Sec 4 Physics

Exam papers with worked solutions

SET A

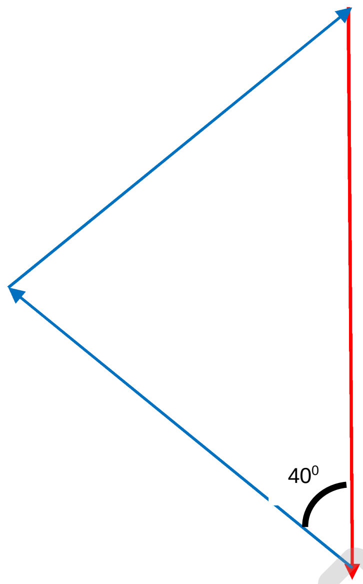
PAPER 2

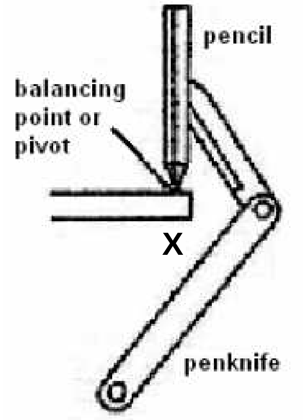
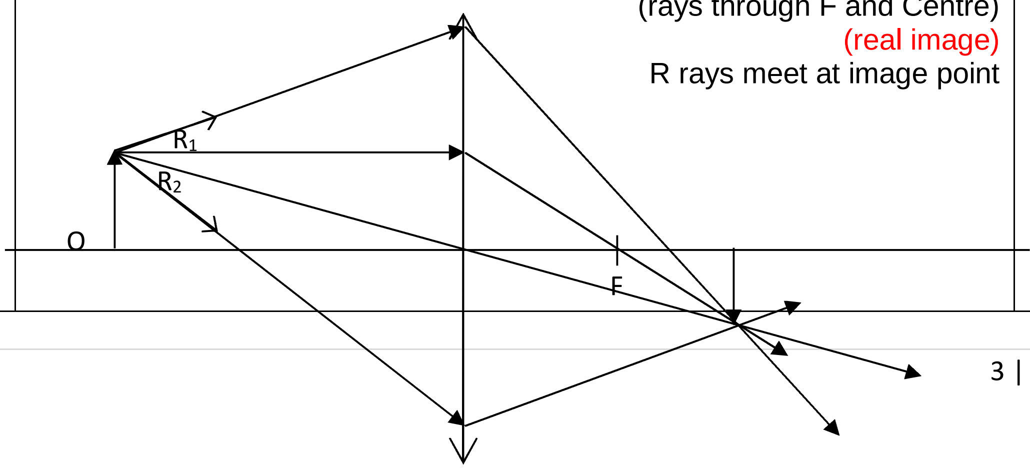
ANSWER

