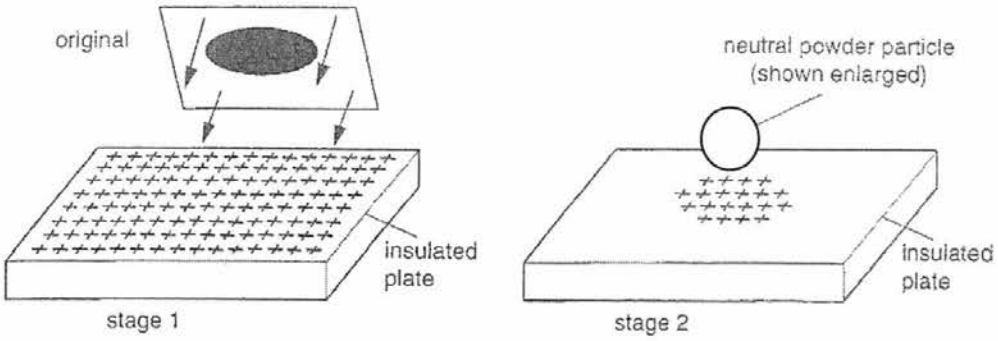


Fig. 8.1

In stage 1, reflected light from the white parts of the original hits the positively charged plate, leaving it as shown in stage 2.
Black powder (toner) is then sprayed onto the plate.
One neutral powder particle is shown enlarged in stage 2.

(i) Based on the information provided, state the effect of light on the charged plate.

.....

.....

..... [1]

(ii) On Fig. 8.1 stage 2, draw the charge distribution on the neutral powder particle.

[1]

(iii) Explain why the particle of powder is attracted to and sticks to the charged plate.

.....

.....

.....

.....

..... [2]

Fig. 9.1 shows a d.c. motor.

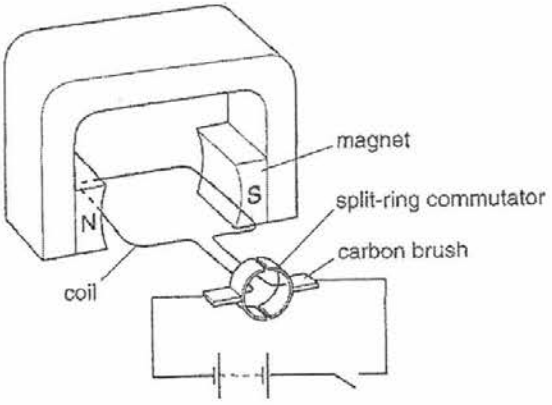


Fig. 9.1

The coil is horizontal, as shown in Fig. 9.1.

(a) **(i)** Explain why the coil turns when the switch is closed.

.....

.....

..... [2]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180°.

.....

.....

..... [2]

(b) Fig. 9.2 shows how the moment acting on the coil depends on time.

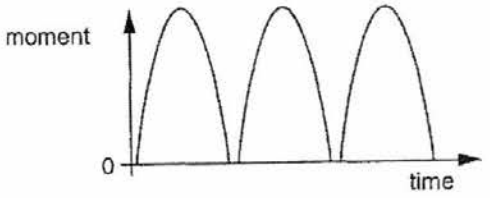


Fig. 9.2

(i) On Fig. 9.2, mark with letter H one time when the coil is horizontal. [1]

(ii) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 9.2.

1. .....

2. .....

Section B (30 marks)

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11**.

10 According to some scientists, battery-powered cars offer many advantages over petrol-driven cars. Rechargeable led-acid batteries are the most common type of batteries used in cars. The data below shows some properties of petrol, of a particular lead-acid battery and of a typical car.

Petrol

density = 700 kg/m^3

chemical potential energy available = 45 MJ/kg

Typical lead-acid battery

chemical potential energy available when fully charged = 2.8 MJ

mass = 20 kg

e.m.f. = 12 V

Car

volume of petrol tank = 4.0×10^{-2} m^3

efficiency of transfer of chemical potential energy of petrol to kinetic energy of car = 25%

drag force (air resistance) at 30 m/s = 580 N

(a) Calculate the chemical potential energy available from a full tank of petrol.

energy = ... [3]

(b) A fully-charged lead-acid battery delivers a constant current of 8.0 A. Calculate the time in hours before the battery needs to be charged again.

time = ... h [2]

(c) **(i)** Calculate the total mass of lead-acid batteries needed to provide the same amount of chemical potential energy as a full tank of petrol.

mass = ... [2]

(ii) Applying Newton's laws, suggest how your answer to **(c)(i)** may affect the performance of a battery-powered car.