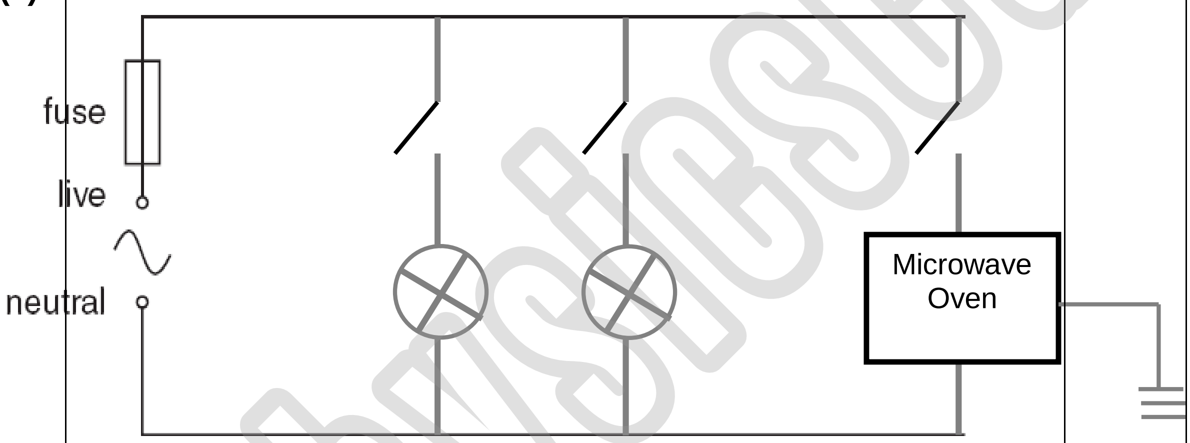
Compiled by

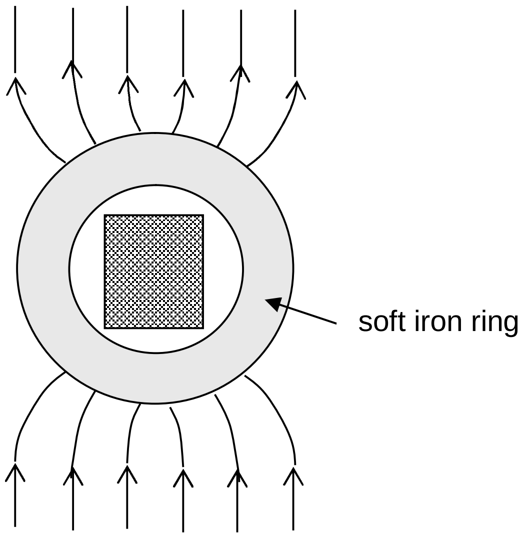
THE PHYSICS CAFE

Answers

Section A		
1(a)	 Appropriate Scale [1] Vectors drawn in correct directions [1] Answer F = 32.6 N [1]	
(b)	They can use less force to hold the pail of water if they reduce the angles between their arms and bodies.	[1]
2(a)	Using conservation of energy, ½ mu^2 + mgh = mgh ½ (20.0) $(5.0)^2$ + (20.0)(10.0)(30.0) = (20)(10)h h = 31.3 m Assumption • No energy is lost due to air resistance. • Cart will reach the top with no speed. (Not accepted: Energy is lost through friction/heat as the question already stated a smooth roller coaster)	 [1] [1] [1]
(b)	Force due to gravity and contact force act vertically downward. Force acts in direction perpendicular to the direction of motion. Hence no work done.	[1] [1]
3(a)	Since the brake fluid is incompressible, pressure at the small piston is transferred to the large piston. Since P1 = P2 F1/A1 = F2 /A2	[1] [1]
(b)	Water has low heat capacity/boiling point as compare to brake fluid.	[1]

4(a)		[1]
(b)	Stable equilibrium. As the pencil is displaced slightly, the position of CG is raised, therefore the weight creates a restoring moment for the pencil to return to its original position	[1] [1] [1]
5	Greater Same as Less than	[1] [1] [1]
6(a)	The amount of heat required to raise the temperature of 1 kg of ice by 1 degree Kelvin is 2100 J.	[1]
b(i)	The temperature did not rise. Ave KE of the molecules did not change during change of state. OR The thermal energy supplied is used to do work to overcome intermolecular forces of attraction or to increase distance between molecules.	[1]
(ii)	$Pt = m(c_i\Delta\theta_i + l_f + c_w\Delta\theta_w)$ $t = m(c_i\Delta\theta_i + l_f + c_w\Delta\theta_w)/P$ $= (0.25(2(2100) + 336000 + 15(4200))/1600 = 63$ s	 [1] [1]
(c)	The ice will cool the water at the bottom, causing its density to increase at the bottom. The denser layer will remain at the bottom, wamer lighter layer at the top, so no convection occurs.	[1] [1]
7(a)	It is a point where rays parallel to the principal axis will converge after passing through the lens.	[1]
(b)	(rays through F and Centre) (real image) R rays meet at image point 	[1] [1] [1]

8(a)	The paper's electrons will be attracted to the end nearer the positively charged rod, leaving the further end of paper positively charged. There is a stronger attraction force than repulsion, so net attraction force is experienced by the paper. Penalize for stating positive charge repelled away.	[1] [1]
(b)	As the paint leaves the nozzle, the positively charged droplets are repelled away from one another to spread evenly They are then attracted towards the negatively charged car body uniformly.	[1] [1]
9(a)	 two lamps, microwave oven are in parallel. Switches are on live wire,	[1] [1]
(bi)	Earthing on the microwave oven shown	[1]
(bii)	If there is a leak in current, it will be conducted to the ground by the earth wire and thus protecting the user.	[1]
(c)	Current through each lamp = 30/240 = 0.125 A Current through microwave oven = 800/240 = 3.33 A Maximum current = 0.125 + 0.125 + 3.33 = 3.58 A Fuse rating 5 A	[1] [1]
10(a)	If there is a large current in the circuit, the soft iron core is **strongly magnetized.** The magnetized soft iron core **attracts the iron lever upwards. The spring pulls the springy metal to the right**. The contacts and thus the circuit are broken.	[1] [1] [1]
(b)	Have less turns in the coil.	[1]
11(ai)	Place a soft iron ring around the box	[1]

(aii)		[1]
(bi)	When the switch is closed, current flows in the coil. According to <u>Fleming's Left-hand Rule</u>, an <u>upward force acts on wire PQ</u> and a <u>downward force</u> <u>acts on wire RT</u> The two forces combine to produce a clockwise <u>rotation</u> on the coil.	 [1] [1] [1]
(bii)	B is split-ring commutator It reverses the current in the coil after half a turn, so as to keep the coil rotating in the same direction.	[1] [1]
Section B		
12(a)	$2d = vt = 3152 \times 0.80 = 2521.6$ m evaluation [1] $d = 1260.8 = 1260$ m (3sf) ans + sf [1]	
(b)	$t_{air} = 2d / v = 2 \times 3000 / (3.0 \times 10^8) = 2.0 \times 10^{-5}$ s [1] $t_{ice} = 2d / v = 2 \times d_{ice} / (1.5 \times 10^8) = (6.4 - 2.0) \times 10^{-5}$ s [1] $d_{ice} = (4.4 \times 10^{-5}) \times (1.5 \times 10^8) / 2 = 3.3 \times 10^3$ m [1]	

(c)

The immense pressure of the ice above causes ice to melt at lower temperatures than it does at the surface [1]

(d)

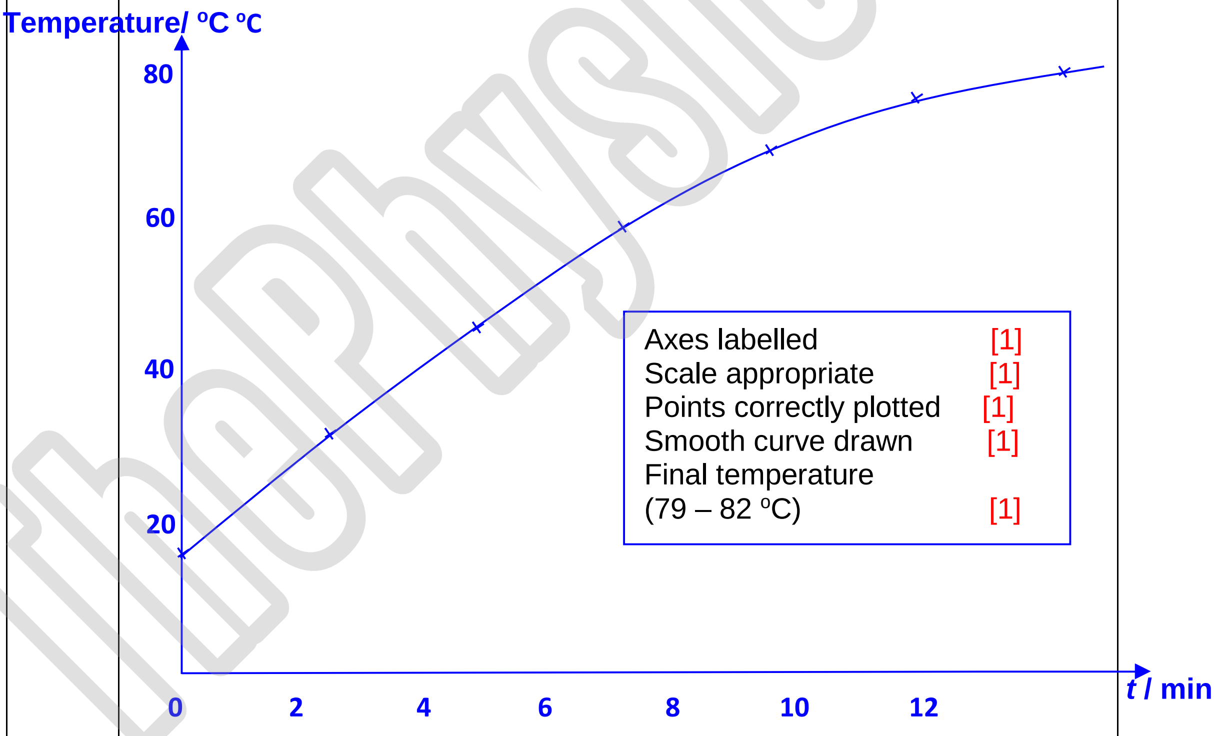
Geothermal heat is trapped and can't readily escape [1] **because of the thick layer of the ice above acts as a good insulator.** [1]