.....

.....

..... [2]

(d) The drag force on the car is directly proportional to the square of its speed.
Using the formula:

power required by car to overcome air resistance = drag force × speed,

show that reduction of speed by 20% can lead to a power saving of almost 50%.

[2]

A particular type of slide for children in a theme park is called 'drop slide'. This is a slide which for the first part of the fall is vertical. Fig. 11.1 shows a child of mass 28 kg on a drop slide.

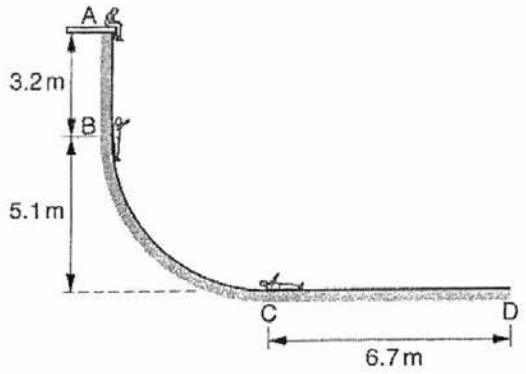


Fig. 11.1

The child drops from A to B, a distance of 3.2 m, before reaching the surface of the slide and then travels around a bend from B to C, while falling a further distance of 5.1 m. At C, the child's speed is the same as it was at B. After this, the child travels 6.7 m horizontally before stopping at D.

(a) Assuming air resistance to be negligible between A and B, calculate the child's speed at B.

speed = ... [2]

(b) Determine the loss of gravitational potential energy of the child between B and C.

loss of gravitational potential energy = ...

(c) Explain why the child's speed is the same at B and C even though there is a loss of gravitational potential energy.

.....

.....

..... [2]

(d) **(i)** Define *work*.

.....

..... [1]

(ii) Calculate the average frictional force slowing the child between C and D.

force = ... [2]

EITHER

(a) During a thunderstorm, a lightning strike has an average current of 1.5×10^4 A. The charge transferred to the ground is 32 C.

Calculate the duration of the lightning strike.

duration = ... [2]

(b) Fig. 11.1 shows a circuit.

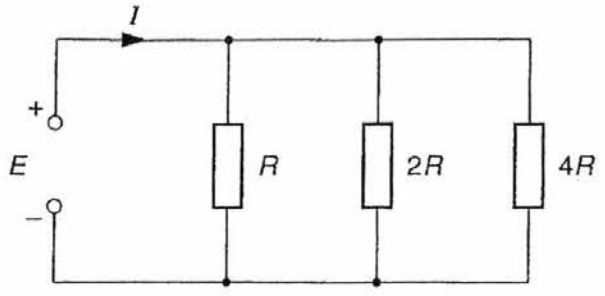


Fig. 12.1

The resistances of the resistors are R, $2R$ and $4R$. The supply has electromotive force, E.

(i) Define the *electromotive force* of the supply.

.....

..... [1]

(ii) Calculate

1. the total resistance of the circuit in terms of R,

resistance = ... [2]

2. the current from the supply in terms of E and R.

current = ... [1]

(c) Fig. 12.2 shows a circuit consisting of two resistors connected in series to a d.c. supply.

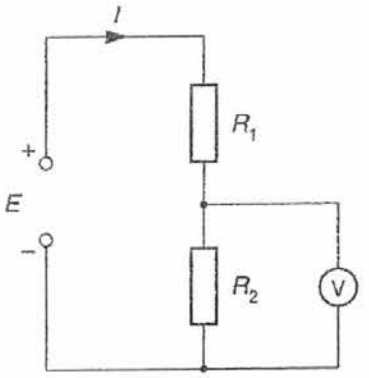


Fig. 12.2

The resistors have resistances R_1 and R_2. The supply has electromotive force, E. The current from the supply is I.

(i) Show that the voltmeter reading V is given by the relation

$$V = \left(\frac{R_2}{R_1 + R_2} \right) E .$$

[2]

(ii) Fig. 12.3 shows a circuit that includes a thermistor.