(e)

The difference between dielectric constants of polar ice and water is very much larger than that between polar ice and soil. [1]

The water reflected a much larger portion of the waves than the soil. [1]

13(a)



Axes labelled	[1]
Scale appropriate	[1]
Points correctly plotted	[1]
Smooth curve drawn	[1]
Final temperature (79 – 82 °C)	[1]

(b)

Net energy gained per second = *m c* $\Delta\theta / t$

= 0.2 x 4200 x 56 / (9 x 60) [1]

= 87.1 W [1]

$\Delta\theta$ = 55, 56, 57

P = 85.6, 87.1, 88.7

Heat energy reaches the water by conduction [1]

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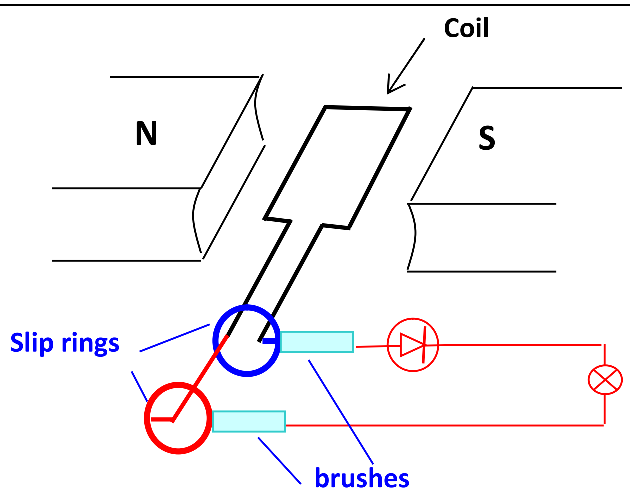
(c)	No. [1] When the water reaches about 80ºC, (rate of) heat lost to the surroundings is equal to the (rate of) heat gained from the candle. [1] Hence temperature does not rise beyond this value.	
14 EITHER		
(a)	When S is closed, current flows in coil P producing a magnetic field. [1] There is an increase (change) in magnetic flux linking coil Q. [1] A current is induced in Q. [1]	
(b)	The coils slide a little closer to each other. [1] Attraction occurs as unlike poles are produced at the ends of the coils near each other. [1]	
(ci)	 Draw and label 2 slip rings [1] Draw and label 2 brushes [1]	
(cii)	Connect the bulb and the diode in series as shown. [1] Repeat with the terminals of the diode in reverse in the circuit. [1] If the bulb lights up in both the circuits, a. c. is produced If the bulb lights up in only one of the circuits, d. c. is produced. [1]	

14 OR

(ai)

Acceleration = gradient = 9.6 / 2 [1]

= 4.8 m s^{-2} [1]

(aii)

Distance = area under graph = ½ x 2 x 9.6 [1]

= 9.6 m [1]

(bi)

Resultant force = zero [1]

(bii)

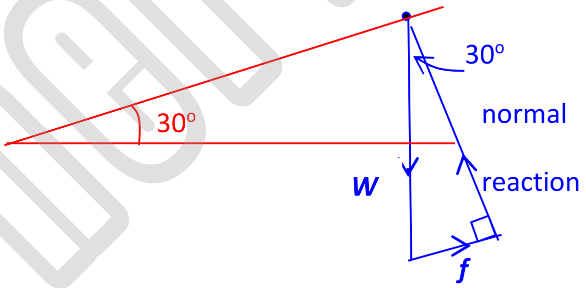
Frictional force = component of weight down the plane

= 8.0 sin 30° [1]

= 4.0 N [1]

Refer below for Vector diagram.

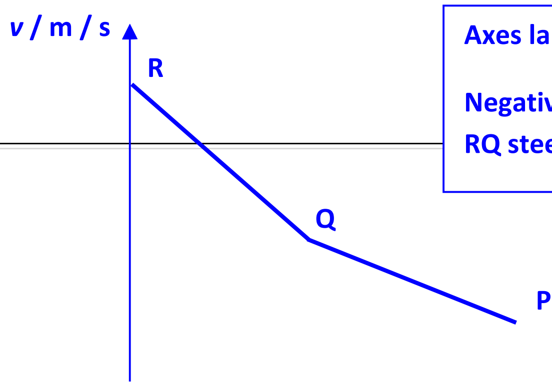
Using Vector triangle



***f* = *W* sin 30°** [1]

= 4.0 N [1]

(c)



Axes labelled [1]

Negative gradient +
RQ steeper than QP [2]

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