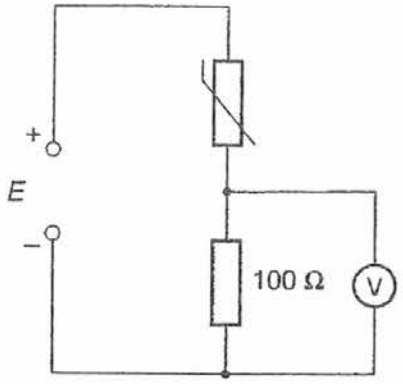


Fig. 12.3

Describe and explain how the voltmeter reading changes as the temperature of the thermistor is increased.

.....

.....

.....

.....

.....

..... [2]

OR

(a) A variable resistor is connected to the terminals of a d.c. supply of e.m.f. 600 V. Fig. 12.4 shows how the resistance R of the variable resistor varies with the power P dissipated in the variable resistor.

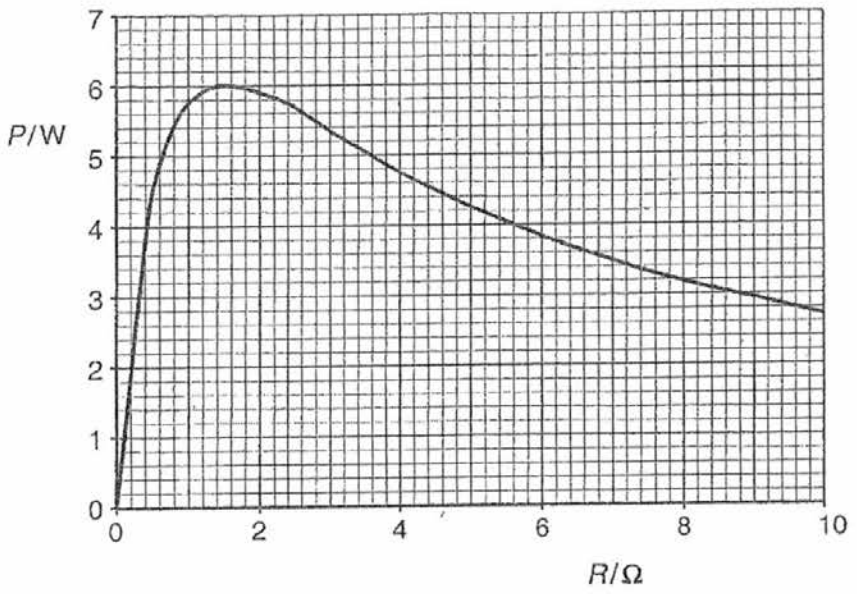


Fig. 12.4

State the maximum power dissipated. Hence, calculate the current in the circuit for maximum power dissipation in the variable resistor.

current = ... [3]

(b) A fully charged car battery has an e.m.f of 12 V. This battery can deliver a constant current of 2.1 A for a period of 5.0 hours. The fully charged car battery is connected to a starter motor, four sidelights and two headlights as shown in Fig. 12.5.

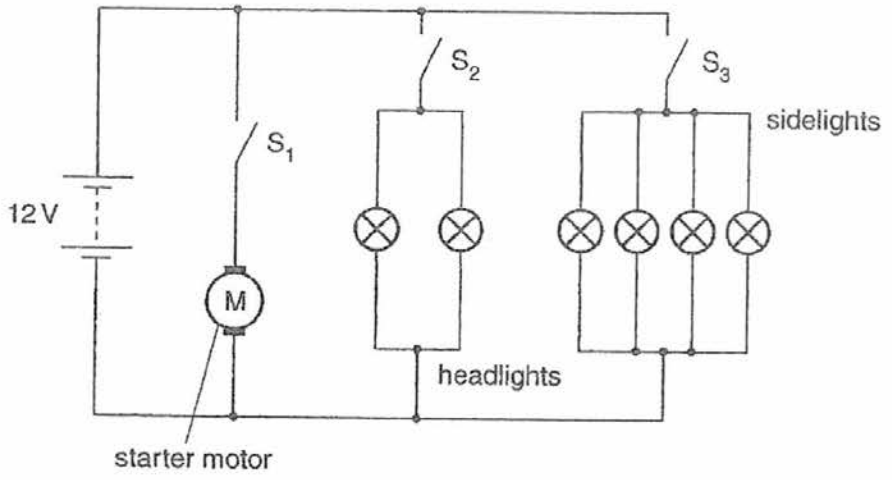


Fig. 12.5

At 12 V, the power rating of each headlight is 48 W. When operating at 12 V, the material of the filament has resistivity of 7.9×10^{-7} Ω m and radius of 9.0×10^{-5} m.

(i) Calculate the resistance of a single headlight.

resistance = ... [2]

(ii) Given the formula

$$R = \frac{\rho L}{A}$$

where

R: resistance of the material,

ρ: resistivity of the material,

L: length of the material,

A: cross-sectional area of the material,

calculate the length of the filament of the headlight. Comment on your answer.

length = ... [2]

comment: .....

.....

..... [1]

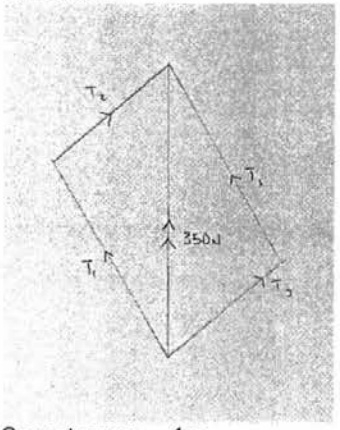
(iii) The resistance of each sidelight is 24 Ω. Calculate the current in the battery when switches S_2 and S_3 are closed and switch S_1 is open.

current = ...

iswers

ction A

Question 1



Correct arrows – 1m
Correct orientation – 1m
1 cm : 50 N OR 1 cm : 35 N OR 1 cm : 25 N
T1 = 275 N (260 N to 290 N)
T_2 = 175 N (160 N to 190 N)

Question 2

(a)
The acceleration is found from the gradient of the velocity-time graph.

(b)
From point A to point C, the stone undergoes decreasing [0.5]
acceleration [1].
From point C to point D, the stone undergoes constant [0.5]
deceleration [1].

(c)
From point A to point B, the air resistance acting on the stone increases while the weight of the stone remains constant. [1]
The two forces act in opposite direction [0.5].
Hence, the resultant force of the stone decreases [0.5].
Since resultant force of a body is equal to the product of its mass and acceleration, acceleration decreases [1].

(d)
The speed of the stone does not become constant before the stone undergoes constant deceleration takes place as it enters the sea.

"Horizontal straight line" is not accepted as it can also imply velocity is zero (i.e. not moving).

Candidates must be specific in telling the examiner which part of the graph indicates the object is in air and which part is in sea.

Question 3

(a)
The particles near the hot plate vibrate faster and collide with (OR hit) their neighbouring particles, transferring the thermal energy through the metal pan.

OR

Free electrons gain energy and move through metal. They collide with (OR hit) the particles in the process.

(bi) *downward at X*

(bii) Water at the bottom gains thermal energy and expands, which causes it to rise. The cold denser water at the top sinks to replace the warm water, setting up a convection current

Question 4

(a)
When an object is in equilibrium, the sum of anti-clockwise moments about a pivot is equal to the sum of clockwise moments about the same pivot.

Mention moments are equal to – award 1m
Mention the same pivot – award 1m
Did not mention "sum of" – deduct 1m
Did not mention "about a point/ pivot" – deduct 1m

(bi)
The 30 N force is exerted at a location which has the longest perpendicular distance from the pivot to the force, hence producing the largest moment about the pivot.

(bii)
moment = F x perpendicular distance
= 30 x 0.20
= 6.0 Nm
OR
moment = F x perpendicular distance
= 30 x 20
= 600 Ncm

(biii)
moment = F x perpendicular distance
600 = F in the brake cable x 1.2
F in brake cable = 500 N

Question 5

(a)
Specific latent heat of vaporisation is the amount of thermal energy required to change unit mass of a substance from liquid state to gaseous state, without a change in temperature.

Mention "from liquid to gas" AND "without change in temperature" – award 1m
Mention "unit mass" – award 1m
No credit for illogical answers although the phrases were mentioned.

(b)
mass of steam produced = 500 – 100 = 400 g
Award 1m

amount of thermal energy supplied = ml_v
= 400 x 2250
= 900000 J

time taken = amount of thermal energy supplied / power rating of heater
= 900000/1200
= 750 s
= 12.5 minutes
Award 1m for either working.

Award 1m for correct answer.

Question 6

(ai)
draw a gradient at the point where the ray 1 touches the surface of the bubble; draw a normal from the gradient to the centre of the bubble
(angle between ray 1 and normal is from 38° to 42°)

(aii)
the angle of incidence is measured from the normal to ray 1

(b)
ray 1 will undergo total internal reflection in the water
ray 2 will refract away from the normal (in an upward manner)
ray 3 will travel in a straight line with no refraction

award mark based on estimation

Question 7

similarities:
same speed (in vacuum)
travel in a vacuum
travel in straight lines
refract/reflect/
carry energy

transverse

differences:
wavelength
frequency

Question 8

(a)
The electrons move from the plate to the cloth, [1]
resulting in the plates to have excess positive charge. [1]
This causes the plate to become positively charged.

Mention "less negative charge/ electron" is not sufficient as the object can still be negatively charged.
Candidates must also be specific over where the charges are since there are two objects here: Plate and cloth.

(bi)
Light neutralises the charge on the plate.

(bii)
negative charge at the bottom and positive charge at the top of the powder particle

(biii)
The negative charge on the particle is attracted to positive charge on the plate. [1]
This is because the force of repulsion between positive charges on the plate and particle is weaker than the attractive force between the positive charge on the plate and the negative charge on the particle. [1]

Question 9

(ai) When the switch is closed, current flows in the coil. [1]
By using Fleming's left-hand rule, the side of the coil next to the N-pole experiences an upward force while the side of the coil next to the S-pole experiences a downward force. [1]
This results in the coil to turn.

(aii) The direction of the current in the coil reverses after it has turned 180°. [1]
However, the force acting on the side of the coil next to the N-pole continues to act upward in the same direction as before. [1]

(bi)
H is indicated at any of the peak.

(bii)
1. The peak of the curve becomes higher. / The moment acting on the coil increases.

2. The frequency of the curve increase. / The time for one period on the graph decrease

ction B

uestion 10

(a)
mass of petrol = density × volume [1]
= 700 × 4.0 × 10^{-2} = 28 kg [1]
chemical potential energy = 45 × 10^6 × 28 = 1.26 × 10^9 J [1]

Marker's comments:
Pure mathematical workings are commonly seen for this question. No marks were deducted but candidates should note that full credit may not be awarded in O levels.
Majority of candidates did well for this question but weaker candidates did not know their prefixes well.

(b)
P = IV = 8.0 × 12 = 96 W
P = E/t
t = E/P
= 2.8 × 10^6 / 96
= 29166.7 s
= 8.10 h

Marker's comments:
Pure mathematical workings are commonly seen for this question. No marks were deducted but candidates should note that full credit may not be awarded in O levels.
Many candidates did well for this question but weaker candidates did not know which formulas to apply.

(ci)
number of lead-acid batteries required = (1.26 × 10^9 /2.8 × 10^6) = 450
total mass = 450 × 20 = 9000 kg

Marker's comments:
Pure mathematical workings are commonly seen for this question. No marks were deducted but candidates should note that full credit may not be awarded in O levels.
Many candidates did well for this question.

(cii)
The mass of a battery-powered car is higher. [1]
By Newton's second law, if the resultant force on the car remains the same, the car will have lower acceleration. [1]

OR

The car has higher inertia. [1]
By Newton's first law, it takes a longer time for the car to start moving. [1]

Marker's comments:

Only stronger candidates correctly mentioned about Newton's first law or second law however many failed to mention about the mass or inertia of the battery-powered car being higher. Hence only few candidates obtained full credit.

(d)
$F = kv^2$
$580 = k \times 30^2$
$k = 29/45 = 0.64444$

P = 580 × 30 = 17 400 W

Award 1m for either working.

If speed is reduced by 20%,
v' = 0.8 × 30 = 24
$F' = 29/45 \times 24^2 = 371.2$
P' = 371.2 × 24 = 8908.8 W [1]

Power saving = (17400 – 8908.8) / 17400 = 0.488 (shown)

Marker's comments:
Stronger candidates were able to calculate the new power correctly however many failed to calculate the power saving. Hence only few candidates obtained full credit.

Question 11

(a)
Total energy at A = Total energy at B
GPE at A = GPE at B + KE at B
$28 \times 10 \times 8.3 = 28 \times 10 \times 5.1 + \frac{1}{2} \times 28 \times v^2$
$83 = 51 + \frac{1}{2} \times v^2$
v = 8.0 m/s

Marker's comments:
This question was generally well answered. However, many candidates did not account for the GPE at A and the GPE at B, they simply used 28 x 10 x 3.2.
Answer was commonly left as 8 m/s but marks were not deducted for the error in significant figures. Candidates are reminded to leave their answers in 2 or 3 significant figures.

(b)
loss in GPE = mgh [1]
= 28 × 10 x 5.1 [1]
= 1428 J
= 1430 J (3 sf) [1]

Marker's comments:
This question was generally well answered.
Answer was commonly left as 1428 J but marks were not deducted for the error in significant figures. Candidates are reminded to leave their answers in 2 or 3 significant figures.

(c)
The loss of gravitational potential energy of 1430 J from B to C is not converted to kinetic energy but converted to thermal and sound energy. [1]

Since kinetic energy of the boy is proportional to the square of his speed based on the formula: KE = ½ × m × v^2, the speed of the boy at C is not increased. [1]

Marker's comments:
This question was not well answered. Many candidates stated that the loss of PE was converted to KE.
Even fewer candidates mentioned that the KE remained the same and thus the speed did not change.

(di)
Work is the product of force and the distance travelled in the same direction as the force.

Marker's comments:
It was surprising that majority of candidates did not know the definition of work with many stating the distance parallel to the force.

(dii)
Energy at C = KE
= work done against friction
½ × 28 × 8^2 = frictional force × 6.7
frictional force = 133.73 N
= 134 N

Marker's comments:
Majority of candidates did not gain credit for this question because of a lack of appreciation of the conversion of KE to work done against friction.

Question 12 (1st option)

(a)
Q = It [1]
32 = 1.5 × 10^4 × t [1]
t = 2.13 × 10^{-3} s [1]

Marker's comments:
This question was generally well answered.

(bi)
Electromotive force is the work done by the supply in driving a unit charge around a complete circuit.

Marker's comments:
Some candidates knew the definition but weaker candidates failed to use the term "unit charge". Many candidates failed to use the term "complete" but no marks were deducted.

(bii)
1.
$1/R_{eff} = 1/R_1 + 1/R_2 + 1/R_3$
$1/R_{eff} = 1/R + 1/2R + 1/4R$ [1]
$1/R_{eff} = 7/(4R)$
$R_{eff} = 4R/7$ [1]

Marker's comments:
This part was generally well answered. But weaker candidates used complex mathematics to get the answer.

2.
V = IR
E = I × 4R/7
I = 7E/(4R)

Marker's comments:
Error carried forward was allowed for this question. This part was generally well answered.

(ci)
V = IR
I = V/R
= $E/(R_1 + R_2)$ ---------- Equation 1

voltmeter reading, V = IR_2
I = V/R_2 ---------- Equation 2

Equate 1 to 2

$V/R_2 = E/(R_1+R_2)$
$V = [R_2/(R_1 + R_2)] \times E$
(shown)

Marker's comments:
Only some candidates obtained full credit for this question. Many tried to use the given equation in their proof and thus gained no credit.

(cii)
As the temperature increases, the resistance of the thermistor decreases and the potential difference across the thermistor thus decreases. [1]
As the thermistor and the fixed resistor are arranged in series, this results in the potential difference across the fixed resistor to increase. [1]

Marker's comments:
Few candidates gave the correct change in potential difference with the correct reason.
CER should be applied to improve quality of answers.

Question 12 (2nd option)

)
aximum power dissipated = 6.0 W [1]

P = IV
6.0 = I × 600
I = 0.010 A [1]

Marker's comments:
This question was generally well answered with correct use of formula.

(bi)
$P = V^2/R$ [1]
$R = 12^2/48 = 3.0\ \Omega$ [1]

Marker's comments:
Weaker candidates did not know the correct formula to apply.

(bii)

cross-sectional area = πr^2
$= 2.54469 \times 10^{-8}\ m^2$

length = $(3.0 \times 2.54469 \times 10^{-8})/(7.9 \times 10^{-7})$
= 0.0966 m
= 9.66 cm

Comment: The length of the filament may be too long for the filament rendering the need to coil in the headlamp.

Marker's comments:
Only stronger candidates calculated the correct length but no candidate mentioned that the length was too long.

(biii)
$1/R_{eff} = 1/R_1 + 1/R_2$
= 1/3 + 1/3 + 1/24 + 1/24 + 1/24 + 1/24
= 5/6
$R_{eff} = 1.2\ \Omega$
I = V/R
= 12 / 1.2
= 10.0 A

Marker's comments:
Weaker candidates did not use the correct resistance in their calculations.